ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2017
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (PART-TIME)

Educational Objectives

Bachelor of Electronics and Instrumentation Engineering curriculum for part-time is designed to prepare the graduates having attitude and knowledge to

1. Have successful technical and professional careers in their chosen fields such as Process Control, Electronics & Information Technology.
2. Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics & Instrumentation

Programme Outcomes

The graduates will have the ability to

a. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
b. Identify and formulate Instrumentation Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
c. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
d. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
e. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also being conscious of the limitations.
f. Understand the role and responsibility of the Professional Instrumentation Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
g. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for sustainable Development.
h. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
i. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
j. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
k. Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments.
l. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PEO \ PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	✓				✓	✓

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

REGULATIONS – 2017

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (PART-TIME)

CURRICULUM AND SYLLABI I TO VII SEMESTERS

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTMA7151	Applied Mathematics	3	0	0	3
2.	PTPH7151	Engineering Physics	3	0	0	3
3.	PTCY7151	Engineering Chemistry	3	0	0	3
4.	PTGE7151	Computing Techniques	3	0	0	3
5.	PTEI7101	Electronics for Analog Signal Processing I	3	0	0	3
		TOTAL	**15**	**0**	**0**	**15**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7201	Electrical and Electronic Measurements	3	0	0	3
2.	PTEI7202	Electronics for Analog Signal Processing II	3	0	0	3
3.	PTEI7203	Instrument Transducers	3	0	0	3
4.	PTEI7204	Signals and Systems	3	0	0	3
PRACTICALS						
5.	PTEI7211	Sensors and Signal Conditioning Laboratory	0	0	4	2
		TOTAL	**12**	**0**	**4**	**14**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7301	Control Systems	3	0	0	3
2.	PTEI7302	Digital Principles and Applications	3	0	0	3
3.	PTEI7303	Industrial Instrumentation I	3	0	0	3
4.	PTEI7304	Microprocessors, Microcontrollers and Applications	3	0	0	3
PRACTICALS						
5.	PTEI 7311	Microprocessor and Interfacing Laboratory	0	0	4	2
		TOTAL	**12**	**0**	**4**	**14**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7401	Analytical Instruments	3	0	0	3
2.	PTEI7402	Industrial Instrumentation II	3	0	0	3
3.	PTEI7403	Process Control	3	0	0	3
4.		Elective I	3	0	0	3
PRACTICALS						
5.	PTEI 7411	Process Control and Instrumentation Laboratory I	0	0	4	2
		TOTAL	**12**	**0**	**4**	**14**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7501	Industrial Instrumentation III	3	0	0	3
2.	PTEI7502	Logic and Distributed Control System	3	0	0	3
3.		Elective II	3	0	0	3
4.		Elective III	3	0	0	3
PRACTICALS						
5.	PTEI 7511	Process Control and Instrumentation Laboratory II	0	0	4	2
		TOTAL	**12**	**0**	**4**	**14**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7601	Thermal Power Plant Instrumentation	3	0	0	3
2.	PTEI7651	Industrial Data Communication	3	0	0	3
3.		Elective IV	3	0	0	3
4.		Elective V	3	0	0	3
PRACTICALS						
5.	PTEI7611	Industrial Automation Laboratory	0	0	4	2
		TOTAL	**12**	**0**	**4**	**14**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTEI7701	Instrumentation in Petrochemical Industry	3	0	0	3
2.		Elective VI	3	0	0	3
3.		Elective VII	3	0	0	3
PRACTICALS						
4.	PTEI7711	Project Work	0	0	9	6
		TOTAL	**9**	**0**	**9**	**15**

TOTAL NO. OF CREDITS: 100

ELECTIVES

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1.	PTGE7071	Disaster Management	3	0	0	3
2.	PTGE7072	Engineering Ethics and Human Values	3	0	0	3
3.	PTGE7073	Human Rights	3	0	0	3
4.	PTGE7074	Total Quality Management	3	0	0	3
5.	PTGE7075	Intellectual Property Rights	3	0	0	3
6.	PTGE7076	Fundamentals of Nano Science	3	0	0	3
7.	PTEI7001	Advanced Control Engineering	3	0	0	3
8.	PTEI7002	Advanced Instrumentation Systems	3	0	0	3
9.	PTEI7003	Advanced Topics in PID Control	3	0	0	3
10.	PTEI7004	Applied Soft Computing	3	0	0	3
11.	PTEI7005	Bio Medical Instrumentation	3	0	0	3
12.	PTEI7006	Discrete Time Signal Processing	3	0	0	3
13.	PTEI7007	Fault Detection and Diagnosis	3	0	0	3
14.	PTEI7008	Fiber Optics and Laser Instrumentation	3	0	0	3
15.	PTEI7009	Fundamentals of Nano Science and MEMS	3	0	0	3
16.	PTEI7010	Fundamentals of Pneumatics and Hydraulics	3	0	0	3
17.	PTEI7011	Instrumentation Standards	3	0	0	3
18.	PTEI7012	Instrumentation System Design	3	0	0	3
19.	PTEI7013	Internet of Things	3	0	0	3
20.	PTEI7014	Microcontroller based System Design	3	0	0	3
21.	PTEI7015	Model Predictive Control	3	0	0	3
22.	PTEI7016	Non-Linear Control Systems	3	0	0	3
23.	PTEI7017	Nuclear Power Plant Instrumentation	3	0	0	3
24.	PTEI7018	Power Electronics Drives and Control	3	0	0	3
25.	PTEI7019	Robotics and Automation	3	0	0	3
26.	PTEI7020	Safety Instrumented System	3	0	0	3
27.	PTEI7021	Unit Operations and Control	3	0	0	3

PTMA7151 **APPLIED MATHEMATICS** **L T P C**

(Common to all branches of B.E / B.Tech (PT) Programmes) **3 0 0 3**

OBJECTIVES :

- To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics.

UNIT I MATRICES **9**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem – Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II FUNCTIONS OF SEVERAL VARIABLES **9**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables - Maxima and minima of functions of two variables.

UNIT III ANALYTIC FUNCTION **9**

Analytic functions – Necessary and sufficient conditions for analyticity – Properties – Harmonic conjugates – Construction of analytic function – Conformal Mapping – Mapping by functions $w = a + z$, az, $1/z$, **-** Bilinear transformation.

UNIT IV COMPLEX INTEGRATION **9**

Line Integral – Cauchy's theorem and integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of Residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS **9**

Existence conditions – Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals –Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TOTAL : 45 PERIODS

OUT COMES :

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

TEXT BOOK :

1. Grewal B.S., " Higher Engineering Mathematics ", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES :

1. Ramana. B.V., " Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig ," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3. Glyn James, Advanced Modern Engineering Mathematics, Prentice Hall of India, Fourth Edition, 2011.
4. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.
5. Ray Wylie C and Barrett.L.C, " Advanced Engineering Mathematics " Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PTPH7151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

OBJECTIVE:

- To introduce the basic physics concepts relevant to different branches of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

OUTCOME:

- The students will acquire knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
3. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

PTCY7151	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free

radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions- Types of isotherms–Frendlich adsorption isotherm,Langmuir adsorption isotherm.Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation.Industrial applications of catalysts.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy-principles, instrumentation (Block diagram) and applications.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

TEXT BOOKS

1. Jain P. C. & Monica Jain., “Engineering Chemistry”, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.

2. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCES

1. Pahari A., Chauhan B., “Engineering Chemistry”, Firewall Media, New Delhi, 2012.

2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.

3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry”, ACME Learning Private Limited., New Delhi., 2010.

4. Vairam S., Kalyani P., Suba Ramesh., “Engineering Chemistry”, Wiley India Pvt Ltd., New Delhi., 2011.

PTGE7151	COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

Common to all branches of Engineering and Technology

OBJECTIVES:

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION 9

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS 9

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS 9

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations.

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures – Unions

TOTAL : 45 PERIODS

At the end of the course, the student should be able to:

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013

2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.

3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES

1.Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006

2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.

3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

PTEI7101	ELECTRONICS FOR ANALOG SIGNAL PROCESSING I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the construction, operation, characteristics and applications of various semiconductor diodes and transistors.
- To impart knowledge on different types of configurations and biasing circuits for BJT and FET.
- To impart knowledge on single & multi-stage amplifiers, power amplifiers and oscillators.
- To enable the students to analyze a given BJT / FET amplifier circuit for voltage gain, current gain, input impedance, output impedance and bandwidth.
- To enable the students to design transistor amplifiers and oscillators for a given set of specifications.

UNIT I SEMICONDUCTOR DIODES 9

PN junction diode: Forward and reverse characteristics, Applications in Rectifier, Switching, Clipper, Clamper and Protection circuits - Zener diode: Forward and reverse characteristics, Application as voltage regulator, Introduction to special diodes: Schottky diode, Varactor diode, Laser diode, Photodiode – UJT characteristics and application as relaxation oscillator, Thyristors: Characteristics and applications of SCR, DIAC and TRIAC.

UNIT II BJT AMPLIFIERS 9

BJT: NPN and PNP transistors, Characteristics of CE, CB and CC amplifier configurations, Biasing circuits, Operating point, Load line – Hybrid model, Two-port analysis, Mid-band analysis of BJT

amplifier using h-parameters – High frequency model, Frequency response of BJT amplifier – Transistor switching circuits.

UNIT III FET AMPLIFIERS 9

FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations – Biasing circuits for JFET and MOSFET, Operating point, Load line – Small signal model, Mid-band analysis of FET amplifier – High frequency model of FET, Frequency response of FET amplifiers - NMOS and CMOS inverter circuits.

UNIT IV MULTISTAGE AND FEEDBACK AMPLIFIERS 9

Multistage amplifier: Coupling schemes for cascading amplifier, General analysis of cascaded amplifier, Cascade and Bootstrap amplifiers. Feedback amplifier: Characteristics of feedback amplifier, AC analysis of feedback amplifiers: Voltage-Series, Voltage-Shunt, Current-Series and Current-Shunt amplifiers. Single and Double Tuned Amplifiers.

UNIT V OSCILLATORS AND POWER AMPLIFIERS 9

Oscillators: Classification, Condition for oscillation - Phase shift oscillators: RC phase shift and Wien Bridge oscillators - Resonant frequency oscillators: Hartley, Colpitts and crystal oscillators. Power amplifiers: Class A, Class B and Class AB amplifiers, Efficiency - Distortion in power amplifiers.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Apply the knowledge of semiconductor device fundamentals to understand the operation of any diode or transistor based circuit.
2. Analyze a given transistor amplifier end evaluate its performance with respect to gain, impedance and bandwidth.
3. Design single stage / multistage BJT/FET amplifiers for a given set of specifications. Select an appropriate diode / transistor circuit for a specific application.

