CollegeofEngineering,Pune

(AnAutonomousInstituteofGovt.ofMaharashtra,PermanentlyAffiliatedtoS.P.PuneUniversity)

DepartmentofInstrumentation&Control

CurriculumStructure&DetailedSyllabus(UGProgram)

ThirdYearB.Tech.

(Revision:A.Y.2016-17,Effectivefrom:A.Y.2017-18)

Program Education Objectives(PEOs):

The Undergraduate students willdemonstrate..

I. To provide the students with solid foundation in mathematics, scienceandInstrumentation Engineering to solve real world problems appropriate to thediscipline.

II. Toabletoapplycurrentindustryacceptedpractices,newandemergingtechnologiestoanalyze, design, implement, and maintain state-of-artsolutions.

III. Toexhibitself-learningcapabilitiestoassimilateandpracticeemergingtheoriesandtechnologies. Exhibit teamwork and effective communicationskills.

IV. Toinculcateprofessionalandethicalattitudeandabilitytorelateautomationissuestosociety atlarge.

V. Tosuccessfullyemployedoracceptedintoagraduateprogram/higherstudies,anddemonstrate a pursuit of lifelonglearning.

Program Outcomes(POs):

The Undergraduate Students willdemonstrate.

a. An ability to apply knowledge of mathematics, Science and EngineeringtoInstrumentation and ControlDiscipline
b. Anabilitytodesignandconductexperimentsformeasurement,measurementdevices/elements, Control System, variety of control algorithms paradigms, final controlelements, etc., and ability to analyze and interpretdata.
c. Beabletoapplytheprinciplesandpracticesforinstrument/system/equipment/device design and development to real world problems adhering to safetyandregulatory standards asapplicable.
d. Be able to work effectively in a various team (may be multidisciplinaryteams).
e. AnabilitytoidentifyformulateandsolveaprobleminInstrumentationandControlEngineering
f. Understandthesocialimpactofautomation,safetyaspectsofautomation,hazardsassociated with various processes, environmental issues, professional ethics,etc.
g. Anabilitytocommunicateeffectivelyinoralandwrittenformwhileformulatingprojectproposals, reports and other relateddocuments.
h. UnderstandtheimpactofInstrumentationandControlsolutionsinaglobal,economic,environmental, and societalcontext.
i. Demonstratetheknowledgeandcapabilitiesnecessaryforpursuingaprofessionalcareer or graduate studies; recognize the need for continuing professionaldevelopment.
j. Understanding of contemporary and emerging technology for various processesand system
k. Abilitytoselectanduselatesthardwareandsoftwaretoolsforvariousprocessesandsystems.
l. Demonstrateanunderstandingofsensors/transducers,Controlsystem,completeautomationsystem.
m. Demonstrateproficiencyinusingahigh-level/lowlevelprogramminglanguagesandnetwork protocols for embedded system applications and networkedsystems.

Correlation between the PEOs and thePOs

PO→ PEO↓	1	2	3	4	5	6	7	8	9	10	11
I	✓	✓	✓	✓							
II	✓	✓	✓		✓						
III					✓	✓					
IV							✓	✓		✓	✓
V								✓	✓	✓	✓

Note: The cells filled in with ✓ indicate the fulfilment/correlation of the concerned PEO with the PO.

List ofAbbreviations

Abbreviation	Title
S.P.P.U.	Savitribai Phule PuneUniversity
A.Y.	AcademicYear
BSC	Basic ScienceCourse
EFC	Engineering FoundationCourse
MLC	Mandatory LearningCourse
ILOE	Institute Level Open Elective Course
SLC	Self LearningCourse
HSMC	Humanities/Social Sciences/ManagementCourse
LLC	Liberal LearningCourse
SBC	Skill BasedCourse
PCC	Program CoreCourse
DEC	Department ElectiveCourse
LC	LaboratoryCourse

T Y B Tech – Instrumentation and Control

(Effective From 2017-18)

Semester V

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	BSC	**Signals & Systems**	3	0	0	3
2	MLC	Constitution of India	1	0	0	0
3	ILOE in Humanities/HSMC	Institute will offer courses • Engineering Economics • Industrial & Corporate Practices • Applied Psychology	2	0	0	2
4	PCC	Process Plant Operations	3	0	0	3
5	PCC	Microcontroller & Its Applications	3	0	0	3
6	PCC	Control System Components	3	0	0	3
7	PCC	Control System Design	3	0	0	3
8	LC	Microcontroller & its Applications Laboratory	0	0	2	1
9	LC	Control System Components Laboratory	0	0	2	1
10	LC	Control System Design Laboratory	0	0	2	1
11	SBC	Computational Techniques II Laboratory	0	1	2	2
		Total	**18**	**1**	**8**	**22**
		Total Academic Engagement and Credits	**27**			**22**

Minor and Honors Course

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1.		Sensing Technology (Minor)	3	0	0	3
2.		Sensor Modeling and Analysis (Honors)	3	0	0	3

T Y B Tech – Instrumentation and Control

(Effective From 2017-18)

Semester VI

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	ILOE in Humanities/ HSMC	Institute will offer courses • Engineering Economics • Industrial & Corporate Practices • Applied Psychology	2	0	0	2
2	MLC	Environmental Studies	1	0	0	0
3	SLC	Technical MOOC/Internship/Industry floated Course	3/0	0	0/6	3
4	PCC	Process Loop Components	3	0	0	3
5	PCC	Digital Signal Processing	3	0	0	3
6	PCC	Instrument System Design	3	0	0	3
7	PCC	Analytical Instrumentation	3	0	0	3
8	LC	Process Loop Component Laboratory	0	0	2	1
9	LC	Digital Signal Processing Laboratory	0	0	2	1
10	LC	Analytical Instrumentation Laboratory	0	0	2	1
11	SBC	Mini Project	0	1	4	3
		Total	**18**	**1**	**10**	**23**
		Total Academic Engagement and Credits	**29**			**23**

Minor and Honors Course

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1.		Mechanical Measurements	3	0	0	3
2.		Process Modeling, Simulation and Optimization (Honors)	3	0	0	3

Semester V

(IE17001) Signals and Systems

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Ability to classify systems based on their properties: in particular, to understand and exploit the implications of linearity, time-invariance, causality, memory, and bounded-input, bounded-out (BIBO) stability.
- Ability to analyze and realize discrete system using z transform
- Determine Fourier transforms for continuous-time and discrete-time signals (or impulse-response functions), and understand how to interpret and plot Fourier transform magnitude and phase functions.
- Understand the sampling theorem and how it links continuous-time signals to discrete-time signals

Unit I: **[6 hours]**
Introduction to Signals and Systems:
Introduction to Signals, Classification of Signals, Continuous Time and Discrete Time Signals, Step and Impulse Functions, Transformation of Independent Variable. Introduction to Systems, Classification of Systems, Properties of Systems, Normal Form of System Equation, Initial Conditions, Impulse Response of a Physical System, system Impulse Response.

Unit II: **[8 hours]**
Analysis of Systems:
System characteristics, Introduction to Convolution, Convolution Sum, Linear and Circular Convolution, Sampling theorem, reconstruction, aliasing, sampling in the frequency domain, sampling of discrete time signals, decimation and interpolation

Unit III: **[6 hours]**
Fourier Transform Analysis:
Fourier analysis for Continuous time signals and systems, Continuous time Fourier series and its convergence, Continuous time Fourier Transform, its properties, frequency response

Unit IV: **[8 hours]**
Discrete Fourier Transform:
Discrete time Fourier series and its convergence, discrete time fourier Transform, its properties, frequency response. Introduction to DFT in time domain and frequency domain, Filtering: Ideal frequency selective filters, Non Ideal frequency selective filters, examples, Butterworth filters

Unit V: **[8 hours]**
Z-Transform:

Definition, properties of z-transform, z-transform of standard sequences, inverse Z-transform, relationship of z-transform with Fourier transform applications of Z-transform to solutions of difference equations, Properties and applications of Z transform.

Unit VI: **[6 hours]**

FIR and IIR system:

Introduction to FIR and IIR system, block diagram representation, cascade, parallel, and feedback interconnections,

FIR and IIR system realization, Direct Form I, Direct Form II, cascade, parallel and transposed realization.

Text Books:

- Michael J. Robert, "Introduction to Signals and Systems", TMH, Second ed., 2003.
- Tarun Kumar Rawat "Signals and Systems", Oxford University Press, first edition 2010 .

Reference Books:

- Alan V Oppenhein, Alan S Wiilsky, "Signals and systems" PHI, Second ed. 2009

(IE17009) Computational Techniques II Laboratory

Teaching Scheme

Practicals : 2 Hrs/week

Tutorial: 1hr/week

Examination Scheme:

Continuous Assessment: 50 Marks

Practical Exam- 50 Marks

1. **Generation of basic continuous time signals and observe its output on CRO**
   i) unit impulse ii) unit step iii) ramp iv) exponential v) sinusoidal vi) sinc vii) square viii) signum ix) triangle Using TMS320C54x/TMS320C67X series of DSP Processors

2. **Basic operation on CT and DT signals i) time reversal ii) time shifting iii) time scaling iv) signal addition v) signal multiplication vi) combination of various operations**
   Generate input [sine wave] from MATLAB → Feed on to TMS320C54x which is running the algorithm → View the output on Oscilloscope

3. **Verification of system properties (i) linearity (ii) time invariance, (iii) causality (iv)stability (v)memory**
   Verify on MATLAB and test on DSP [convert the MATLAB code / develop your own C code]

4. **Computation of linear convolution of given signals**
   Verify on MATLAB and test on DSP [convert the MATLAB code / develop your own C code]

5. **Computation of correlation of given signals**
   Verify on MATLAB and test on DSP [convert the MATLAB code / develop your own C code]. Use graph view in CCS to observe the output.

6. **Computation of impulse response and step response of LTI systems**
   Verify on MATLAB and test on DSP [convert the MATLAB code / develop your own C code]

7. **Computation of DTFT of a sequence**
   Verify on MATLAB and test on DSP [convert the MATLAB code / develop your own C code10. Sampling a given analog signal and study of aliasing]
   Implement it on TMS320C54x. Generate the mixed signal from PC→ feed to the TMS320C54x [use the Audio codec on the board] board → observe on CCS graph with filter and without filter.

8. **Implementation of Fast Fourier Transform (FFT) Algorithm, for performing frequency domain analysis on a variety of signals.**
   a. Implement FFT Algorithm on MATLAB simulate on MATLAB and view the output
   b. Implement same FFT Algorithm on TMS320C54x and view the output via CCS Graph window
   c. Implement same FFT Algorithm on TMS320C67x and view the output via CCS Graph window

(IE17002) Process Plant Operations

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Knowledge of unit operations and effect of other parameters on them. [PEO-1] [PO-b]
- Apply instrumentation basics to the unit operations [PEO-2] [PO-f]
- Propose the unit operation sequence and equipment required in different industries [PEO-2] [PO-j]

Unit I: **[6 hours]**

Introduction: Unit operations and unit processes. Different physical and chemical laws in reference to different unit operations. Basic concepts of corrosion and protection from corrosion. Unit operation involved in different manufacturing industries.

Unit II: **[8 hours]**

Fluid transportation operations and equipments: Basic concepts of fluid transportation operations, different means of fluid transportation. Basic concepts, specifications and working of pumps, compressors, fans, blowers. Selection of equipment and its material for different applications. Discussion of discrete operation.

Unit III: **[8 hours]**

Heat transfer Operations: Concepts of Energy balance, heat transfer coefficients. Basic principles, working and selection criteria for double pipe, shell & tube heat exchangers, boilers, condensers, evaporators, cooling towers.

Role of kinetics, types of reaction/reactors, biochemical reactions commonly encountered in chemical process industries, Role of thermodynamics.

Unit IV: **[8 hours]**

Mass transfer Operations: Material and energy balance with or without chemical reactions mass transfer coefficients. Principles , working , process & mechanical design considerations for equipments used for unit operations like distillation, extraction, drying, humidification, dehumidification, absorption, filtration, sedimentation.

Unit V: **[4 hours]**

Size reduction and mechanical separation operations: Crushing and grinding, size separation and screening. Selection criteria and considerations for equipment used for size reduction and mechanical separation. Laws of commutation forced and hindered setting. Working of forth floatation, hydro cyclones, jigging and concentration equipment.

Unit VI: **[8 hours]**

Unit operations in different industries: Identification and justification of unit operations used in different industries like food, pharma, paper, sugar, cement, fertilizer, Petrochemical industry with help of process flow diagram

`

Text Books:

1. Warren L. McCabe, Julian C. Smith, Peter Harroitt "Unit Operation in Chemical Engineering" McGraw Hill. Fifth ed., 2005.

Reference Books:

1. Bela G Liptak, "Instrument Engineers Handbook: Process Control" Pearson Education, Third ed., 1985.

(IE17003) Microcontrollers and Its Applications

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Understanding the basic principles of Microcontroller based design and development. [PEO2][PO-m]
- To encourage the students to have a better understanding on state-of-the-art interfacing technologies, their potential applications and their market views. [PEO2][PO-m]
- Ability to undertake problem identification, formulation and selection of appropriate Microcontrollers. [PEO1][PO-e]
- To test whether students can apply their knowledge of fundamentals of Microcontrollers, programming and interfacing technology to solve and design simple engineering problems. [PEO1][PO-a]

Unit 1:

Microcontroller Architecture Basics: **[8 hours]**

Difference between microprocessor and microcontroller, CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. Difference between 8-bit and 16-bit microcontroller. Architecture of MCS-51 microcontroller, memory structure, different registers (SFR's) and addressing modes MSP430x5x series

block diagram, address space, CPU, memory sub system, I/O sub system and control logic, addressing modes

Unit II:

Programming Basics: [8 hours]

Concept of assembler directives, editor, linker, debugger, simulator, emulator. Instruction set, instruction formats, and various addressing modes of MCS-51 microcontroller. Writing assembly language programs for 8051. Introduction to embedded-C; Integrated Development Environment (IDE), cross-compiler, In System Programming, simple program for delay generation. Programming tools of MSP430x5x.

Unit III: [6 hours]

I/O Programming:

Ports and Ports structure, I/O programming, interfacing with simple switch, LED. Seven segment LED interfacing techniques. Programming with alphanumeric LCD and matrix keypad. Watchdog timer and system clocks. Programming with MSpP430, Low Power aspects of MSP430: low power modes, Active vs Standby current consumption, FRAM vs Flash for low power & reliability.

Unit IV: [6 hours]

On-chip Peripheral:

Programming with on-chip Timers, Counters, UART, RS485 transceiver. Interrupts, interrupt execution sequence, programming with software and hardware interrupts. Analog to digital convertor, interfacing with external serial and parallel ADC's, Digital to analog convertor (DAC), interfacing with DAC.

Unit V:

Timers, PWM and Mixed Signals Peripherals: [8 hours]

MSP430: Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA. Power considerations: Programming for optimal power consumption while using peripherals, MSP430 intelligence in power management

Case Study:

8051 based—DC motor control and stepper motor control. MSP430 based- Embedded system application using ADC & PWM demonstrating peripheral intelligence. "Remote Controller of Air Conditioner Using MSP430"

Unit VI:

Communication Protocols and other external peripherals [6 hours]

Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

Text Book

- The 8051 Microcontroller and Embedded Systems, by Muhammad Ali Mazidi, Janice Mazidi and RolinMckinlay, 2nd edition, Prentice-Hall, Inc, USA, @2005
- MSP430 Microcontroller Basics by John H. Davis, 1st edition, Newnes, @2008

Books and other References:

- Intel Manual: MCS-51 Architecture

(IE17005) Control System Components

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcome:

- Ability to select and use the components for electrical systems [PEO1][PO-c]
- Ability to identify, formulate and solve a problem using pneumatic system in instrumentation and control engineering. [PEO1][PO-e]
- Ability to identify, formulate and solve a problem using hydraulic system in instrumentation and control engineering. [PEO1][PO-e]

Unit I:

Motors: [10 hours]
Types, working principle, characteristic, and mathematical model of following: Motors AC Motors, DC motors, stepper, servo, linear, Synchronous, Generators, and alternator.

Unit II:

Selection Criterion: [6 hours]
Selection criterion of above components for various industrial applications such as position control, speed control, power generation, machine automation, telemetry, etc.

Unit III:

Types, working principle, characteristics, and symbolic representation of following: [6 hours]
Switches: Toggle, Slide, DIP, Rotary, Thumbwheel, Selector, Limit, Proximity, Combinational switches, zero speed, belt sway, pull cord. Relays: Electromechanical, Solid state relays, relay packages Contactors : Comparison between relay & contactor, contactor size and ratings Timers : On Delay, Off delay and Retentive.

Unit IV:

Permissive, Sequencing & Interlocking for motors: [6 hours]
Concept of sequencing & Interlocking, Standard symbols used for Electrical Wiring Diagram, Electrical Wiring diagrams for Starting, Stopping, Emergency shutdown, (Direct on line, star delta, soft starter) Protection devices for motors: Short circuit protection, Over load Protection, Over/ under voltage protection, Phase reversal Protection, high temperature and high current Protection, over speed, Reversing direction of rotation, Braking, Starting with variable speeds, Jogging/Inching Motor Control Center: Concept and wiring diagrams.