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias, Satyabrata Jit, “Electronic Devices and Circuits”, 3rd Edition, McGraw-Hill, 2011.

2. Donald A. Neaman, “Electronic Circuits Analysis and Design”, 3rd Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.

2. Sedra and Smith, “Microelectronic circuits”, 7th Edition, Oxford University Press, 2014.

3. Ben G. Streetman and Sanjay K. Banerjee, “Solid State Electronic Devices”, 7th Edition, 2014.

4. Donald A. Neaman, “Semiconductor Physics and Devices Basic Principles”, 3rd Edition, McGraw-Hill, 2003.

5. Salivahanan, S. and Suresh Kumar, N., “Electronic Devices and Circuits”, 2nd edition, McGraw-Hill, 2011.

6. NPTEL video lectures on "Electronics for Analog Signal Processing I" by Prof. K.R.K. Rao, IITM.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	C	d	e	f	g	h	i	j	k	l
1	✓											
2		✓										
3			✓									
4					✓							

PTEI7201 ELECTRICAL AND ELECTRONIC MEASUREMENTS LT PC
3 0 0 3

COURSE OBJECTIVES

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, resistance, inductance and capacitance.
- To have an adequate knowledge in the measurement techniques for power and energy.
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters.
- In-depth understanding and idea of analog and digital instruments.
- Detailed study of display and recording devices.

UNIT I MEASUREMENT OF ELECTRICAL PARAMETERS 9

Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wein Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.

UNIT II POWER AND ENERGY MEASUREMENTS 9

Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter: Theory and Adjustments – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.

UNIT III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS 9

D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.

UNIT IV ANALOG AND DIGITAL INSTRUMENTS 9

Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement.

UNIT V DISPLAY AND RECORDING DEVICES 9

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays –Trends in display technologies – X-Y recorders – Magnetic tape recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. An ability to compare the working principles, merits, demerits and errors of different types of electrical instruments and can understand about different instruments that are used for measurement purpose.
2. Understanding of how different bridge networks are constructed and balanced for finding out values of resistance, capacitance and inductance.
3. An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
4. Able to apply the principles and practices for instrument design and development to real world problems.

TEXT BOOKS:

1. Kalsi, H.S., " Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2010.

2. Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co., New Delhi, 2010.

REFERENCES:

1. Northrop, R.B., "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 2008.

2. Carr, J.J., "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	E	f	g	h	i	j	k	l
1	✓											✓
2				✓								
3	✓											
4					✓							

PTEI7202 ELECTRONICS FOR ANALOG SIGNAL PROCESSING II LT P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the basics of operational amplifiers, their characteristics and their configurations.
- To impart knowledge about the concepts and applications of timer, PLL, ADC and DAC.
- To enable the students to analyze the given integrated circuit and evaluate the output.
- To enable the students to design signal conditioning circuits using operational amplifiers.
- To enable the students to design multi-vibrator circuits using OPAMP / Timer for switching applications.

UNIT I OPERATIONAL AMPLIFIERS 9

Differential amplifier: BJT and FET configurations, Differential mode and common mode equivalent circuits, Single-ended and Double-ended output, CMRR – OPAMP: Internal blocks, Ideal characteristics, DC and AC characteristics of non-ideal OPAMP, Frequency compensation techniques, Methods of improving Slew rate and CMRR – Inverting and Non-inverting OPAMP configurations, Summing and Difference amplifiers.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIER 9

Differentiator and Integrator: ideal and practical circuits, V to I and I to V converters - Instrumentation amplifier circuit analysis, Instrumentation amplifier IC – Active Filters: Low pass, High pass, Band pass and Band reject filters – Comparator, Schmitt trigger, Multi-vibrators, Triangular wave generator, Sine wave generator, Function generator - Clipper and Clamper – Log and Antilog amplifiers.

UNIT III TIMER AND PHASE LOCKED LOOP 9

Timer IC: Internal blocks – Multi-vibrator circuits and their applications. VCO: Functional block diagram, Operation, V-F conversion factor, Application – Phase detector: Analog and Digital, Conversion gain – PLL IC: Internal block diagram, Operation, Capture range, Lock range, Applications: Generation of FM signal, Demodulation of AM, FM and FSK signals.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog switches, Sample and hold IC, DAC principle, Resolution, Range – Types: Weighted R, R-2R and Inverted R-2R, DAC ICs – ADC: Principle, Types: Flash, Counting, Single slope, Dual slope, Successive approximation – ADC ICs.

UNIT V SPECIAL FUNCTION IC'S 9

Analog multiplier: Single, double and four quadrant multipliers - Operational trans-conductance amplifier, Power amplifier: Audio and video amplifiers – Linear voltage regulator: Internal blocks, low and high voltage regulator operation, Current protection – Switched regulator, Buck, Boost & Buck/boost regulators – Switched capacitor filter, Isolation amplifier, Opto-coupler.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to interpret data sheet of a given analog IC.
2. Ability to apply the knowledge of analog IC's to understand the operation of a given

electronic circuit involving IC's.

3. Ability to analyze an electronic circuit involving IC's and evaluate its output.
4. Ability to design an analog IC based electronic circuit for a given application.
5. Compare the performance of IC based circuits with discrete component circuits for the same application.

TEXT BOOKS:

1. Ramakant Gayakwad, "Op-amps and Linear Integrated Circuits", 4th Edition, Prentice Hall, 2000.

2. Robert, F., Coughlin, Frederick F., Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 5th Edition, Prentice Hall, 1998.

REFERENCES:

1. Sergio Franco, "Design with Operational Amplifiers and Linear Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2002.

2. Paul R. Gray, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2010.

3. Roy Choudhry, D. and Shail B. Jain, "Linear Integrated Circuits", 2nd Edition, New Age International, 2003.

4. NPTEL video lectures on "Electronics for Analog Signal Processing II" by Prof. K.R.K. Rao, IITM.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	B	c	d	e	f	g	h	i	j	k	l
1				✓								
2	✓											
3		✓										
4				✓								
5					✓							

PTEI7203 **INSTRUMENT TRANSDUCERS** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- Get to know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS **9**

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS **9**

Static characteristics: Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS **9**

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS **9**

Inductive transducers – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of Capacitive transducers – Different types & Signal Conditioning – Applications: Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER TRANSDUCERS **9**

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451).

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply the mathematical knowledge and science & engineering fundamentals

gained to solve problems pertaining to measurement applications.
2. Be able to analyze the problems related to sensors & transducers.
3. Be able to select the right sensor/transducer for a given application.
4. Be able to determine the static and dynamic characteristics of transducers using software packages.

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2011.

2. Renganathan, S.," Transducer Engineering", Allied Publishers, New Delhi, 2003.

REFERENCES:

1. Neubert, H.K.P., "Instrument Transducers – An Introduction to their Performance and Design", Oxford University Press, Cambridge, 2003.

2. Albert, D. Helfrick and Cooper, W. D., "Modern Electronic Instrumentation and Measurement Techniques", PHI Learning Pvt. Ltd., 2011.

3. Murthy, D.V.S., "Transducers and Instrumentation", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

4. John P. Bentley, "Principles of Measurement Systems", 4th Edition, Pearson Education, 2004.

5. Bolton, W., "Engineering Science", Elsevier Newnes, 5th Edition, 2006.

6. Patranabis, D., "Sensors and Transducers", 2nd Edition, Prentice Hall of India, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	L
1	✓	✓										
2					✓							
3				✓	✓							
4					✓							

PTEI7204	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the representation and classification of continuous-time and discrete-time signals.
- To impart knowledge on the methods and impact of analog to digital conversion and digital to analog conversion.
- To teach the analysis of CT and DT systems through various transform techniques such as Laplace transform, Fourier transform and Z-transform.
- To familiarize the concept of random signals and their statistical properties.

UNIT I INTRODUCTION TO CT SIGNALS AND SYSTEMS 9

Introduction to signals and systems and their classifications. Definition of CT signal, Representation of elementary CT signals: – Impulse, Pulse, Step, Ramp, Exponential, Sinusoidal. Classification of CT signals: – periodic and a-periodic, power and energy, deterministic and random signals. Definition of CT system, Classification and characterization with examples: – Static & dynamic, causal & non causal, linear & non linear, time variant & time invariant, stable & unstable, FIR & IIR.

UNIT II ANALYSIS OF CT SIGNALS AND SYSTEMS 9

Time domain analysis:-solutions of differential equation. Fourier series and Fourier transform analysis of signals, spectrum of CT signals, Laplace Transform analysis of signals and systems, Analysis of random signals.

UNIT III DISCRETIZATION AND SIGNAL RECONSTRUCTION 9

Discretization of signals: sample and hold circuit**, Sampling:-** Sampling theorem, selection of sampling rate, Types of sampling, Aliasing:- Aliasing effects, Anti-aliasing filter, Quantization:- Quantization errors due to truncation and rounding in fixed and floating point representations, signal reconstruction:-Interpolation using zero-order hold & first order hold.

UNIT IV CLASSIFICATION AND ANALYSIS OF DISCRETE TIME SIGNALS 9

DT signals: – Introduction, Definition, Elementary DT signals, Characterization. DT systems: Definition, Classification, Characterization. Time domain analysis: - Solutions of difference equations.

UNIT V TRANSFORM TECHNIQUES FOR DT SIGNALS AND SYSTEMS 9

Discrete Time Fourier Transform:– Definition, Existence and Properties. Z-Transform – Definition, Properties, ROC and its properties, Inverse Z Transform. Analysis of DT systems using Z Transforms: – Stability, Causality, Recursive, Non-recursive systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students

- Will gain ability to generate different types of CT and DT signals.
- Will be capable to analyze and characterize any given CT or DT system and obtain the time response and frequency response.
- Will gain knowledge on the application of transform techniques.
- Will be familiarized with random signals and their statistical properties.

TEXT BOOKS

1. Allan V. Oppenheim, S. Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, Indian Reprint, 2007.

2. Tarun Kumar Rawat, Signals and Systems,Oxford University Press,2010

3. Arun K Tangirala, Principles of system identification, CRC press 2015

REFERENCES

1. H P Hsu, Signals and Systems, Schaum's Outlines,Tata McGraw Hill,2006.

2. John Alan Stuller, An Introduction to signals and Systems,Thomson,2007.

3. Edward W Kamen,Bonnie S Heck,Fundamentals of Signals and Systems using the Web and MATLAB,Pearson,Indian Reprint,2007.

PTEI7211 SENSORS AND SIGNAL CONDITIONING LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.

LIST OF EXPERIMENTS

1. Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermo-well.
2. Static and Dynamic characteristics of RTD and Thermistor.
3. Characteristics of linear displacement transducers (LVDT and Hall Effect sensor).