Unit V:

Pnuematic Components: [6 hours]
Pneumatic Power Supply and its components: Pneumatic relay (Bleed &Non bleed, Reverse & direct), Single acting & Double acting cylinder, Special cylinders: Cushion, Double rod, Tandem, Multiple position, Rotary Filter Regulator Lubricator (FRL), Pneumatic valves (direction controlled valves, flow control etc), Special types of valves like relief valve, pressure reducing valve

Pneumatic Circuits: Sequence diagram (step-displacement) for implementing pneumatic circuits, Standard Symbols used for developing pneumatic circuits, Different Pneumatic Circuits: Reciprocating, Sequencing, Anti-cycle repetition, Block transfer, Speed regulation.

Unit VI:

Hydraulic Components: [6 hours]

Hydraulic supply, Hydraulic pumps, (cylinder & motor), Hydraulic valves. Hydraulic Circuits: Standard Symbols for developing hydraulic circuits, Different Hydraulic Circuits: Meter in, Meter out, Reciprocating, speed control, Sequencing of cylinders, Direction control.

Text Books :

- Electrical Technology by B.L.Theraja, Vol. II, 2005, S. chand Publication.
- Industrial Electronics,Petruzella(Manual),Tata McGraw Hill.
- Pneumatic Instrumentation by Majumdhar, TMH
- Industrial Hydraulics, Pippenger and Heckes.

Reference Books:

- Pneumatic,FestoDidacticHydraulics, Festo Didactic
- Hydraulics, Festo Didactic

(IE17007) Control System Design

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- An ability to design output feedback controller in state space
- Ability to design full state observer
- Ability to design lead, lag, lead-lag compensators
- Ability to model hydraulic, pneumatic, thermal systems

Unit I:

State Space: [7 hours]

General state space representation, converting state space to transfer function and vice versa controller design introduction, design with state feedback, controller design by Ackerman's formula

Unit II:

Controller and Observer Design: [8 hours]

Pole placement, solving pole placement with MATLAB, Controllability, different approaches for controller design, Introduction to observer , full order and reduced order observer, observability, different approaches for observability design.

Unit III:

Design of controller with root locus: [7 hours]

transient response via gain adjustment, improving time domain specifications (steady state error, transient response) by cascade compensation, feedback compensation

Unit IV:

Controller design: [8 hours]

Design of Proportional (P), Integral (I), Derivative (D), PI, PD, PID controllers, lead, lag, lead-lag controller by root locus method.

Unit V:

Design of controller in frequency domain: [6 hours]

Design of controller with bode plot: improvement of steady state and transient response with lead, lag, lead lag compensator design.

Unit VI:

System uncertainties and disturbances: [6 hours]

Effect of uncertainties and disturbances on system performance, uncertainty and disturbance estimation, Effect of uncertainties and disturbances on controller and observer design, effect of measurement noise and un- modelled dynamics.

Text Books:

- Norman Nise, "Control System Engineering", Wiley India, Fifth ed., 2009.
- K. Ogata," Modern Control Engineering", PHI, Fifth ed., 2009.

Reference Books:

- G. C. Goodwin, S. F. Graebe, M. E. Salgado; "Control System Design", PHI, First ed. 2002.
- Friedland, "Control System Design", Dover Publication, First ed., 2005.

(IE17004)Microcontroller and Its Applications Laboratory

Teaching Scheme
Practical: 2hrs/week

Examination Scheme:
Continious Assesment: 50 Marks
Practical Exam- 50 Marks

Students should perform minimum 12 experiments using following embedded platforms:

1. Six experiments on **8051** microcontrollers
2. Six experiments using TI **MSP430** microcontroller

Course Outcomes:

- Ability to develop, design and debug of high level language programs for MCS-51 based and MSP430 based microcontroller with basic interfacing techniques on different interfacing devices [PEO1][PO-a]
- Ability to identify, and select an appropriate microcontroller as well as development tools for given applications [PEO1][PO-e]
- Ability to function effectively as an individual and in teams, with the capacity to be a leader or manager as well as an effective team member[PEO1][PO-k]

Experiments using 8051:

1. Learn and understand assembly instructions for 8051 and assembly programming for arithmetic, compare and memory block transfer.
2. Learn and understand embedded C programming using Keil IDE. Programming for basic arithmetic operations and GPIO programming
    a) Delay generation
    b) LED blinking
    c) Switch and LED interfacing
3. Display interfacing techniques and programming for 7-segment and LCD display
    a) 7-segment LED programming
    b) Alphanumeric LCD programming
4. On-chip peripherals programming
    a) Timers and counters
    b) PWM generation
    c) Polling method and Interrupt method programming
5. ADC,DAC and Serial port programming
    a) Programming for on-chip UART
    b) ADC Programming
    c) DAC Programming
6. External peripherals programming
    a) Interfacing of external EEPROM and RTC using I2C protocol
    b) Interfacing of external ADC using SPI protocol

Embedded C Experiments using MSP430:

1. Learn and understand how to configure MSP430F5529 Launch pad digital I/O pins. Write a C program for configuration of GPIO ports for MSP430 (blinking LEDs, push buttons interface).

Exercises:

a)Modify the delay with which the LED blinks.

b) Modify the code to make the green LED blink.

c) Modify the code to make the green and red LEDs blink:

- Together
- Alternately

d) Alter the code to turn the LED ON when the button is pressed and OFF when it is released.

e) Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.

f) Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.

2. Usage of Low Power Modes:
   Configure the MSP430F5529 Launch pad for Low Power Mode (LPM3) and measure current consumption both in active and low power modes. Use MSP430F5529 as hardware platform and measure active mode and standby mode current.

Exercises:

a) How many Low power modes are supported by the MSP430G2553 platform?

b) Measure the Active and Standby Current consumption in LPM3 mode for the same application using MSP430F5529 Launch Pad

3. Learn and understand GPIO based Interrupt programming. Write a C program and associated GPIO ISR using interrupt programming technique.

Exercises:

a) Write the code to enable a Timer interrupt for the pin P1.1.
b) Write the code to turn on interrupts globally

4. Implement Pulse Width Modulation to control the brightness of the on-board, green LED. This experiment will help you to learn and understand the configuration of PWM and Timer peripherals of the MSP430F5529.

Exercises:

a) Observe the PWM waveform on a particular pin using CRO.
b) What is the maximum resolution of PWM circuitry in MSP430F5529 Launch pad?
c) Change the above code to create a PWM signal of 75% duty cycle on particular PWM pin.

5. Learn and understand Serial Communication Interface module of MSP430F5529 for UART based serial communication. The main objective of this experiment is to use UART of the MS P430F5529 to communicate with the computer.

Exercise:

a)Modify the above code to transmit the set of strings to the serial terminal via UART as shown below:

char str1[]="MSP430Fx Launch pad"
char str2[]= "Ultra low power mixed signal processing applications"

6. Understand and Configure 2 MSP430F5529 Launch pad's in master-slave communication mode for SPI protocol.

Exercises:

a) Which port pins of MSP430 can be configured for SPI communication?
b) What is the data transfer rate supported by MSP430 for SPI communication?

(IE17006) Control System Components Laboratory

Teaching Scheme
Practical: 2hrs/week

Examination Scheme:
Continious Assesment: 50 Marks
Practical Exam- 50 Marks

Course Outcomes:

- An ability to characterize performance of motor
- Implementation of electrical circuits for motor operation
- Implementation of pneumatic circuits to solve a problem
- Implementation of hydraulic circuits to solve a problem

List of Experiments

1. Study of symbols used in electrical wiring diagram
2. Study of electromagnetic relay and solid state relay
3. Wiring diagram for logic function AND/OR/NOT
4. Wiring diagram for DOL/ Star-delta starter
5. Study of Pneumatic system components
6. Build pneumatic circuit to operate single acting and double acting cylinder.

7. Build pneumatic circuit to operate double acting cylinder using AND and OR function
8. Build of Pneumatic circuit for speed control of a cylinder.
9. Build pneumatic circuit to operate double acting cylinder using time delay function
10. Study of hydraulic system components
11. Build hydraulic circuit to operate double acting cylinder
12. Build hydraulic circuit to operate double acting cylinder using electro hydraulic Components.
13. Field Visit

(IE17008) Control System Design Laboratory

Teaching Scheme
Practical: 2hrs/week

Examination Scheme:
Continious Assesment: 50 Marks
Practical Exam- 50 Marks

Course Outcomes:

- Able to design controllers and observer for general systems to validate performance on real time system
- Able to design and validate the effect of uncertainty and disturbances on controller and observer design
- Able to design and PI, PD, PID controllers and evaluate the performance

Students have to perform minimum 12 experiments in MATLAB environment and validate in real time domain.

List of Experiments:

1. Find state transition matrix from a given system dynamic
2. Design an observer for a given system by using state space method.
3. Validation of observer design on QUBE (position and speed control).
4. Design state feedback controller for a given system.
5. Validation of controller design on QUBE (position and speed control)
6. Design controller by adjusting gain for a given system by using root locus method.
7. Validation of controller design on QUBE (position and speed control).
8. Design controller for improving transient and steady state response by root locus method.
9. Design of PID controller.
10. Validation of PID controller design on QUBE (position and speed control).
11. Design of lead controller to satisfy given specifications using bode plot.
12. Design of lag controller to satisfy given specifications using bode plot.
13. Design lag-lead controller to satisfy given specifications using bode plot.
14. Validation of lag-lead controller design on QUBE (position and speed control).
15. Study effect of uncertainty and disturbance on system performance.
16. Design of uncertainty and disturbance method and validate on QUBE.

AS English Language Proficiency-I

Teaching Scheme
Lectures :1 Hrs/week
Practical:3 Hrs/week

Examination Scheme:
T1 and T2: 25 Marks each
End-Sem Exam: 50 Marks

Course Outcomes:

- Students will be able to communicate well using meaningful sentences for conversations or speeches.
- They will be able to reproduce their understanding of concepts of communicating using English language
- They will be able to reproduce their understanding of concepts of communicating using English language
- Students will be able to better Presentation skills and participate in healthy discussions both formal and informal among peers
- They will be more confident facing interviews, acquiring professional skills and will be industry ready

Unit I:
Communication as a skill: need for effective business communication for Engineers

Unit II:
Conversational Skill Development: Formal and informal expressions, general discussions, Vocabulary Building

Unit III:
Business Communication: Letter Writing, Note making, Minutes, Summarizing,

Unit IV:
Business Etiquette: Mannerisms and Grooming

Reference Books:

- Communication Skills for Engineers by S. Mishra & C. Muralikrishna (Pearson)
- Communication Skills for Technical Students by T.M. Farhathullah (Orient Longman)
- Essential English Grammar (Elementary &Interme.) Raymond Murphy (CUP)
- Communication for Business: A Practical Approach by Shirley Tailor (Longman)
- Communication for Business: A Practical Approach by Shirley Tailor (Longman)
- Written Communication in English by Saran Freeman (Orient Longman)

German Language-I

Teaching Scheme
Lectures :2 Hrs/week

Examination Scheme:
Oral Exam: 40 Marks each
Written Exam: 60 Marks

Course Outcomes:

- Students would know the basic information of Germany.

- Students would be familiar with the pronunciation of German letters and greetings
- Students would be able to count till 100
- Students would be able to introduce themselves
- Students would be able to form basic questions
- Students would be able to read the city map

Unit I:
Start auf Deutsch : Deutschland, Deutsch sehen und hörenersteKontakte, Texte: Lied, Postkarte, Wortfelder: internationaleWörter, deutsche Namen

Unit II:
Café:GespräcHeimCafé , Texte: Getränkekarte, Telefonbuch, Rechnungen, Wortfelder: GespräcHeimCafé, Zahlenbis 100, Strukturwörter

Unit III:
Städte, Länder, Sprachen: Sehenswürdigkeiten in Europa, Sprqachen in Europa, Nachbarsprachen, Texte: Landkarten, einStatistik, Texte: Landkarten, einStatistik

Unit IV:
Menschen und Haüser : Wohnwelten, Texte: Möbelkatalog, E-Mail, Wphnungsgrundriss, Wortfelder: Räume und Möbel, Wohnformen

Reference Books:

- Funk, Kuhn, &Demme. Studio d A1. Deutsch alsFremdsprache. 2011. Goyal Publishers & Distributors Pvt. Ltd. Delhi, India.

Personnel Psychology- I

Teaching Scheme
Lectures :2 Hrs/week

Examination Scheme:
Field Assignments : 40 Marks each
End Sem Exam: 60 Marks

Course Outcomes:
- Students will have understanding of organizational concepts and behavior.
- Students will have understanding about their own personality for corporate world.
- Students will understand importance of groups and its dynamics.
- Students will understand the importance of self management and development.

Unit I:
Introduction: Basic concepts in Organizational set up and its importance

Unit II:
Personality and corporate world: Know and accept yourself. Preparing for corporate world, approaches towards work

Unit III:

Group behaviour and leadership: Group behaviour and effectiveness, effective leadership and management principles

Unit IV:

Self management& development: Efficient working habits, self training and self development

Text Books:

- Khana S.S.- (2016) Organizational Behaviour(Text and Cases) Chand and company Pvt. Ltd. Delhi.
- Rae Andr'e :- (2008) organizational behavior. Dorling Kindersley (India) Pvt. Ltd
- Wallace Hand Masters L.- (2008) Personality development..Cengage Learning India Pvt. Ltd.

Reference Books:

- Robbins S, JudgeA, Vohra N:-(2013)Organizational behavior.(15thed) Pearson Education,Inc
- Singh Kavita:- (2010) Organizational behavior-Text and cases. Dorling Kindersley (India) pvt. Ltd

Industrial Psychology-I

Teaching Scheme
Lectures :2 Hrs/week

Examination Scheme:
Field Assignments : 40 Marks each
End Sem Exam: 60 Marks

Course Outcomes:

- Students would understand the nature, scope, challenges and role of technology in Industrial Psychology.
- Students would learn about major psychological factors that influence individual differences in behaviour at work Students will understand importance of groups and its dynamics.
- Students would understand the importance of motivation and involvement in determining satisfaction at work.
- Students would understand the elements of psychometric testing and develop skills to face the same in future
- Students would learn about physical and psychological aspects related to workplace in terms of environmental conditions, safety and health
- Students would get to know the stressors of work and learn coping strategies to strike work-life balance
- Students would understand the role of human factors, especially sensory systems and cognitive abilities, in designs that promote man-machine harmony
- Students would demonstrate the knowledge gained through practical implementation

Unit I:

Introduction to Industrial Psychology : Nature and Development of Industrial/Work Psychology, Historical background- Time and Motion Study, Hawthorne Studies, World War I & II, Scope & Challenges: Current status, Role of Technology

Unit II:

People at Work: Individual Differences: Personality, Intelligence, Emotional Intelligence, Creativity & Innovation, Perception & Attitudes, Motivation- N-Ach, Expectancy Theory & Equity Theory, Modern Approach to Motivation; Job Satisfaction- Job Diagnostic Model, Measuring Job Satisfaction, Psychometric Testing at Work- Cognitive Abilities, Personality, Emotional Intelligence

Unit III:

Characteristics of Workplace: Working Conditions- Physical (E.g. Work Schedule, etc.) & Psychological (E.g. Fatigue, Boredom, etc.), Safety & Health Practices at Workplace- Accidents, Violence, Harassment, Alcoholism & Drug, Stress at Workplace- Individual Responses to Stress; 3 Cs of Stress- Causes, Consequences & Coping with Work Stress

Unit IV:

Engineering Psychology-I : Brief History and Scope, Person-Machine Systems- Basic Human Factors: Sensory systems- Visual (light, colour, night vision, depth perception), Auditory (sound, alarms, noise), Tactile & Vestibular senses; Cognition & Decision Making, Displays: Visual & Auditory, Control

Reference Books:

- Landy, F. J. & Conte, J. M. (2010). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology. 2nd Edition. Wiley India: New Delhi
- Matthewman, L., Rose, A. & Hetherington, A. (2009). Work Psychology. Oxford University Press: India
- Schultz, D. & Schultz, S. E. (2002). Psychology and Work Today. Pearson Education: New Delhi.
- Schultz, D. & Schultz, S. E. (2013). Psychology and Work Today: An Introduction to Industrial and Organizational Psychology. 7th Edition. Pearson Education: New Delhi
- Wickens, C. D.; Lee, J. D., Liu, Y. & Gordon Becker, S. E. (2015). An Introduction to Human Factors Engineering. 2nd Edition. Pearson Education: New Delhi

Japanese Language I

Teaching Scheme
Lectures :2 Hrs/week

Examination Scheme:
Oral Exam :20 Marks
Written Exam: 80 Marks

Course Outcomes:

- Students would know the basic information of Japan
- Students would be familiar with the pronunciation, Accent, Intonation and Japanese writing System Hiragana, Katakana and Kanji
- Students would be able to speak daily greetings
- Students would be able to count the numerals
- Students would be able to introduce themselves, Family members

- Students would be able to understand Colors, Years ,Months and Days, Time expressions, Directions to read the city map

Unit I:
Introduction to Japanese Syllables (phonetic alphabet), greetings & Self introduction, Identifying things, point objects and listen to their names, Listen to things and places etc. Creating shopping lists

Unit II:
Introduction to Time, day of the week, simple inquiries on telephone, Means of transport, Basic conversations of everyday life

Unit III:
Frame questions in Japanese. Vocabulary of giving and receiving objects, Stating , impressions/things surrounding us, Expressing likes and dislikes, good/bad, possessions, Talking about the country, town and the environment.

Unit IV:
Quantity, number of people, time, period etc., Stating thoughts and impressions, Conveying, movement (e.g. go / come).