4. Characteristics of angular displacement transducers (Synchros and Capacitive transducer).

5. Sensitivity analysis of strain gauge bridges (quarter, half and full).

6. a. Static characteristic of flapper-nozzle system.

   b. Loading effect on resistive potentiometer.

7. Characteristic of seismic type accelerometer.

8. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.

9. a. Design of V/I and I/V converters.

   b. Design and testing of Instrumentation amplifier.

10. Design of cold junction compensation for Thermocouples and lead wire compensations for RTD.

11. Design of signal conditioning circuits for high output impendence sensor (pH).

12. PC Based Data Acquisition system.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Understand the concepts of measurement, error and uncertainty.
2. Understand the static and dynamic characteristics of measuring instruments.
3. Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
4. Acquire knowledge of operation and applications of special transducers.
5. Acquire knowledge of interfacing and analyzing different stages of signal conditioning units.
6. Ability to present the results in oral form as well as in written form as a report.
7. Ability to interpret the results and draw meaningful conclusions.
8. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO\PO	a	B	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓									
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7				✓								
8									✓		✓	

PTEI7301 **CONTROL SYSTEMS** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students familiarize about various representations of systems.
- To develop linear models mainly state variable model and Transfer function model from Non Linear systems.
- To make the students analyze linear systems in time domain and frequency domain.
- To train the students to design compensator for system(s) using time and frequency domain techniques.

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Hydraulic systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II STATE SPACE MODEL OF LTIV AND LTV SYSTEMS 9

State variable formulation – Non uniqueness of state space model – State transition matrix –Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability.

UNIT III TIME DOMAIN AND STABILITY ANALYSIS 9

Standard test inputs – Time responses – Time domain specifications – Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation.

UNIT IV FREQUENCY DOMAIN ANALYSIS 9

Frequency response plots: Bode plot, Polar plot and Nyquist plot – Frequency domain specifications: Resonance peak, Resonant frequency and Bandwidth – Stability Analysis: Gain margin and Phase margin.

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques – Introduction to Non-linear system.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
2. Ability to do time domain and frequency domain analysis of various models of linear system.
3. Ability to come out with solution for complex control problem.
4. Ability to interpret characteristics of the system to develop mathematical model.
5. Ability to design appropriate controller for the given specifications.

TEXT BOOKS:

1. Benjamin C. Kuo, “Automatic Control Systems”, 7th Edition PHI Learning Private Ltd., 2010.

2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, 3rd Impression, 2009.

2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.

3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5th Edition, 2010.

4. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	J	k	l
1	✓											
2		✓										
3			✓									
4				✓								
5			✓									

PTEI7302 DIGITAL PRINCIPLES AND APPLICATIONS LT P C
3 0 0 3

COURSE OBJECTIVES

- To study various number systems, Boolean expressions and simplifications.
- To study, analyze and design of the combinational logic circuits for arithmetic operations.
- To study, analyze and design of sequential circuits, registers and counters.
- To study, analyze and design asynchronous sequential circuits and to know the functions of ASM charts.
- To learn memory components, PLA, PAL and the basic of HDL.

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 9

Review of number systems – Arithmetic operations in binary number system – Binary codes – Boolean algebra and rules – Boolean functions: Simplifications: standard / canonical form of SOP and POS, Simplification using Karnaugh Map and Tabulation methods – Basic logic gates – Universal gates.

UNIT II COMBINATIONAL LOGIC 9

Combinational circuits – Analysis and design procedures – Circuits for arithmetic operations: Full adder, Carry look-ahead adder, binary adder, adder-subtractor, comparators – Code conversion – Decoders and Encoders – Multiplexers and De-multiplexers.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 9

Sequential circuits – Flip flops: Triggering, types, conversions, excitation tables – Analysis and design procedures – State reduction and state assignment – Shift registers – Counters: MOD counters, up-down counter, ring counters – Sequence detectors.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and design of asynchronous sequential circuits – Reduction of state and flow tables – Race-free state assignment – Arithmetic State Machines: Introduction, components, features, examples.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES 9

RAM and ROM types – Memory decoding - Error detection and correction - Programmable logic devices: Programmable Array Logic – Programmable Logic Array – Types of sequential programmable devices – Hardware Description Language: Introduction - HDL for combinational logic circuits - HDL for Sequential logic circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

At the end of the course, the student should have the ability:

1. To apply mathematics knowledge of number systems, Boolean expressions / functions.
2. To analyze the combinational and sequential circuits.
3. To design combinational logic circuits for different problems.
4. To design sequential logic circuits for various problems.
5. To investigate various programmable logic devices.

TEXT BOOKS:

1. Morris Mano, M. and Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL”, 5th Edition, Prentice Hall, 2013.

2. Donald P Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications”, 8th Edition, McGraw-Hill, 2014.

REFERENCES:

1. Thomas L. Floyd, “Digital Fundamentals”, 11th Edition, Prentice Hall, 2015.

2. Anand Kumar, A., “Switching Theory and Logic Design”, 2nd Edition, PHI, 2014.

3. John F. Wakerly, “Digital Design Principles and Practices”, Pearson Education, 2008.

4. Arijith Saha and Nilotpal Manna, “Digital Principles and Logic Design”, Laxmi Publication, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO \ PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓										
2		✓										
3		✓	✓	✓								
4		✓	✓	✓								
5				✓								

PTEI7303 INDUSTRIAL INSTRUMENTATION I LT P C
3 0 0 3

COURSE OBJECTIVES

- To make students understand the various measuring techniques for displacement, velocity, force, torque, acceleration, vibration, density, viscosity, humidity and moisture

UNIT I MEASUREMENT OF DISPLACEMENT AND VELOCITY 9

Displacement: Gauge blocks, Ultrasonic, Laser Interferometer Displacement Sensors - Michelson, Magnetic Displacement Sensors: Magnetostrictive Sensors, Magnetoresistive Sensors, Hall Effect Sensors and Magnetic Encoders, optical encoders and syncro resolver. Velocity: Relative, translational and rotational velocity measurement - revolution counter and timer – capacitive acho - drag cup type tacho - AC and DC tacho generators- Stroboscope.

UNIT II MEASUREMENT OF FORCE AND TORQUE 9

Force: Analytical balance, Steel yard, Electronic microbalance- Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells Torque: Measurement using load cell, Strain gauge and relative angular twist

UNIT III MEASUREMENT OF ACCELERATION, VIBRATION AND SHAFT POWER 9

Measurement of Acceleration: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Gyroscopes. Measurement of vibration: Mechanical type vibration instrument, calibration of vibration pickup .Shaft power measurement: Torsion dynamometer - prony brake - hydraulic absorption dynamometer.

UNIT IV MEASUREMENT OF VISCOSITY AND DENSITY 9

Viscosity: Units and definitions of viscosity terms - Friction tube Viscometer, Saybolt viscometer, Rotameter type and Torque type viscometers - Industrial Consistency Meters

Density: Baume scale and API scale, Pressure head type densitometers, displacer type densitometer, Float type densitometers, buoyancy effect densitometer, radioactive and resonance type densitometer, Ultrasonic densitometer and hot wire gas bridge densitometer.

UNIT V MEASUREMENT OF HUMIDITY AND MOISTURE 9

Humidity: Definitions of humidity terms - Dry and wet bulb psychrometers – hair hygrometer - Resistive and capacitive type hygrometers – Dew cell –Commercial type dew meter.

Moisture: Different terms to express moisture content in a material - Different methods of moisture measurements: Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in granular materials, solid penetrable materials like wood.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand the construction and working of instruments used for measurement of Displacement, velocity, force, torque, acceleration, vibration, shaft power, density, viscosity, humidity and moisture.
- Ability to select instruments according to the application.
- Understand the concept of calibration of measuring instruments

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., “Measurement systems Application and Design”, 5th Edition, Tata McGraw-Hill Education Pvt. Ltd, 2007.

2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES:

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.

2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.

4. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.

5. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.

6. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.

PTEI7304	MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS	L T P C 3 0 0 3

COURSE OBJECTIVES

- To get familiarized with architecture, addressing modes and instructions of 8085 & 8086 microprocessor.
- To get exposed to high Performance and advanced architectures.
- To gain knowledge on essential peripherals and the associated interfacing ICs.
- To get acquainted with 8-bit microcontroller and be able to program in assembly and C-language.
- To design microcontroller based system/application.

UNIT I ARCHITECTURE OF 8085/8086 PROCESSOR 9

Evolution of Microprocessors – Introduction to 8085 – Architecture – Addressing Modes –Timing diagrams – Introduction to 8086 – Architecture – Maximum mode – Minimum mode – Addressing Modes & Programming.

UNIT II ADVANCED ARCHITECTURES 9

Road to Higher Performance – Past and current Performance, Trends in Processor – Pipeline concepts and Performance – Superscalar Processing – Hardware Accelerators – Multiprocessor – RISC and CISC Processors – Nano Programming – Case study

UNIT III PERIPHERALS AND THEIR INTERFACING 9

Programmable Peripheral Interface (8255) - Keyboard display controller (8279) – ADC – DAC Interface – Programmable Timer Controller (8254) – Programmable interrupt controller (8259) – Serial Communication Interface (8251) – DMA Controller (8257).

UNIT IV MICROCONTROLLER ARCHITECTURE & PROGRAMMING 9

8051 Microcontroller – Architecture – Instruction Set – Addressing modes – Interrupts – Assembly Language Programming - Programming 8051 Timers – Serial Port Programming – Interrupts Programming – 8051 Programming in C.

UNIT V 8051: INTERFACING AND SYSTEM DESIGN 9

LCD & Keyboard Interfacing – ADC, DAC interfacing – External Memory interfacing – Sensor Interfacing – Motor Control – Relay – PWM – DC & Stepper Motor – Design of traffic light control and Washing machine control.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the architecture of any advanced Processor to keep in pace with technological challenges.
2. Apply the acquired Programming skills and relate to any Processor/microcontroller in a multidisciplinary project.
3. Able to utilize the IT tools like TASM, MASM and Proteus to develop electronic prototyping and thereby establishing real time control.

4. Ability to develop/design microcontroller based system paving way for automation and continuous development.

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085", 6th edition, Penram International Publishing, 2013.

2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Revised 2nd Edition, Indian edition 2007, 11th Reprint 2010, Tata McGraw-Hill.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.MCKinlay, "The 8051 Microcontroller and Embedded Systems", 2nd Edition 2008, 5th Reprint, 2010, Pearson Education.

2. Krishna Kant, "Microprocessor and Microcontroller Architecture programming and system design using 8085, 8086, 8051, 8096, PHI", 7th Reprint 2011.