Reference Books:
- Minnano no Nihongo 1-1.Goyal Publishers& Distributors Pvt. Ltd. Delhi, Indiai

MINOR COURSES - INSTRUMENTATION

Sensing Technology

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Identify, formulate and solve a problem of Instrumentation and Control Engineering [PEO2][PO-e]
- Design and conduct experiments for measurement and ability to analyze and interprets data. [PEO1] [PO-b]
- Demonstrate an understanding of sensors / transducers. [PEO3][PO-l]

Unit I: **[6 hours]**
Introduction: Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration.

Unit II: **[8 hours]**

Temperature measurement: Temperature scales, classification of temperature sensors, standards, working principle, types, materials, design criterion:Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistors), radiation sensors (pyrometers), Temperature switch.

Unit III: **[7 hours]**

Pressure measurement: Definition, pressure scale, standards, working principle, types, materials, design criterion: Manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance type, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure sensors, low-pressure sensors, Pressure switch.

Unit IV: **[7 hours]**

Level measurement: Standards, working principle, types, materials, design criterion: float, displacers, bubbler, and DP- cell, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducers, level gages, resistance, thermal, TDR/ PDS type, solid level detectors, fiber optic level detectors, Level switches.

Unit V: **[9 hours]**

Flow measurement: Standards, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter), secondary or rate meter (obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), Flow switches.

Unit VI: **[5 hours]**

Chemical sensors: Standards, working principle, types, materials, and design criterion: Chemical sensors (pH and conductivity).

Text Books:

- B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis” by, Tata McGraw Hill Education, Second ed., 2004.
- A. K. Sawhney, “Electrical & Electronic Instruments & Measurement”, Dhanpat Rai and Sons, Eleventh ed., 2000.

Reference Books:

- E.O. Dobelin, “Measurement Systems”, McGraw Hill, Fourth ed., 1990.
- D. Patranabis, “Principle of Industrial Instrumentation”, Tata McGraw Hill, Second ed., 1999.
- SabrieSoloman, “Sensors Handbook” ,McGraw Hill Publication, First ed., 1998.
- B.G. Liptak, “Process Measurement & Analysis”, Chilton Book Company, Third ed., 1995.
- D.V.S. Murthi, “Instrumentation and Measurement Principles”, PHI, New Delhi, Second ed. 2003.

MAJOR (HONORS) COURSES – INSTRUMENTATION

(IE(HO)-17001) Sensor Modelling and Analysis

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- To design the sensor according to method discussed and standards
- To conclude on the characteristics of designed sensors

Unit I: Overview of Sensors **[8 hours]**
Characterization and calibration of sensors, Physical characteristics, Accuracy, Response time testing, Classification and mathematical modeling of order, zero, first, second order sensors and their frequency and time domain analysis, modeling tools, Various design standards

Unit II: Resistive and Capacitive **[6 hours]**
Overview on types and applications, Design Consideration and selection criteria, Sensor fabrication techniques, Aging effects, Failure analysis, Material selection, Safety guidelines

Unit III: Inductive and Magnetic **[6 hours]**
Overview on types and applications, Design Consideration and selection criteria, Sensor fabrication techniques, Aging effects, Failure analysis, Material selection, Safety guidelines

Unit IV: Ultrasonic and Optical **[6 hours]**

Overview on types and applications, Design Consideration and selection criteria, Sensor fabrication techniques, Aging effects, Failure analysis, Material selection, Safety guidelines

Unit V: Wireless and SMART sensors **[6 hours]**

Overview on types and applications, Design Consideration and selection criteria, Sensor fabrication techniques, Aging effects, Failure analysis, Material selection, Safety guidelines

Unit VI: Chemical and Biosensors **[6 hours]**

Overview on types and applications, Design Consideration and selection criteria, Sensor fabrication techniques, Aging effects, Failure analysis, Material selection, Safety guidelines

Text Books

- Chapman, P., “Smart Sensors”, ISA Publications,1995.
- SabrieSoloman, “Sensors Handbook”, McGraw-Hill , 1999

Reference Books

- ISA–S37.1–1975 (Reaffirmed 1982), “Electrical Transducer Nomenclature and Terminology,”Instrument Society of America, 1975.
- Brayan Eggins, “Chemical Sensors and Biosensors” John Wiley& Sons, 2003.
- Eric Udd , “Fiber optics sensors”, Wliey, 1991

Semester VI

(IE17015) Mini Project

Course Outcomes:

- Designing and implementation of mini project which includes measurement of parameter signal processing, controlling, debugging related to objectives defined in the problem statement. [PEO1,2,3][PO-e, k, d, l].

Objectives:

- Understand the practical aspect of shielding, cabling and noises in electronics circuits
  Implementation of mini project

Contents:

Students are required to develop various modules required for their final year project, or a minim project e.g. power supply, processor module, interfacing module, display and signal conditioning module. The PCB and enclosure design is part of the activity of this subject. Testing of various modules as per industrial standards and practices is part of the experimental work. System Design Selection of sensors, signal conditioning, standard signals and noise considerations of typical systems.Student has to develop a mini project which will handle and measure a physical parameter such as temperature, pressure, vibration

(IE17010) Process Loop Components

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Objectives:

- To understand operation of transmitter, convertors and final control elements.
- To select components for control loop.
- To study basic building block of Programmable Logic Controller.

Unit I: **[8 hours]**

Fundamentals of Process Control & Transmitters:

Representation of process loop components using standard symbols, Need of transmitter (concept of field area & control room area), Need for standardization of signals, current, voltage and pneumatic signal standards, concept of live & dead zero, Signal conditioning (analog & digital) for RTD, T/C, magnetic flow meter, DPT, span & zero adjustment, Two wire transmitter, Electronic and pneumatic transmitters, Electronic Differential Pressure Transmitter: Types, mounting (Installation), manifolds, calibration setup, Application of DPT for level measurement, Zero elevation, Suppression.
SMART transmitter: Comparison with conventional transmitter, Block schematic.
Converters: Difference between converter & transmitter, Pneumatic to current converter, Current to pneumatic converter

Unit II: **[6 hours]**

Types of control actions:

Discontinuous: ON/OFF

Continuous: Proportional, integral, derivative, proportional-Integral, Proportional- Derivative, Proportional-Derivative-Integral, Anti-reset windup, Rate before reset Concept of bump less transfers in PID controller, Effect of process Characteristics on PID combination, control actions for various processes.

Unit III: **[6 hours]**

Tuning of controller: Quarter Amplitude Decay Ratio, Loop disturbance, optimum control, Measure of quality, stability criteria

Tuning methods: Process Reaction Curve(open loop), Ziegler Nichols (closed loop), set point tuning Vs load disturbance tuning. PID with limitations (offset, saturation in D, & reset windup) rate before reset, PID variations & tuning, digital controller (position & velocity algorithms, effect of sampling time) Digital PID controllers: concept of velocity & position algorithm, block schematic of series and parallel combinations.

Unit IV: **[8 hours]**

Programmable Logic Controller

Continuous versus Discrete Process Control, ladder diagram using standard symbols, Architecture of PLC, Types of Input & Output modules (AI, DI, AO, DO), wiring diagram, Interfacing pneumatic & Hydraulic systems, Fixed & Modular PLC (Rack, Slot, Grouping), Specifications, manufacturers, PLC ladder diagram and instructions, PLC Programming for process applications

Unit V: **[8 hours]**

Control valve: Necessity, comparison with other final control elements, Classification of control valves based on: Valve body. Construction, type of actuation, application etc. Construction, Advantages, Disadvantages & applications of Globe: single, double, 3way, angle, Gate, Needle, Diaphragm, Rotary valves, Ball, Butterfly.

Types of actuators: Spring Diaphragm, Piston cylinder (power cylinder), Pneumatic, Hydraulic, Electro-hydraulic, Electric, and smart actuators.

Control valve terminology: Range ability, turndown, valve capacity, Air to open, Air to close, valve gain

Control valve characteristics: Inherent & installed Control valve accessories

Positioners: Application/Need, Types, Effect on performance of control valves. Volume boosters, Pressure Boosters, Reversing relay, Solenoid valves, Air lock, position indicating switches, Electro pneumatic converter, Hand wheel.