3. Ray, A.K. and Bhurchandi, K.M., "Advanced Microprocessor and Peripherals", 2nd Edition, Tata McGraw-Hill, 2007.

4. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thompson Delmar Learning, 2007, New Delhi.

5. Dogan Ibrahim, "Microcontroller Based Applied Digital Control", John Wiley & Sons Ltd, 2006.

6. John P.Hayes, "Computer Architecture & Organization", 3rd Edition, Tata McGraw-Hill, 1998.

7. Behrooz Parhami, "Computer Architecture From Microprocessor to supercomputer", Oxford Publishing, 2014 Indian Reprint.

8. Krishna Kumar, "Lecture Notes on Microprocessors and Microcontrollers", NPTEL, E-Learning Course, IISc Bangalore.

9. Pramod Agarwal, "Lecture Notes on Microprocessor", NPTEL, E-Learning Course, IIT Roorkee.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/ PO	a	b	c	d	e	f	g	h	i	j	k	l
1												✓
2									✓			
3					✓							
4							✓					

PTEI7311 MICROPROCESSOR AND INTERFACING LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

- To develop skill in program writing for 8085, 8086 processors and 8051microcontroller.
- To gain Practical knowledge on interfacing hardware and associated software.
- To get trained to Programming and interfacing using simulators.
- To get exposed to programming and interfacing using ARM7, ARM11, MSP430, and PIC microcontroller.

LIST OF EXPERIMENTS

ASSEMBLY LANGUAGE PROGRAMMING

1. a) Understanding the instruction set of 8085 µp.

   b) PROGRAMMING using Arithmetic, Logical instructions of 8085 microprocessor.

2. a) Understanding the instruction set of 8086 µp.

   b) Programming using String manipulation instructions (Compare &Scan) of 8086 microprocessor.

3. a) Understanding the instruction set of 8051 µc.

   b) Programming using Arithmetic, Logical and Bit manipulation instructions of 8051 microcontroller

SIMULATION EXPERIMENTS

4. Turbo assembler Programming (using arithmetic, logical, string instructions) of 8086.
5. Interfacing Keyboard / LCD with µc.
6. Interfacing ADC/DAC/ stepper motor with µc.

Hardware based Experiments using 8085 / 8086 / 8051 / ARM7 / ARM11 / MSP430 and PIC MICROCONTROLLER

7. Interfacing ADC and DAC with µp / µc.
8. Data transfer between computer and µp / µc.
9. a) Interfacing Keypad (4 x 4) with µp / µc.

   b) Interfacing LCD with µp / µc .

. 10. **I^2C** based RTC/ EEPROM/ 7-Segment display Interface with µp / µc.

11. Interfacing limit Switches/ Push buttons/ Solenoid valves/ Pumps with µp / µc.

12. a) Realization of PID algorithm in µp / µc.

b) µp / µc based control of temperature / Level process.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to exploit the features/instruction of the microprocessor and microcontroller to develop microprocessor/microcontroller based system.
2. Provide automation solutions to the real-time processes and thereby improving the efficiency.
3. Facilitate interdisciplinary projects based on the acquired programming skills.
4. Ability to present the results in oral form as well as in written form as a report
5. Ability to interpret the results and draw meaningful conclusions.
6. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1		✓										
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5				✓						✓		
6									✓			

PTEI7401 **ANALYTICAL INSTRUMENTS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY 9

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

UNIT II CHROMATOGRAPHY 9

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.

Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
2. Assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative

analytical methods for quality assurance.
3. Critically evaluate the strengths and limitations of the various instrumental methods.
4. Develop critical thinking for interpreting analytical data.

TEXT BOOKS:

1. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.

2. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.

3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCES:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.

2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).

3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.

4. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	F	g	h	i	j	k	l
1	✓											
2					✓							
3			✓									
4				✓								

PTEI7402 INDUSTRIAL INSTRUMENTATION II LT P C
3 0 0 3

COURSE OBJECTIVES

- To make students understand the various measuring techniques for temperature and pressure.
- To make students analyze the characteristics of each measurement device and design signal conditioning circuits for the same.

UNIT I PRESSURE MEASUREMENT I **9**

Units of pressure – Different types of Manometers- Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain

gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor

UNIT II PRESSURE MEASUREMENT II **8**

Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, lionization gauges, Cold cathode type and hot cathode type – Installation and maintenance of pressure gauges - Calibration: Dead Weight Tester.

UNIT III TEMPERATURE MEASUREMENT I **10**

Definitions and standards – Primary and secondary fixed points – Thermometers: Different types of filled in system thermometers, sources of errors and their compensation – Bimetallic thermometers – Thermistors: Material, Construction, working, characteristics and linearization.

UNIT IV TEMPERATURE MEASUREMENT II **10**

RTDs: Material, Construction, Working, characteristics, lead wire compensation and signal conditioning circuit. IC sensor.

Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Commercial circuits for cold junction compensation, Response of thermocouple, Signal conditioning for thermocouple, Special techniques for measuring high temperature using thermocouple - installation and maintenance of thermocouples.

UNIT V TEMPERATURE MEASUREMENT III **8**

Radiation fundamentals - Radiation methods of temperature measurement – Optical pyrometers - Total radiation pyrometers —- Two color radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the construction and working of instruments used for measurement of temperature and pressure.
2. Ability to select instruments according to the application.
3. Understand the concept of calibration of instruments and gain knowledge about temperature measurement devices.
4. Ability to design signal conditioning circuits and compensation schemes for temperature measuring instruments.

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., “Measurement systems Application and Design”, 5th Edition, Tata McGraw-Hill Education Pvt. Ltd, 2007.

2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES:

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.

2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.

4. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.

5. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.

6. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras. Temperature sensor selection, Installation and Calibration. selection and installation .

PTEI7403 **PROCESS CONTROL** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce technical terms and nomenclature associated with Process control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To introduce students to the fundamentals of system identification.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I PROCESS DYNAMICS **9**

Need for process control – Hierarchical decomposition of control functions – Servo and regulatory operations – Continuous and Batch processes – Mathematical Modeling of Processes: Level, Flow and Thermal processes – Lumped and Distributed parameter models – Degrees of Freedom – Interacting and non-interacting systems – Self regulation – Linearization of non-linear systems – Dynamic behavior of processes.

UNIT II CONTROL VALVE **9**

Actuators: Pneumatic and electric actuators – I/P converter – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Valve body: Commercial valve bodies – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Materials for Control Valves – Control Valve selection

UNIT III CONTROL ACTIONS **9**

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless Auto/manual Mode transfer, Anti-reset windup Techniques and Direct/reverse action – Realization of PID Controller using Analog Circuits – Introduction to fractional order PID controller

UNIT IV PID CONTROLLER TUNING – SINGLE LOOP REGULATORY CONTROL & ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL **9**

PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control – Ratio control – Inferential control – Split-range – override control – Adaptive Control

UNIT V MODEL BASED CONTROL SCHEMES & INTRODUCTION TO MULTI-LOOP REGULATORY CONTROL & CASE –STUDIES **9**

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller – Single Loop Dynamic Matrix Control – Introduction to Multi-loop Control Schemes – Control Schemes for Distillation Column, CSTR, pH, and Heat Exchanger – Three-element Boiler drum level control – P&ID diagram.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COS)

1. Ability to understand technical terms and nomenclature associated with Process control domain.
2. Ability to build models using first principles approach as well as analyze models.
3. Ability to Design, tune and implement PID Controllers to achieve desired performance for various processes
4. Ability to Analyze Systems and design & implement control Schemes for various processes.
5. Ability to use appropriate software tools (Example: MATLAB/SCILAB) for analysis and design of Process Control System.
6. Ability to Identify, formulate and solve problems in the Process Control Domain.

TEXT BOOKS:

1 Seborg ,D.E., Mellichamp, D.P., Edgar, T.F., and Doyle,F.J., III, "Process Dynamics and Control", John Wiley and Sons, 3rd Edition, 2010.

2 Bequette, "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004.

REFERENCES:

1 Michael King, "Process Control: A Practical Approach", Wiley, 2010.

2. Baumann, H.D., "Control Valve Primer – A User's Guide", ISA, 2008.

3. Antonio Visioli, "Practical PID Control" Springer- Verlag London, 2006.

4. Aidan O'Dwyer, "Handbook of PI and PID Controller Tuning Rules", Imperial College Press, 2009.

5. George Stephanopoulos, "Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.

6. Bela G. Liptak, "Instrument Engineers' Handbook", 4th Edition, Volume Two: Process Control and Optimization, CRC Press, 2005.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1					✓	✓						
2	✓	✓		✓								
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PTEI7411 PROCESS CONTROL AND INSTRUMENTATION LABORATORY I **L T P C 0 0 4 2**

COURSE OBJECTIVES

To impart theoretical skills in

- Process Identification
- Tuning of PID controller including Auto-tuning
- PID Enhancements (Cascade and Feed-forward Control Schemes) and
- Design and Implementation of basic and advanced Control schemes using simulation software.
- To make the students aware about calibration of meter, sensors and transmitters.
- To make the students conscious about the working and operation of different types of analytical sensors.
- To identify, formulate, and analyze complex problems regarding sensors and transmitter
- To use research-based knowledge and research methods for interpretation of data from sensors

LIST OF EXPERIMENTS

Process Control

Simulation Based Experiments

1. Interpretation of P & ID (ISA S5.1)

2. Simulation of Lumped/ Distributed Parameter System.
3. Identification of Transfer function model of a Typical Industrial Process using non-parametric identification methods.
4. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process.
5. Design and Implementation of Feed forward and Cascade control schemes on the simulated model of a Typical Industrial Process.
6. (i) Analysis of MIMO system.
   (ii)Design and implementation of Multi-loop PID schemes on the simulated model of a Typical Industrial Process.

Industrial Instrumentation

1. Testing of pressure gauge using dead weight tester.
2. a) Calibration of thermocouple and RTD using temperature calibrator.
   b) Calibration of temperature transmitter using multifunction calibrator.
3. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator.
4. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
5. Measurement of Conductivity, pH and Viscosity of Test solutions
6. a)Temperature Measurement using IR Thermometer.
   b) Measurement of Pressure using fiber optics system.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Get exposed to simulation tools such as MATLAB/LABVIEW/ASPEN.
2. Be able to build dynamic models using the input-output data of a process.
3. Get acquainted with PID implementation issues and be able to tune the PID controller.
4. Ability to obtain servo and regulatory responses and be able to analyze and draw meaningful conclusions.
5. Be able to design and implement simple adaptive control scheme and model based control scheme.
6. Be able to present the results in written and oral forms.
7. Ability to work as a Member in a group.
8. Ability to experimentally measure industrial process parameters such as temperature, pressure and viscosity.
9. Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
10. Ability to calibrate sensors and transmitters.
11. Abilty to present the results in oral form as well as in written form as a report and graph.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1						✓						
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7										✓		
8									✓			

PTEI7501 INDUSTRIAL INSTRUMENTATION III LT P C
3 0 0 3

COURSE OBJECTIVES

- To make students understand the various measuring techniques for flow and level
- To make students understand different type of transmitters.

UNIT I VARIABLE HEAD TYPE FLOWMETERS 9

Expression for flow rate through restriction(compressible and incompressible flow) – Orifice plate – different types of orifice plates – Cd variation – Pressure tapings – Venturi tube – Flow nozzle – Dall tube – Elbow taps – Pitot tube, combined pitot tube, averaging pitot tube – installation and applications of head flow meters.

UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 9

Positive displacement flow meters: Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter: Turbine flow meter – Variable Area flow meter: Rota meter theory, characteristics, installation and applications – Mass flow meter: Angular momentum, Thermal and Coriolis type mass flow meters – Calibration of flow meters: Dynamic weighing method.

UNIT III ELECTRICAL TYPE FLOW METERS 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT IV LEVEL MEASUREMENT 9

Level measurement: Float gauges – Displacer type – Bubbler system – Load cell – Conductivity sensors – Capacitive sensors – D/P methods – Nucleonic gauge – Ultrasonic gauge, DIP ultrasonic sensors – Boiler drum level measurement: Differential pressure and Hydra step methods – Solid level measurement.

UNIT V TRANSMITTERS 9

Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.

COURSE OUTCOMES

1. Ability to understand the construction, installation and working of different variable head type flow meters.
2. Able to understand the construction, working and calibration of different quantity flow meters, variable area flow meters, mass flow meters, electrical type, open channel and solid flow meters.
3. Gain knowledge about the construction, working and calibration of different type of transmitters.
4. Able to choose appropriate flow meters or level sensor for an application.

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., “Measurement systems Application and Design”, 5 Edition, Tata McGraw-Hill Education Pvt. Ltd., 2007.
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

REFERENCES:

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005
2. Jain, R.K., “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
3. Singh, S.K., “Industrial Instrumentation and Control”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
4. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.

PTEI7502 LOGIC AND DISTRIBUTED CONTROL SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries.
- To provide a fundamental understanding of the different languages used for PLC programming.
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs.
SCADA: Remote terminal units- Master station - Communication architectures.

UNIT II BASICS OF PLC PROGRAMMING(LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.

UNIT III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.

UNIT V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.
2. Ability to develop PLC program in different languages for industrial sequential applications.
3. Able to select and use most appropriate automation technologies for a given application.
4. Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1 Petruzella, F.D., “Programmable Logic Controllers”, 3rd Edition, Tata McGraw-Hill, 2010.

2 Lucas, M.P., “Distributed Control System”, Van Nostrand Reinhold Company, New York, 1986.

REFERENCES:

1 Clarke, G., Reynders, D. and Wright, E. "Practical Modern SCADA Protocols: DNP3, IEC 60870.5 and Related Systems", Newnes, 1st Edition, 2004.

2 Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.

3 McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5thEdition, McGraw-Hill handbook, New York, 1999.

4 NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓											
2			✓									
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PTEI7511 PROCESS CONTROL AND INSTRUMENTATION LABORATORY II **LT P C 0 0 4 2**

COURSE OBJECTIVES

To impart theoretical skills in

- Process Identification
- Tuning of PID controller including Auto-tuning
- PID Enhancements (Cascade and Feed-forward Control Schemes) and
- Design and Implementation of basic and advanced Control schemes

  using the facilities available in the Process Control lab.
- To make the students aware about calibration of meter, sensors and transmitters.
- To make the students conscious about the working and operation of different types of analytical sensors.
- To identify, formulate, and analyze complex problems regarding sensors and transmitter
- To use research-based knowledge and research methods for interpretation of data from sensors.

LIST OF EXPERIMENTS

Process Control

Hardware Based Experiments

1. (i) Study of a Process Control Training plant.

   (ii) Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner).

2. Design and implementation of ON-OFF controller for the Temperature Process.

3. Control of flow process using industrial type PID controller.

4. PC based control of level process.

5. On-line monitoring and control of a pilot plant using an industrial type distributed control system.

6. Design and implementation of advanced control scheme (adaptive controller or model predictive Control scheme) on the skid mounted pilot plant.

Industrial Instrumentation

1. Level measurement using d/p transmitter including elevation consideration
2. a) Calibration and configuration of smart transmitter using HART communicator.
   b) Calibration and configuration of transmitters using loop calibrator.
3. Monitor of Physiological Parameters using Vital signs monitor
4. Interfacing Different types of flow meter with PC using DAC
5. Determination of stoichiometry ratio in a combustion process.
6. a) Testing of Rotameter.b) Instillation of d/p based level Transmitter.
7. Design and Testing of Electromagnetic Flow meters.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Gain hands on experience in working with SKID mounted pilot plants (Flow/Level/Temperature/ Pressure Control Loop(s))
2. Ability to experimentally measure industrial process parameters such as flow and level
3. Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.
4. Ability to calibrate sensors and transmitters.
5. Abilty to present the results in oral form as well as in written form as a report and graph.
6. Ability to interpret the results of analysis and draw meaningful conclusions
7. Ability to work as a member of a team while carrying out experiments.

PTEI7601 **THERMAL POWER PLANT INSTRUMENTATION** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- Gain knowledge on different types of power plants.
- Study about the important process variables and their measurements.
- To understand the important control loops involved in thermal power plants.
- To analyze the various parameters related to steam turbines**.**

UNIT I OVERVIEW OF POWER GENERATION 9

Survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – Importance of instrumentation in power generation – Thermal power plant – Building blocks – Combined Cycle System – Combined Heat and Power System – sub critical and supercritical boilers.

UNIT II MEASUREMENTS IN POWER PLANTS 9

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement– Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

UNIT III BOILER CONTROL I 9

Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Control of deaerator – Drum level control: Single, two and three element control – Furnace draft control – implosion and explosion – flue gas dew point control – Trimming of combustion air – Soot blowing.

UNIT IV BOILER CONTROL II 9

Burners for liquid and solid fuels – Burner management – Furnace safety interlocks – Coal pulverizer control – Combustion control for liquid and solid fuel fired boilers – air/fuel ratio control– fluidized bed boiler – Cyclone furnace.

UNIT V TURBINE MONITORING AND CONTROL 9

Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Able to understand and analyze the process diagram of hydel, thermal, nuclear, wind and solar power plants.
2. Will be in a position to select instruments for monitoring various parameters related to thermal power plant.
3. Able to develop, analyze and select appropriate control strategy for various systems involved in thermal power plant.
4. Gain knowledge on the important terms related to turbine monitoring system and able to analyze the problems related to turbine governing.

TEXT BOOKS:

1. Sam Dukelow, “Control of Boilers”, Instrument Society of America, 1991.

2. Gill, A.B., “Power Plant performance”, Butterworth and Co (Publishers) Ltd, 2003.

REFERENCES:

1. Krishnaswamy, K. and Ponnibala, M., “Power Plant Instrumentation”, PHI Learning Pvt. Ltd., New Delhi, 2011.

2. Liptak B.G., “Instrumentation in Process Industries”, Chilton Book Company, 2005.

3. Jain R.K., “Mechanical and Industrial Measurements”, Khanna Publishers, New Delhi, 1999.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
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PTEI7651 INDUSTRIAL DATA COMMUNICATION LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of the Industrial data communications systems.
- To provide a fundamental understanding of common principles, various standards, protocols.
- To provide insight into some of the new principles those are evolving for future networks.

UNIT I DATA NETWORK FUNDAMENTALS 9

EIA 232 interface standard – EIA 485 interface standard – ISO/OSI Reference model – Media access protocol: Command/response, Token passing and CSMA/CD – TCP/IP – Bridges – Routers – Gateways – Standard ETHERNET Configuration

UNIT II MODBUS AND HART 9

MODBUS: protocol structure, Function codes. Evolution of signal standard: HART communication protocol – Communication modes – HART Networks – HART commands – HART applications – Troubleshooting

UNIT III PROFIBUS AND FF 9

Fieldbus: Introduction – General Fieldbus architecture – Basic requirements of Fieldbus standard –

Fieldbus topology – Interoperability and Interchangeability. Profibus: Introduction – Profibus protocol stack – Profibus communication model – Communication objects – Foundation field bus versus Profibus.

UNIT IV AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET 9

AS interface: Introduction – Physical layer – Data link layer – Operating characteristics. Device net: Introduction – Physical layer – Data link layer and Application layer.
Industrial Ethernet: Introduction – 10Mbps Ethernet – 100Mbps Ethernet.

UNIT V WIRELESS COMMUNICATION 9

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture – sensor network scenario. Wireless HART – Existing Wireless Options: IEEE 802.15.4 - ISA 100 – Zigbee – Bluetooth **–** their relevance to industrial applications

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Gain knowledge on various industrial data communication networks, protocols and their selection.
2. Able to select and use most appropriate networking technologies and standards for a given application.
3. Ability to design and ensuring that best practice is followed in installing and commissioning the data communications links to ensure they run fault-free.
4. Ability to understand requirements of industrial application and provide wired or wireless solution.

TEXT BOOKS:

1 Mackay, S., Wright,E., Reynders,D., and Park,J., “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes Publication, Elsevier, 2004.

2 Buchanan,W., “Computer Busses: Design and Application”, CRC Press, 2000.

REFERENCES:

1 Bowden,R., “HART Application Guide”, HART Communication Foundation, 1999.

2 Bela G.Liptak, “Instrument Engineers’ Handbook, Volume 3 : Process Software and Digital Networks”, 4th Edition, CRC Press, 2011.

3 Berge,J., “Field Buses for Process Control: Engineering, Operation, and Maintenance”, ISA Press, 2004.

4 Lawrence (Larry) M. Thompson and Tim Shaw, “Industrial Data Communications”, 5th Edition, ISA Press, 2015.

5. NPTEL Lecture notes on, ”Computer Networks” by Department of Electrical Engg., IIT Kharagpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	F	g	h	i	j	k	l
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PTEI7611 INDUSTRIAL AUTOMATION LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

To teach the importance of measurement for monitoring, control and to impart theoretical and practical skills in

- Sensor Data acquisition, Data analysis, Data processing and Data visualization.
- Interfacing Conventional and Smart Field Devices (Transmitters & Control Valves) with Industrial Type Programmable Logic Controller and Distributed Control System
- Understanding the Instruction set of Programmable Logic Controller.
- Programming of Industrial Type Programmable Logic Controller (Ladder Logic, Function Block Programming, Sequential Function Chart and Instruction List)

LIST OF EXPERIMENTS

1. Interfacing Level Transmitter and Control Valve with Personal Computer.

2. (i) Study of PLC Field Device Interface Modules (AI, AO, DI, DO Modules)
   (ii) Interfacing Analog/Digital Input/output Devices with Industrial Type PLC
3. Simple exercises using the Instruction Set of an Industrial Type PLC.