Unit VI: **[6 hours]**

Explosion Proof Housing, Encapsulation, Sealing, & Immersion, Purging systems Hazardous area classification & intrinsic safety, Concept of safety cycle, HAZOP, fault tolerance and safety integrity level

Text Books:

- Curtis Johnson , “Process Control and Instrumentation Technology, Prentice-Hall of India Fourth Edition, 1997
- Norman A. Anderson , “Instrumentation for Process Measurement and Control”, CRC Press, Third Edition, 1980
- B. G. Liptak , “Process Control, Instrument Engineering Hand book”, Chilton Book Company, Third Edition, 1995
- Gary Dunning , “Introduction to Programmable Logic Controller”, Cengage Learning India Pvt. Ltd., Third Edition, 2006
- John W. Webb, “Programmable Logic Controllers”, Prentice Hall, Fourth Edition, 1999

Reference Books:

- E. B. Jones , “Instrument Technology”, Butterworths, Forth Edition, 1985
- A. B. Corripio, “Tuning of Industrial Control Systems, Publisher: ISA, Second Edition, 2001
- William Andrews , “Applied Instrumentation in Process Industries”, Gulf, Second Edition, 1979
- Control Valve Handbook, Fisher Controls International, Inc. third Edition, 2001

(IE17012)Digital Signal Processing

Teaching Scheme
Lectures: 3 hours / week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

- Apply the various programming techniques on DSPs.[PEO2,PO-a,k]
- Design FIR and IIR filters using different techniques.[PEO1,PO-e]
- Determine the frequency, steady state and transient response of LTI systems.[PEO1,PO-a,e]
- Apply the DFT and FFT methods for various signals and determine their frequency response.[PEO1,PO-e]

Unit I: **[6 hours]**

Frequency Response Characteristics of LTI system:

Frequency response of a system to complex exponential and sinusoidal signals, steady state and transient response to sinusoidal inputs signals, computation of frequency response functions. Design of LTI systems as frequency selective filters. Finite Impulse Response, Infinite Impulse response filter structures for FIR filters: direct, cascade, frequency sampling and lattice. Structure of IIR filters: direct, cascade, parallel, lattice. Effect of finite word length in Digital filters

Unit II: **[6 hours]**

FIR Filters:

Finite Impulse Response Filters Introduction to finite impulse response filters, linear phase filters, symmetric & anti –symmetric filters, Design of FIR filter: windowing method, analysis of different types of windows ,frequency sampling method, optimal equiripple, FIR differentiators.

Unit III: **[6 hours]**

IIR Filters:

Infinite Impulse Response Filter Introduction to Infinite Impulse Response filter, Butterworth, Chebyshev approximation. Design of IIR filters: Impulse invariant method, bilinear transformation, approximation derivative method, IIR filters design using least square method: Pade approximation. Frequency transformations: low pass to high pass, band pass, band reject.

Unit IV: **[8 hours]**

Multi-Rate Filters and Sampling:

Changing the sampling rate, Down sampling, Up sampling, Fractional rate changes, Noble identities, Poly phase Decomposition Narrowband filter banks, Delay Systems, Integer sampling rate converters, Rational sampling rate converters, Multi rate filter realization structures, sub band processing

Unit V: **[8 hours]**

Wavelet Transform:

Short time Fourier Transform (STFT), continuous wavelet transform (CWT), Introduction to discrete wavelet transform (DWT), Interpretation of DWT, Signal representation with Harr wavelet

Unit VI: **[8 hours]**

Digital Signal Processor:

Harvard architecture and modified Harvard architecture. Introduction to fixed point and floating point DSP processors, architectural features, Computational units, bus architecture and memory architecture, data addressing, address generation unit, program control, program sequencer, pipelining, interrupts, features of external interfacing, on-chip peripherals, hardware timers, host interface port, clock generator, SPORT.

Programming of DSP Processor Addressing modes, Instruction set, Programming tools such as DSP Assembler, IDE environments like CCS for DSP chip or visual DSP for Analog DSP chips, programming using DSP processor, I/O Programming.

Text Books:

- Proakis, Manolakis, “DSP Principles, algorithms and applications-, Pearson, Fourth ed.,2009.
- Oppenheim and Schafer, “Discrete time signal processing”, Pearson Publication, Second ed.,2007.

Reference Books:

- TMS320C67XX DSP Reference set, Vol. 2 1999.
- P. Lapsley, J. Bier, A. Shoham, E. A. Lee, “DSP processor fundamentals: Architecture and features”, IEEE Press,1997.
- RulpphChassaing,“DSPandApplicationswithTMS320C673&TMS320C716”, Wiley IEEE, Seconded.

- A Antoniou, “DSP filter analysis and Design”, McGraw Hill,1979.
- Avtarsingh, S. Srinivasan, “DSP Implementation using DSP microprocessorswith examples” from TMS320C54XX”,2004.

(IE17014) Instrument System Design

Teaching Scheme
Lectures: 3 hours / week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

- An ability to analyze the requirement of Instrument and systems
- An ability to design various electronic circuits, noises identification and appropriate elimination methods related to instrument and system
- An ability to select, design appropriate enclosure, cables, PCB
- An ability to estimate, analyze, improve the reliability of instrument and system

Unit I: **[8 hours]**

Basic Concept of Instrumentation Design, Needs Analysis :with respect to systems deployed in; Medical, Industrial, Test and Measurement, Home Appliances, Military
Functional requirements & Specifications, Impact on the design due to adverse Electrical, Thermal and Mechanical Operational Environments.

Unit II: **[8 hours]**

Noise Sources, Electrical, Magnetic, RF, Static, Ground Loops, Shielding, near and far field, shielding effectiveness, absorption and reflection loss, shielding with magnetic material, contact protection, glow and arc discharges, loads with high inrush current, Inductive and resistive load contact protection networks for inductive loads, intrinsic noise sources.

Unit III: **[8 hours]**

ESD, inductive charging human body model, ESD protection in equipment, software in ESD protection ,Sensitive devices, input filters, clamping suppressors

Unit IV: **[8 hours]**

Electronic design guideline Noise in electronic circuits. Capacitive and inductive coupling and effect of shield, shielding to prevent magnetic radiation, co-axial and twisted pair cable, grounding, safety ground, signal ground, single and multi point ground, Hybrid ground, grounding of cables shields, Ground loops and low frequency and high frequency analysis of common mode signals, guard shields.

Unit V: **[8 hours]**

Enclosure Design Guidelines. NEMA, DIN, BSI, ANSI standards Index protection (IP), cable design guidelines; Printed circuit board design guideline, layout scheme, grid systems, PCB size, Design

rules for digital circuits, and Design rules for analog circuits, single and multilayer PCB, CE / Underwrites Laboratories (UL) Compliance.

Unit VI: [6 hours]

Reliability, bath tub curve, Reliability for series parallel system, MTTF, MTTR, MTBF, availability, Redundancy and stand by systems.

Text Books:

- Henry OTT, "Noise reduction Techniques in Electronics Circuit", Wiley International, Second ed., 2009.

Reference Book:

- Balguruswamy, "Reliability Engineering", TATA McGraw-hill Publication, Third ed. , 2005
- Walter C. Bosshart, "Printed Circuit Board", Tata McGraw-Hill publication, Third ed. ,2009.

(IE17016) Analytical Instrumentation

Teaching Scheme
Lectures: 3 hours / week

Examination Scheme:
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

- Justify use of spectroscopic instruments. [PEO1][PO-e]
- Summarize and classify capabilities and limitations of separation techniques in solving real world problem. [PEO3][POd]
- Familiarize with current literature, research in analytical instrumentation such as smart sensor system [PEO2][PO-j]

Unit I : [8 hours]

Introduction to Chemical instrumental analysis, advantages over classical methods, classification: Spectral, electro analytical and separative methods, Interaction of radiation with matter, Source(continuous and LASER), detector and optics design, Visible spectrophotometer (Colorimeter), online colorimeter for process applications, turbidity meter, turbidity analysers and its applications, laboratory instruments such as centrifuge, oven, and magnetic stirrers.

Unit II: [7 hours]

UV-Visible spectrophotometers and its types with its optical system design and its applications ,UV and Visible analysers with its applications in process industries, FTIR spectrophotometers and its applications

Unit III: [5 hours]

Emission Spectra, Quantitative measurements, Flame P hotometer and its applications , concept of design of atomic absorption spectrophotometer, spectrum interpretation, interferences, applications of atomic absorption spectrophotometer

Unit IV: [8 hours]

Classification of Chromatographic methods, Gas chromatography, Process Gas Chromatograph and its applications in industries such as process, food and pharmaceuticals High Performance Liquid Chromatography (HPLC), and its applications, mass spectrometer,ICP-MS and its applications

Unit V [7 hours]

Different types of gas analyzers for measurement of Oxygen, NO_2, ammonia, carbon dioxide, Flue gas analysers, working and its applications

Unit VI [7 hours]

Introduction to smart chemical sensors, MOS based gas sensors, Voltametery and conductometry based liquid sensors, moisture sensors for liquid and solid sample analysis, smart chemical sensor system design and its applications

Text Books:

- Willard, Merritt, John AurieDean, "Instrumental Methods of Analysis", CBS Publishers & Distributors, New Delhi, Seventh ed., 1988.
- R. S. Khandpur, "Handbook of Analytical Instruments", Tata McGraw–Hill Publications, Second ed., 2006.

Reference Books:

- Bela G Liptak, "Analytical Instrumentation Handbook", Chilton, Second ed., 1994.
- Leslie S Ettre, Albert Zlatkis, "The Practice of Gas Chromatography", John Wiley and son's publication, First ed., 1967.
- Skoog, Holler, Nieman, "Principles of Instrumental Analysis", Thomson bookscole publications, Sixth ed., 2006.

(IE17011) Process Loop Components Laboratory

Teaching Scheme

Practicals: 2 hours / week

Examination Scheme:

Term Work: 50 marks

Practical Exam: 50 marks

Course Outcomes:

- An ability to apply knowledge of design of analytical with emphasize on safe use of analytical instruments
- Ability to select and use an analytical instrument in the physical, chemical and biological world and appreciate role of instrumentation

- An ability to identify, formulate and solve a problem based on spectroscopy and chromatography analysis

List of Experiments:

1. Design of signal conditioning for a K-type thermocouple/ RTD
2. Development of mathematical model of control valve
3. Configuration of D.P Transmitter and its application for flow
4. Calibration of I/P converter
5. Tuning of PID controller
6. Study of control valve & plot the characteristics of control valve
7. Implementation of Discrete control using PLC programming
8. Implementation of Timer for a given applications using PLC
9. Implementation of Counter for a given applications using PLC
10. Interfacing PLC to hydraulic circuits
11. Interfacing PLC to Pneumatic circuits
12. Designing intrinsic safety circuits (Zener barrier)
13. Field Visit

(IE17013)Digital Signal Processing Laboratory

Teaching Scheme
Practicals: 2 hours / week

Examination Scheme:
Term Work: 50 marks
Practical Exam: 50 marks

List of Experiments:

1. Computation of linear convolution
   Compute linear convolution of two sequences on DSP LCDK6748 kit
2. Computation of circular convolution
   Compute Circular convolution of two periodic sequences on DSP LCDK6748 kit
3. Computation of Correlation of given sequence
   Compute the cross correlation of two sequences on DSP LCDK6748 kit
4. Computation of impulse response of LTI system
   For given transfer function find the impulse response and print the output sequence using DSP LCDK6748 kit
5. Computation of DFT of a sequence
   Compute the DFT of sequence and print the output sequence magnitude using DSP LCDK6748 kit
6. Implementing audio loop back using onboard CODAC
7. Simple audio interface to DSP LCDK6748 kit and loop back example using on board audio ADC and DAC
   Generation of basic continuous time signals
   Generate sine wave, square wave and sweep (chirp) signal using DSP and observe its output on CRO
8. FIR filter design using window
   Compute Low pass and High pass FIR filter coefficients using different window in MATLAB
9. FIR filter implementation
   Implement FIR filter for audio application on DSP LCDK6748 using on board CODAC
10. IIR filter design using Butterworth and Chebyshev approximation

Compute Low pass and High pass IIR filter coefficients using Butterworth and Chebyshev approximation in MATLAB

11. IIR filter implementation
    Implement IIR filter for audio application on DSP LCDK6748 using on board CODAC
12. Study practical – Face detection using DSP kit and analog camera
    Interface analog camera to DSP lCDK6748 kit and demonstrate face detection algorithm

(IE17017)Analytical Instrumentation Laboratory

Teaching Scheme
Practicals: 2 hours / week

Examination Scheme:
Term Work: 50 marks
Practical Exam: 50 marks

Pre-requisite experiments:

P-1. Study and characterization of light source, photodetectors, absorption filters and optical components.

P-2. Study of chemical sensor material properties

P-3. Basic knowledge of microcontroller, MATLAB, LabView.

List of Experiments

1. Visible spectrophotometer for quantitative and qualitative analysis of sample
2. UV-Visible spectrophotometer for qualitative and qualitative measurement of sample and compare the results with Visible spectrophotometer.
3. To analyse a given water sample using turbidity meter and apply virtual instrumentation for analysis.
4. Modelling and design of multiparameter monitor system and validate the result.
5. Determination of moisture content in a liquid sample using Karl Fischer titrator.
6. To measure the pH and conductivity of given sample and classify taste of the same.
7. Design of hydrocarbon Detection system using volatile organic compound (VOC) sensor with virtual instrumentation using DAQ card.
8. Design and implementation of Gas signal conditioning/ analysis of chromatograph.
9. Design and implementation of particle detection in sample water using laser and photodiode preferably an array of sensor.
10. Mathematical modelling of optical filters of different wavelength using MATLAB.
11. Field Visit

English Language Proficiency II

Teaching Scheme
Lectures :1 Hrs/week
Practical:3 Hrs/week

Examination Scheme: 100 Marks
T1 and T2: 25 Marks each
End-Sem Exam: 50 Marks

Course Outcomes:

- Students will be able to communicate well using meaningful sentences for conversations or speeches.

- They will be able to reproduce their understanding of concepts of communicating using English language
- Students will be able to read and comprehend communication well and write effectively and enhance formal communication
- Students will be able to better Presentation skills and participate in healthy discussions both formal and informal among peers
- They will be more confident facing interviews, acquiring professional skills and will be industry ready

Unit I:
Linguistic Competence Building: Enhancement of Word Power, Formal and Group Discussions

Unit II:
Presentation Skill Development: Oral and Written Presentations

Unit III:
Business Writing: Business Reports, CV, Resume, SoP

Unit IV:
Job Readiness: Recruitment and Selection Procedure, Interview Etiquette, and Mock Interviews

Reference Books:
- Written Communication in English by Saran Freeman (Orient Longman)
- Communication for Business: A Practical Approach by Shirley Tailor (Longman)
- Business Correspondence and Report Writing, R. C. Sharma & Krishna Mohan (TMGH)
- Enhancing Employability at Soft Skills by Shalini Varma (Pearson)
- Corporate Communication by JaishriJethwaney (OUP)

German Language II

Teaching Scheme **Examination Scheme:**
Lectures :2 Hrs/week Oral Exam: 40 Marks
Practical: Written Exam: 60 Marks

Course Outcomes:
- Students would understand conversations of time and appointments
- Students would be familiar with the place orientation and directions
- Students would be able to converse about professions and schedules at work
- Students would be familiar with the tourism and culture of Germany

Unit I:
Termine: Termine und Verabredungen, Pünktlichkeitinterkulturell, Texte: Meldebestätigung, Veranstaltungsangebote, Arztchild, Gedicht, Wortfelder: Uhrzeiten, Wochentage, Tageszeiten

Unit II:

Orientierung:Orientierung am Arbeitsplatz, Der Wegzur Arbeit, Die Stadt Leipzig/ Quiz online, Texte: Stadtplan, Etagenplan, Terminkalender, Prospekt, Wortfelder: Stadt, Verkehrsmittel, Büro und Computer

Unit III:
Berufe: Beruf und Alltag, Texte: Visitenkarten, Wörterbuchauszüge, Wortfelder: Berufe und Tätigkeiten

Unit IV:
Berlin sehen **:**Eine Exkursiondurch Berlin, Orientierung in der Stadt, Projekt ,,Internetrally'', Texte: Busplan, Stadtplan, Postkarte, Exkursionsprogramm, Wortfelder: Tourismus, Kultur

Reference Books:
Funk, Kuhn, &Demme. Studio d A1. Deutsch alsFremdsprache. 2011. Goyal Publishers & Distributors Pvt. Ltd. Delhi, India.

Personnel Psychology II

Teaching Scheme **Examination Scheme:**
Lectures :2 Hrs/week Field Assignments : 40 Marks each
Practical: End Sem Exam: 60 Marks

Course Outcomes:
- Students will understand importance of motivation.
- Students will be able to realize importance of standards of behavior at work place
- Students will get guide lines to achieve workplace success
- Students will enable to manage stress and conflict in their personal life and at workplace.

Unit I:
Motivation: Self motivation and motivating others in their job

Unit II:
Emotional Intelligence &values :Emotional intelligence and Standards of conducts

Unit III:
Work place success : Setting goals, performance appraisal and moving ahead

Unit IV:
Stress & conflict management at work place: Occupational stress and conflict, strategies for stress and conflict management

Text Books:

- Khana S.S.- (2016) Organizational Behaviour(Text and Cases) Chand and company Pvt. Ltd. Delhi.
- Rae Andr'e :- (2008) organizational behavior. Dorling Kindersley (India) Pvt. Ltd
- Wallace Hand Masters L.- (2008) Personality development..Cengage Learning India Pvt. Ltd.