4. PLC Exercises-I (Hardware Implementation)
   i. Filling/draining control operation.
   ii. Reversal of DC motor direction.

5. PLC Exercises-II (Hardware Implementation)
   i. Traffic light control.
   ii. Alarm Annunciator Sequence.

6. Control of Level Process using an Industrial Type PLC

7. Implementation of Discrete Control Sequence in PLC using Sequential Function Chart

Programming method.

8. Implementation of Discrete Control Sequence in PLC using Instruction List Programming method.

9. (i) Study of DCS Field Device Interface Modules (AI, AO, DI, DO, H1 Modules)
   (ii) Interfacing Analog/Digital Input/Output Devices with an Industrial Type DCS
10. Implementation of Feedback Control Scheme in DCS using IEC 61131-3 Function Block Programming method.

11. (i) Interfacing HART and FF enabled Field Devices with Industrial Type DCS.
    (ii) Demonstration of PID Control in Field Devices.

12. Interfacing Wireless HART enabled Field Devices with DCS.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Gain hands on experience in working with Industrial Automation Systems (Industrial Type DCS & PLC)
2. Be able to Configure Function Blocks and develop Feedback Control Schemes.
3. Ability to monitor and Control a pilot plant using Industrial Type DCS/PLC
4. Be able to analyze & interpret results and draw meaningful conclusions.
5. Be able to present the results in written and oral forms.
6. Ability to work as a Member in a group.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
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6									✓			

PTEI7701 INSTRUMENTATION IN PETROCHEMICAL INDUSTRY LT P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the students the method of oil recovery and the steps involved in oil gas production process.
- To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model.
- To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
- To provide information about the most important derivatives obtained from petroleum products.
- To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT I OIL EXTRACTION AND OIL GAS PRODUCTION 9

Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT II IMPORTANT UNIT OPERATIONS IN REFINERY 9

Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.

UNIT III DERIVATIVES FROM PETROLEUM 9

Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene —Derivatives from ethylene – Derivatives from propylene.

UNIT IV IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9

BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT V SAFETY IN INSTRUMENTATION SYSTEMS 9

Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Gain knowledge on oil gas production process and important unit operations in a refinery
2. Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes.
3. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.
4. Gain knowledge on the most important chemical derivatives obtained from petroleum products.
5. Understand safety instrumentation followed in process industries.

TEXT BOOKS:

1. Waddams, A.L., “Chemicals from Petroleum”, Wiley, 1973. (digitized in 2007).

2. Balchen, J.G., and Mumme K.I., "Process Control Structures and Applications", Von Nostrand Reinhold Company, New York, 1988.

REFERENCES:

1. Liptak, B.G., "Instrumentation in Process Industries", Chilton Book Company, 2005. (Digitized in 2008.)

2. Austin, G.T. and Shreeves, A.G.T., "Chemical Process industries", McGraw-Hill, 2012.

3. Havard Devold, "Oil and Gas Production Handbook", ABB, 2006.

4. Paul Gruhn and Harry Cheddie, "Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA Press, 2006.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	F	g	h	i	j	k	l
1	✓											
2			✓									
3					✓							
4	✓											
5	✓											

PTEI7711 **PROJECT WORK** **LT P C**
0 0 9 6

COURSE OBJECTIVES

The student should be made to:

- learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
- prepare a good technical report.
- Gain Motivation to present the ideas behind the project with clarity.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of Sensor/Activator/Controller, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL : 135 PERIODS

COURSE OUTCOMES(COs)

At the end of the course, the student should be able to:

1. select a good project and able to work in a team leading to development of hardware/software product.
2. prepare a good technical report and able to present the ideas with clarity

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
2										✓		✓

PTGE7071 DISASTER MANAGEMENT LT P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

PTGE7072 ENGINEERING ETHICS AND HUMAN VALUES L T P C

(Common to all branches) **3 0 0 3**

OBJECTIVES

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

UNIT I HUMAN VALUES 9

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime - the challenger case study.

UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIES ON SAFETY 9

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and chernobyl as case studies.

UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

TOTAL : 45 PERIODS

OUTCOMES

- Students will have the ability to perform with professionalism , understand their rights,legal ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics –

Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

PTGE7073 HUMAN RIGHTS LT P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

PTGE7074 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

OBJECTIVES

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning--Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures-- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

PTGE7075 INTELLECTUAL PROPERTY RIGHTS LT P C
3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL :45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. Intellectual Property Rights and Copy Rights, Ess Ess Publications.

REFERENCES

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

PTGE7076 FUNDAMENTALS OF NANO SCIENCE L T P C
3 0 0 3

OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),"The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

PTEI7001	ADVANCED CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The student should be made to:

- gain knowledge on the methods of plotting Nyquist chart for multivariable system.
- develop state space models.
- design state feedback control schemes and state observers.
- learn the different types of non-linearities and phase plane analysis.
- understand the different methods of determining the stability of non-linear systems.

UNIT I FREQUENCY DOMAIN DESCRIPTIONS 9

Properties of transfer functions - poles and zeros of transfer function matrices – singular value analysis – Multivariable Nyquist plots.

UNIT II STATE SPACE APPROACH 9

Review of state model for systems – State transition matrix and its properties – free and forced responses – controllability and observability – Kalman decomposition – minimal realization – balanced realization.

UNIT III STATE FEEDBACK CONTROL AND STATE ESTIMATOR 9

State Feedback – Output Feedback – Pole placement technique – Full order and Reduced Order Observers – Deadbeat Observers – Dead beat Control

UNIT IV NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Phase plane analysis (analytical and graphical methods) – Limit cycles – Equivalent Linearization – Describing Function Analysis, Derivation of Describing Functions for different non-linear elements.

UNIT V STABILITY OF NON-LINEAR SYSTEMS 9

Stability concepts – Equilibrium points – BIBO and Asymptotic stability – Stability Analysis by DF method – Lyapnov Stability Criteria – Krasovskil's method – Variable Gradient Method – Popov's Stability Criterion.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to:

- analyze MIMO systems methods of plotting Nyquist chart for multivariable system.
- analyze the state space models and capable to design state feedback control schemes and state observers.

TEXT BOOK:

1. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2010.

REFERENCE BOOKS:

1. C.T. Chen, "Linear System Theory and Design", Prentice Hall, 3rd Edition, 2003
2. M.Gopal, "Modern Control System Theory", Wiley Eastern Limited, 2nd edition, 1996.
3. W. L. Luyben, "Process Modeling, Simulation and Control for Chemical Engineers", 2 nd edition, McGraw Hill, 1990.
4. D.P.Atherton, "Stability of non linear systems", Prentice Hall, 1986.

PTEI7002 **ADVANCED INSTRUMENTATION SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.
- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques
- To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84 and ISA 88.
- To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments ,Process Flow diagrams, Instrument Loop diagrams, Instrument Hookup diagrams and Piping and Instrumentation Diagrams

UNIT I MEASUREMENT OF PROCESS PARAMETERS **9**

Measurement of temperature, pressure, flow and level – application - selection – calibration methods.

UNIT II INSTRUMENTS FOR ANALYSIS **9**

Ion selective electrodes - Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid –CO,CO2 ,NO and SO Analyzers- Hydrocarbon and H2S Analyzers – Dust, smoke, Toxic gas and radiation monitoring.

UNIT III SAFETY INSTRUMENTATION **9**

Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.

UNIT IV INSTRUMENTATION STANDARDS **9**

Instrumentation Standards - significance of codes and standards – overview of various types - Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.

UNIT V DOCUMENTATION IN PROCESS INDUSTRIES **9**

Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems - Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) - Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams – Location Plans for Instruments - Cable Routing Diagrams – Typical Control /Rack Rooms Layout – Vendors Documents and Drawings

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

students will be able to

- understand the instrumentation behind flow, level, temperature and pressure measurement
- acquire basic knowledge on the various types of analyzers used in typical industries.
- understand the role of Safety instrumented system in the industry.
- explain Standards for applying Instrumentation in Hazards Locations.
- Design, develop, and interpret the documents used to define instruments and control systems for a typical project, including P&IDs, loop diagrams, specification forms, instrument lists, logic diagrams, installation details, and location plans

REFERENCE BOOKS

1. B.G.Liptak, "Instrumentation Engineers Handbook (Process Measurement & Analysis)", Fourth Edition, Chilton Book Co, CRC Press, 2005.
2. Al.Sutko,Jerry.D.Faulk, "Industrial Instrumentation", Delmar publishers, 1996.
3. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., "Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA,2006.
4. Safety - ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative.
5. Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves; ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011.
6. Documentation Standards - ANSI/ISA5.4-1991 - Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 - Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-1981 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

PTEI7003 ADVANCED TOPIC IN PID CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID Controller Design methods and about PID stabilization for Linear Time-invariant models.
- To develop the skills needed to design adaptive and non-linear PID control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.

UNIT I INTRODUCTION 9

Evolution of PID controller – PID Controller Structures – PID Implementation Issues – Tuning of PID Controller using Classical Approaches.

UNIT II PID CONTROLLER DESIGN 9

PID Controller Design Techniques : Pole placement, Lamda Tuning, Direct Synthesis, Gain Margin & Phase Margin and Optimization methods - Auto-Tuning.

UNIT III PID STABILIZATION 9

Stabilization of Linear Time-invariant Plants using P/PI/ PID controllers – Optimal Design using PID Controllers – Robust and Non-fragile PID Controller Design.

UNIT IV ADAPTIVE/NON-LINEAR PID CONTROL SCHEMES 9

Gain Scheduled PID Controller - Self-tuning PI/PID Controller – PID Types Fuzzy Logic Controller – Predictive PID Control.

UNIT V INTRODUCTION TO FRACTIONAL ORDER SYSTEM AND FRACTIONAL ORDER PID CONTROLLER 9

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional-Order Systems - Filter Approximations to Fractional-Order Differentiations –Model reduction Techniques for Fractional Order Systems – Fractional Order PI/PID Controller Design.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Ability to determine the advanced Features supported by the Industrial Type PID Controller.
2. Ability to Design, tune and implement P/PI/PID Controllers to achieve desired Performance for various processes.
3. Ability to design and implement adaptive PID controllers and Non-linear PID Control schemes.
4. Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems.

TEXT BOOKS:

1. Karl J. Astrom and Tore Haggland, “Advanced PID Control”, ISA Publications, 2005.

2. Aniruddha Datta, Ming-Tzu Ho, and Shankar P. Bhattacharyya, “Structure and Synthesis of PID Controllers”, Advances in Industrial Control, Springer Verlag London, 2000.

REFERENCES:

1. Antonio Visioli, “Practical PID Control” Springer- Verlag London, 2006

2. Aidan O’ Dwyer, “Handbook of PI and PID Controller Tuning Rules”, Imperial College Press, 2009.

3. Xue, D., Chen, Y.Q., and Atherton, D.P., "Linear Feedback Control Analysis and Design with MATLAB, Advances in Design and Control", Society for Industrial and Applied Mathematics, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/ PO	a	b	c	d	e	f	g	h	i	j	k	l
1					✓							
2	✓	✓	✓	✓	✓							
3	✓		✓	✓	✓			✓				
4	✓		✓	✓	✓			✓				

PTEI7004 **APPLIED SOFT COMPUTING** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- Get familiarized with different architectures and training algorithms of neural networks.
- Get exposed to the various neural modeling and control techniques with case study using simulation tool box.
- Gain Knowledge on fuzzy set theory and fuzzy rules.
- Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box.

UNIT I ARTIFICIAL NEURAL NETWORK (ANN) 9

Introduction to ANN: Biological neuron, artificial neuron, activation function, Perceptron – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function (RBF) network – Online learning algorithms: BPA through time – RTRL algorithms – Reinforcement learning.

UNIT II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Need for using ANN in Modeling and Control – Modeling of non-linear systems using ANN: Generation of training data, Identification of Optimal architecture, Model validation – Control of non-linear systems using ANN: Direct and Indirect neuro control schemes – Adaptive neuro controller – Case study – Familiarization with neural network toolbox.

UNIT III FUZZY SET THEORY 9

Fuzzy set theory – Operation on fuzzy sets: Scalar cardinality, Fuzzy cardinality, Fuzzy union and intersection Fuzzy complement (Yager and Sugeno), Equilibrium points, Aggregation, Projection, Composition, Cylindrical extension, Fuzzy relation – Fuzzy membership functions .

UNIT IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Modeling of non-linear systems using fuzzy models: TSK model – Fuzzy logic controller: Fuzzification, Knowledge base, Decision making logic, Defuzzification – Adaptive fuzzy systems – Case Study – Familiarization with fuzzy logic toolbox.

UNIT V HYBRID CONTROL SCHEMES 9

Need for Hybrid control – Neuro-Fuzzy Control scheme – ANFIS – Case study – Familiarization with ANFIS toolbox – Introduction to Genetic Algorithm and Particle swarm optimization – Optimization of membership function and rule base using Genetic Algorithm – Introduction to Support vector machine.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Be able to analyze problems to formulate models and develop control schemes using soft computing techniques for non-linear systems.
2. Be able to apply engineering fundamentals to use hybrid schemes and optimization algorithms to obtain solution for complex engineering problems.
3. Be capable of using modern IT tool boxes to simulate case studies

TEXT BOOKS :

1. Fausett, L.V., "Fundamentals of Neural Networks, Architecture, Algorithms and Applications", Pearson Education, 2008.

2. Ross, T.J., "Fuzzy Logic with Engineering Applications", Wiley, 3rd Edition, 2010.

REFERENCES:

1. Goldberg, D.E., "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Longman Publishing Company Inc. 1989.

2. Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 1992.

3. Klir G.J., and Bo, Yuan, "Fuzzy sets and fuzzy logic, Theory and applications", Prentice Hall, 1995.

4. Ethem Alpydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)", MIT Press, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓										
2	✓											
3					✓							

PTEI7005	BIO MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make students understand various physiological signal measurements, Identification and classification.
- To make students understand various Biomedical Instruments used for Bio-potential measurement and non-electrical parameter measurement.
- To make students familiarized with the medical imaging and understanding the concept of assisting and therapeutic devices.

UNIT I BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 9

Terminology of medicine and medical devices – Generalized medical Instrumentation systems – Classification of Biomedical instruments – Medical measurement constraints – Interfering and modifying inputs – Compensation Techniques – Bio-statics – Design criteria – Transducers Selection criteria – The origin of Bio-potentials – Electrical activity of excitable cells – Volume conductor fields – Bio-potential Electrodes: The electrode-Electrolyte interface, Polarization: Polarizable and non-polarizable electrodes, Electrode behavior and circuit models, Electrode arrays, Surface and Microelectrodes.

UNIT II ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes and analysis of biomedical signals – ECG, EEG, EMG, ERG – Lead systems and recording methods – Typical waveforms – Noise and artifacts – Electrical safety in medical environment: Physiological Effect of Electrical Current, shock hazards – leakage current – Instruments for checking safety parameters of biomedical equipment.

UNIT III NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers, pH of blood – Measurement of blood pCO2, pO2, finger-tip oximeter – ESR, GSR measurements.

UNIT IV MEDICAL IMAGING SYSTEMS 9

X-ray machine- Computer radiography – Computer tomography – Magnetic resonance imaging – Nuclear medicine – Single photo emission computer tomography – Positron emission tomography – Ultrasonography – Endoscopy – Thermal Imaging.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy – Therapeutic and Prosthetic Devices – Infant Incubators – Drug Delivery Devices – Surgical Instruments.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Able to understand the operation of different medical devices.
2. Able to measure and analyze the Biological signals.

3. Able to apply these instruments in diagnosis, therapeutic treatment and imaging fields.

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 4th Edition New York, 2009.

2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.

2. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.

3. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.

4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition, 2011.

5. Duane Knudson," Fundamentals of Biomechanics", Springer, 2003.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO\PO	a	b	c	d	e	F	g	h	i	j	k	l
1	✓		✓	✓	✓							
2	✓		✓	✓	✓							
3					✓	✓						✓

PTEI7006 **DISCRETE TIME SIGNAL PROCESSING** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the basic concepts of Digital Signal processing.
- To make the students familiarize various mathematical tools for analyzing Discrete Time Systems.
- To make the students design Digital Filters based on the Filter specifications.
- To provide the exposure to the architectures of DSP processors.
- To implement various algorithms in DSP for solving Real-time problem.

UNIT I INTRODUCTION **9**

Digital signal processing: Block diagram, advantages and applications, Linear and circular convolution, convolution techniques for long duration sequence, autocorrelation and cross correlation, aliasing effects in time domain – Review of DTFS, DTFT and Z-Transform.

UNIT II DFT AND FFT **9**

DFT properties, magnitude and phase representation – Direct computation of DFT – FFT: Radix 2 DIT & DIF algorithms, computational complexity, DFT and IDFT using FFT algorithms.

UNIT III DIGITAL IIR FILTERS **9**

Introduction, design procedures for digital IIR filters, frequency transformation techniques – Digital Butterworth and Chebyshev IIR filter design using impulse invariant and bilinear transformation – Realization of IIR filters.

UNIT IV DIGITAL FIR FILTERS **9**

Introduction, advantages of FIR over IIR filters - linear phase filters – Windowing technique: Rectangular, Triangular, Hamming, Hanning and Kaiser windows – Realization of FIR filter structures.

UNIT V FINITE WORD LENGTH EFFECTS AND DSP PROCESSORS **9**

Finite word length Effect – Fixed and floating point number representation, Quantization errors – Finite word length effects in IIR and FIR filters – Introduction to DSP architectures – addressing modes and Instruction set.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to apply various mathematical tools for analyzing discrete time system based on the knowledge of mathematics
- Ability to design digital filters.
- Ability to come out with solutions for solving simple/complex problem.
- Ability to use DSP Processor for real-time implementation.

TEXT BOOKS:

1. Proakis, J.G., and Manolakis, D.G., "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, 2003 / PHI.

2. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, 2009.

REFERENCES:

1. Mitra, S.K., "Digital Signal Processing" – A Computer Based Approach, Tata McGraw-Hill, 2001.
2. Uyemura, J.P., "A first course in Digital System Design An integrated approach", Cengage Learning, 2000.
3. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing" John Wiley & Sons,1986.
4. NPTEL Video Lecture series on, "Digital Signal Processing" by Prof. S.C. Dutta Roy, IIT Delhi.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓											
2			✓									
3			✓									
4					✓							

PTEI7007 FAULT DETECTION AND DIAGNOSIS LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of different Fault Detection and Diagnosis methods.
- To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
- To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
- To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
- To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves.

UNIT I INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS 9

Introduction – Types of faults and different tasks of Fault Diagnosis and Implementation – Different

approaches to FDD: Model free and Model based approaches-Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

UNIT II FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS **9**

Limit Checking of absolute values – Trend Checking – Change detection using binary thresholds – adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.

UNIT III FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS **9**

Introduction – Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation - Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation.

UNIT IV FAULT DIAGNOSIS USING STATE ESTIMATORS **9**

Introduction – Review of State Estimators – Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach

UNIT V CASE STUDIES **9**

Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs) :

1. Ability to explain different approaches to Fault Detection and Diagnosis.
2. Ability detect faults using Limit Checking, Parameter estimation methods, Principle Component Analysis.
3. Ability to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
4. Ability to design and detect faults in sensor and actuators using GLR and MLR based Approaches.
5. Ability to detect and quantify and compensate stiction in Control valves.

TEXT BOOKS:

1 Janos J. Gertler, “Fault Detection and Diagnosis in Engineering systems”, 2nd Edition, Marcel Dekker, 1998.

2 Rolf Isermann, **“**Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance”, Springer Verlag, 2006.

REFERENCES:

1 Steven X. Ding, “Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools”, Springer Publication, 2012.

2 Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault-Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.

3. Mogens Blanke, "Diagnosis and Fault-Tolerant Control", Springer, 2006.

4. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/ PO	a	b	c	d	e	f	g	h	i	j	k	l
1					✓							
2	✓	✓	✓	✓	✓							
3	✓	✓	✓	✓	✓							
4	✓	✓	✓	✓	✓							
5	✓	✓	✓	✓	✓							

PTEI7008 FIBRE OPTICS AND LASER INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES

- To discuss about theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics for various types of optical fibers and attenuation measurement system.
- To provide an overview of recent advances in fiber optic sensor technology.
- To provide knowledge on principle of laser generation, laser system and its types.
- To emphasize how lasers have been used for industrial applications.
- To acquaint the students with fundamentals of holography.

UNIT I OPTICAL FIBER AND THEIR PROPERTIES 9

Principles of light propagation through a fiber – laws related to light propagation through fiber – Different types of fiber and their properties, Fiber manufacture – mechanical and transmission characteristics – Connectors & splicers – Fiber termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICALFIBER 9

Fiber optic sensors – Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain – fiber optic gyroscope – Polarization Maintaining fibers.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers, Excimer lasers, VCSEL .