Reference Books:

- Robbins S, JudgeA, Vohra N:- (2013)Organizational behavior.(15th ed) Pearson Education,Inc
- Singh Kavita:- (2010) Organizational behavior-Text and cases. Dorling Kindersley (India) pvt. Ltd

Industrial Psychology (Part II)

Teaching Scheme
Lectures :2 Hrs/week

Examination Scheme:
Field Assignments : 40 Marks each
End Sem Exam: 60 Marks

Course Outcomes:

- Students would learn about major psychological factors involved in the process of employment
- Students would acquire psychological skills required to sustain employability
- Students would understand the elements of organizational culture for enhancing group/team behaviour
- Students would understand the role of diversity in workforce and acknowledge the multicultural factors influencing workplace behaviour
- Students would learn to apply the concepts of Engineering Psychology with respect to their disciplines
- Students would learn about the impact of Psychological factors in consumer behaviour and role of conscious efforts needed in designing products
- Students would demonstrate the knowledge gained through practical implementation

Unit I:

Managing People at Work : Employee Selection- Techniques, Fair Employment Practices, Biographical Information, Interviews, References & Letters of Recommendation, Job Analysis- Types; Newer Developments, Performance Assessment: Evaluation & Appraisal- Objective & Subjective Techniques, Bias, Post Appraisal Interviews, Organizational Training- Types of Training, Psychological Issues; Career Development & Planning

Unit II:

Groups at Work : Relationships- At workplace, Issues, Developing Effective Relationships, Groups & Teams- Stages of Group Development, Group Behaviour, Social Identity Theory, Leadership- New Approaches- Leader-Member Exchange, Transactional, Transformational & Charismatic Leaderships, Diversity at Workplace- Cultural Differences (Multiculturalism, Psychometric Testing, Motivation, Work-related Attitude, Leadership, Team work, etc.)

Unit III:

Engineering Psychology-II : Workspace Designs- General Principles, Design of Standing & Seating Work Areas, Human Anthropometry- Structural & Functional Data, Use of Anthropometric Data in Design, Human Computer Interaction- Software Design Cycle, System & User Characteristics, Principles & Guidelines for Design, Automation- Problems, Function

Allocation; Transportation- Visibility, Hazards & Collisions, Characteristics of Impaired Driver, Safety Improvements, Industrial Robots

Unit IV:

Consumer Psychology : Scope & Research Methods- Surveys, Public Opinion Polls, Focus Groups, Observations of Shopping Behaviour, Neuromarketing, Advertising- Nature, Scope & Types, Consumer Behaviour & Motivation- Buying Habits, Product Pricing, Targeted Advertising, Visual Merchandising- Psychological Perspective- Techniques, Impulse Buying, Online Visual Merchandising

Reference Books:

- Landy, F. J. & Conte, J. M. (2010). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology. 2nd Edition. Wiley India: New Delhi
- Matthewman, L., Rose, A. & Hetherington, A. (2009). Work Psychology. Oxford University Press: India
- Schultz, D. & Schultz, S. E. (2002). Psychology and Work Today. Pearson Education: New Delhi.
- Schultz, D. & Schultz, S. E. (2013). Psychology and Work Today: An Introduction to Industrial and Organizational Psychology. 7th Edition. Pearson Education: New Delhi
- Wickens, C. D.; Lee, J. D., Liu, Y. & Gordon Becker, S. E. (2015). An Introduction to Human Factors Engineering. 2nd Edition. Pearson Education: New Delhi

Japanese Language II

Teaching Scheme	**Examination Scheme:**
Lectures :2 Hrs/week	Oral Exam : 20 Marks
	Written Exam: 80 Marks

Course Outcomes:

- Students would be able to acquire target phrases and expressions
- Students would master elementary Japanese grammar
- Students would be able to converse about professions at work
- Students would be familiar with the customs, work culture & society of Japan

Unit I:

Formation of requests, asking for permission/prohibition, speaking conversations of everyday life

Unit II:

Rules and prohibitions, expressing potential and hobbies, sharing experiences

Unit III:

Rules and prohibitions, expressing potential and hobbies, sharing experiences. Utilization of modifying forms

Unit IV:
Vocabulary of Machines, Directions, Forms of verbs (give/take/receive), Description of condition and coming to decision

Reference Books:

- Minnano no Nihongo 1-1.Goyal Publishers& Distributors Pvt. Ltd. Delhi, Indiai

MINOR COURSES - INSTRUMENTATION

IE Mechanical Measurement

Teaching Scheme **Examination Scheme:**
Lectures : 3 Hrs/week T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

- Identify, formulate and solve a problem of Instrumentation and Control Engineering [PEO2][PO-e]
- Design and conduct experiments for measurement, and ability to analyze and interpret data. [PEO1] [PO-b]
- Demonstrate an understanding of sensors / transducers. [PEO3][PO-l]

Unit I: **[8 hours]**

Displacement Measurement: Resistive: Potentiometer, Linear and rotary, Loading Effect types of strain gauges. Inductive: LVDT and Eddy current type Transducers. Capacitive: Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall effect transducers Optical transducers. Precision measuring instrument (gauges), Applications of displacement sensors

Unit II: **[6 hours]**
Velocity and speed measurement: Standards, working principle, types, materials, design criterion: Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Shaft speed measurement. Applications of velocity measurement sensors.

Unit III: **[8 hours]**
Vibration and acceleration measurement: Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type. Applications of Accelration and vibration sensors.

Unit IV: **[8 hours]**
Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer,

etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Applications of Force and Torque sensors.

Unit V: **[6 hours]**

Allied Sensors: Standards, working principle, types, materials, design criterion: leak detector, flame detector, smoke detector, humidity, density, viscosity sensors, and digital transducers, Sound sensors, and Proximity sensors.

Unit VI: **[6 hours]**

Advances in sensors technology : Working Principle, types, Materials: Smart sensors, MEMS, Nano sensors, Semiconductor sensors, Optical fiber sensors. Applications of these technologies in various industry sectors.

Text Books:

- B. C. Nakra, and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
- A. K. Sawhney, "Electrical & Electronic Instruments & Measurement", DhanpatRai and Sons, Eleventh ed., 2000.

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, Fourth ed., 1990.
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, Second ed., 1999.
- SabrieSoloman, "Sensors Handbook" ,McGraw Hill Publication, First ed., 1998.
- B.G. Liptak "Process Measurement & Analysis", Chilton Book Company, Third ed., 1995.
- D.V.S. Murtha, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.
- R.K.Jain, "Engineering Metrology", Khanna Publisher, Delhi,Eighteenth ed.,2002.

MAJOR COURSES - INSTRUMENTATION

(IE(HO)-17002)Process Modelling Simulation and Optimization

Teaching Scheme **Examination Scheme:**

Lectures : 3 Hrs/week T1 and T2: 20 Marks each

End-Sem Exam: 60 Marks

Course Outcomes:

1. Use process models based on first principles , conversation principles and process data [PEO1, POa]
2. Have an understanding of computational techniques to solve process models [PEO3, POe]
3. To understand optimization problem formulations [PEO3, POe]
4. Get familiar with analytical techniques used to solve single objective, unconstrained and constrained optimization problems. [PEO1, POb]
5. Formulation of non-linear programming problems and its solution methods. [PEO1, POd]

Unit I: Introduction [4 hours]

Definition of process Model, Physical and Mathematical modeling, deterministic and stochastic processes, models, need of models and their classifications, model building, black-box model

Unit II: Mathematica Models [8 hours]

Classification of mathematical models, use of mathematical models, principles of formulation, fundamental laws, continuity equations, energy equations, transport equations, equations of state, equilibrium, kinetics.

Case study: CSTR Model, boiler-heat exchanger model

Unit III: Model Solving and Simulation [8 hours]

Solving non-linear simultaneous equations using Newton's Method. Ordinary differential equations and differential algebraic equations and solving ODE's and DAE, partial differential equations, solution of PDE's by finite difference methods. Introduction to various simulation software and solvers

Unit IV: Optimization Problems [10 hours]

Optimization problems, objective function, constraint and unconstraint surfaces, classification of optimization problems. Convexity and concavity of functions having one and two variables. Optimization of a function with one and multiple variables, gradient vectors, subject to equality constraints and Lagrangian multipliers, Hessian matrix formulation, necessary and sufficient conditions of optimality (KKT) conditions. First derivative method, Newton's and quasi-Newton's method, conjugate gradient method of unconstrained optimization problems.

Unit V: Linear Programming [6 hours]

Standard form of linear programming problem, canonical form of LP problem, Simplex method, simplex algorithm, construction of simplex tableau, minimization versus maximization problem

Unit VI: Constrained Optimization and Non-linear Programming Problems [6 hours]

Constrained optimization, formulation of equality constraint and inequality constraint optimization problems, KKT conditions, Lagrangian methods, NLP and solution of NLP by sequential quadratic programming (SQP) methods

Text Books:

- Luyben W. L., "Process Modeling Simulation and Control for Chemical Engineers", 2nd Ed., McGraw Hill, 1990
- S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P)Ltd., New Delhi, 2000

Reference books:

- Edger, Himmelblau, Lasdon, Optimization of Chemical Processes,McGraw-Hill International, Edition.
- K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.