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Material Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography – Basic principle – Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers – laser and tissue interaction – Laser instruments for surgery – removal of tumours of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3. Understand laser theory and laser generation system.
4. Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.

TEXT BOOKS:

1. Keiser, G., “Optical Fiber Communication”, McGraw-Hill, 3rd Edition, 2000.

2. Eric Udd, William B., and Spillman, Jr., “Fiber Optic Sensors: An Introduction for Engineers and Scientists “, John Wiley & Sons, 2011.

REFERENCES:

1. John and Harry, “Industrial lasers and their application”, McGraw-Hill, 2002.

2. John F. Ready, “Industrial Applications of Lasers”, Academic Press, Digitized in 2008.

3. Monte Ross, “Laser Applications”, McGraw-Hill, 1968.

4. NPTEL lecture on “Advanced optical communication” by R.K. Shevgaonkar, IIT Bombay.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	F	g	h	i	j	k	l
1	✓											
2			✓									
3	✓											
4			✓									

PTEI7009 FUNDAMENTALS OF NANO SCIENCE AND MEMS LT P C
3 0 0 3

COURSE OBJECTIVES

- To provide wide information dealing with nano material and its necessity.
- To understand the impact of various steps needed to be followed in nano material preparation.
- To analyze methods involving preparation of nano scale devices.
- To provide knowledge about working nature and neighborhood condition regarding the preparation.
- To Explore the properties of various types of nano materials.

UNIT I INTRODUCTION 9

Nano scale Science and Technology – Implications for Physics, Chemistry, Biology and Engineering – Classifications of nano structured materials – nano particles – quantum dots, Nano wires – ultra-thin films – multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 9

Bottom-up Synthesis – Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 9

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography.

UNIT IV PREPARATION ENVIRONMENTS 9

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues,
flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Will be familiar with various preparation methods of nano material
2. Will be in a position to learn and keep in pace with recent nano scale materials
3. To draw well-founded conclusions applying the knowledge acquired from research and research methods of nano science and MEMS.

TEXT BOOKS:

1. Mickwilson et al, “Nano Technology: Basic science and Emerging Technologies”, Chapman &

Hall/CRC Press, 2004.

2. Jeremy J.Ramsden, “Nano Technology: an Introduction”, Elsevier Publication, 2011.

REFERENCES:

1. Edelstein, A.S., and Cammearata, R.C., eds., “Nano materials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. John Dinardo, N., “Nano scale characterization of surfaces & Interfaces”, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000.

3. Timp, G., (Editor), “Nanotechnology”, AIP press/Springer, 1999.

4. Akhlesh Lakhtakia (Editor), “The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”, Prentice-Hall of India (P) Ltd, New Delhi, 2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
1		✓	✓									
2								✓				✓
3			✓									
4												
5												

PTEI7010 FUNDAMENTALS OF PNEUMATICS AND HYDRAULICS L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce the fundamentals of hydraulic and pneumatic systems and their applications.
- To provide knowledge about the components involved in hydraulic and pneumatic systems.
- To select the control strategy for hydraulic and pneumatic systems.
- To gain basic safety precaution for hydraulic and pneumatic systems.
- To understand the concept of interfacing these systems with PLC and various microcontrollers.

UNIT I FLUID POWER PRINCIPLES AND FUNDAMENTALS 9

ntroduction to fluid power – Advantages and Applications – Fluid power systems – Types of fluids –Properties of fluids – Basic of Hydraulics: Pascal's Law,Principles of flow ,work, Power and Torque. Properties of air – Perfect Gas Laws.

9

UNIT II HYDRAULIC SYSTEM AND COMPONENTS

Pumping Theory – Pump Classification – Fixed and Variable displacement Pumps: Working, Advantages, Disadvantages and Performances. Hydraulic Actuators: Cylinders, Types and Construction Hydraulic motors – Performance charts. Accessories – Accumulator and Intensifiers.

UNIT III CONTROL OF HYDRAULIC SYSTEMS 9

Control Components: Direction control, flow control and pressure control valves – Types, Applications – Types of actuation – Pressure Switches – Fluid power ANSI Symbol. Industrial Hydraulic circuits – Regenerative, Double-Pump, sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control – Hydrostatic Transmission.

9

UNIT IV PNEUMATIC SYSTEM

Compressors – Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators – Introduction to Fluidics – Pneumatic logic circuits AND,OR, MEMORY, etc.

UNIT V ELECTRO HYDRALIC AND ELECTROPNEUMATIC CIRCUITS 9

Sequential circuits – design for simple applications using cascade method – Electro Pneumatic circuits – Microprocessor and PLC – Applications in Hydraulic and Pneumatics – Low cost Automation – Hydraulic and Pneumatic Power Packs – Installation, Fault finding and Maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to select hydraulic or pneumatic components and to design for automation.
2. Gain knowledge on control of hydraulic and pneumatic systems.
3. Ability to select proper control scheme for the given applications.
4. Capable of proper installation, fault finding and maintenance of hydraulic and pneumatic systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", 7th edition, Pearson education, 2014.
2. Srinivasan, R., "Hydraulic and Pneumatic Controls", 2nd edition, Vijay Nicole Imprints, 2008.

REFERENCES:

1. William W. Reaves, "Technology of Fluid Power", Delmer Publishers, 1997.
2. Petor Rohner, "Fluid power logic circuit Design", Macmillon Press Ltd, 1990.
3. Andrew Parr,"Hydraulics & Pneumatics", Jaico Publishing House, 2004.
4. Majumdar, "Oil Hydraulics: Principles and Maintenance", Tata McGraw Hill, 2004.
5. Majumdar, "Pneumatic system: Principles and Maintenance", Tata McGraw Hill, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	L
1					✓							
2	✓											
3					✓							
4					✓							

PTEI7011 INSTRUMENTATION STANDARDS L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart basic knowledge on Instrumentation standards.

UNIT I STANDARDS ORGANIZATION 9

Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI.

API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems.

UNIT II ISA STANDARDS 9

Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12):

12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37)

UNIT II ISA STANDARDS - CONTROL VALVE AND ACTUATOR **9**

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24, 75.26.

Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

9

UNIT IV ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

UNIT V BS , ISO, IEC, & ANSI **9**

Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the role of standards organization.
2. Ability to interpret and follow different standards while carrying out installation of sensors, transmitters, Industrial automation systems, PLC programming, documentation, equipment selection in hazardous area and instrument specification forms.
3. Ability to understand and follow different standards while performing control valve sizing, actuator sizing and orifice sizing etc.
4. Ability to interpret and follow different standards while carrying out monitoring and control of fossil fuel power plants and nuclear power plants.

TEXT BOOKS:

1. API Recommended Practice 551, “Process Measurement Instrumentation”, American Petroleum Institute, Washington, D.C., 1st Edition, May 1993.

2. API Recommended Practice 554, “Process Instrumentation and Control – 3 parts”, American Petroleum Institute, Washington, D.C., 1st Edition, October 2008.

3. ISA standard 5, “Documentation of Measurement and Control Instruments and Systems”, ISA, North Carolina, USA.

4. ISA standard 12, “Electrical Equipment for Hazardous Locations”, ISA, North Carolina, USA.

5. ISA standard 20, “Instrument Specification Forms”, ISA, North Carolina, USA.

6. ISA standard 37, “Measurement Transducers”, ISA, North Carolina, USA.

7. ISA standard 75, “Control Valve Standards”, ISA, North Carolina, USA.

8. ISA standard 96, “Valve Actuator”, ISA, North Carolina, USA.

9. ISA standard 77, “Fossil Power Plant Standards”, ISA, North Carolina, USA.

10. ISA standard 67, “Nuclear Power Plant Standards”, ISA, North Carolina, USA.

11. BS EN 60584-1, “Thermocouples - EMF specifications and tolerances”, British Standard, 2013.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO\PO	a	b	c	d	e	f	g	h	i	j	k	l
1						✓	✓					
2			✓		✓	✓	✓					
3			✓		✓	✓	✓					
4	✓		✓		✓	✓	✓					

PTEI7012 INSTRUMENTATION SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on the design of signal conditioning circuits for the measurement of Level, temperature and pH.
- To develop the skills needed to design, fabricate and test Analog/ Digital PID controller, Data Loggers and Alarm Annunciator
- To make the students familiarize design orifice and control valve sizing.

UNIT I DESIGN OF SIGNAL CONDITIONING CIRCUITS 9

Design of V/I Converter and I/V Converter- Analog and Digital Filter design – Signal conditioning circuit for pH measurement –Compensation circuit - Signal conditioning circuit for Temperature measurement - Cold Junction Compensation – software and Hardware approaches -Thermocouple Linearization – Software and Hardware approaches

UNIT II DESIGN OF TRANSMITTERS 9

RTD based Temperature Transmitter – Thermocouple based Temperature Transmitter- Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters.

UNIT III DESIGN OF DATA LOGGER AND PID CONTROLLER 9

Design of ON / OFF Controller using Linear Integrated Circuits- Electronic PID Controller – Microcontroller Based Digital PID Controller - Micro - controller based Data Logger – Design of PC based Data Acquisition Cards

UNIT IV ORIFICE AND CONTROL VALVE SIZING 9

Orifice Sizing: - Liquid, Gas and steam services - Control Valves – Valve body:- Commercial valve bodies – Control valve sizing – Liquid, Gas and steam Services – Cavitation and flashing – Selection criteria – Rotameter Design.

UNIT V DESIGN OF ALARM AND ANNUNCIATION CIRCUIT 9

Alarm and Annunciation circuits using Analog and Digital Circuits – Thyristor Power Controller – Design of Programmable Logic Controller

TOTAL : 45 PERIODS

COURSE OUTCOMES

Ability to design signal conditioning circuits for temperature sensors, V/I and I/V converters

- Ability to design and fabricate smart transmitters
- Ability to design, fabricate and test PID controllers and alarm circuits
- Ability to carry out orifice and control valve sizing for Liquid/Steam Services

REFERENCE BOOKS

1. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2014.
2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
3. R.W. Miller, “Flow Measurement Engineering Handbook”, Mc-Graw Hill, New York 1996.
4. Bela G. Liptak, “Instrument Engineers Handbook - Process Control and Optimization”, 4th Edition, Vol.2, CRC Press,2008.
5. Thakore and Bhatt ,”Introduction to Process Engineering and Design” , TATA McGraw-Hill,2007.

PTEI7013	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the principles of IoT and the IoT Enabling Technologies
- To impart knowledge about the Internet principles
- To Enable the students to understand the design methodologies for IoT
- To impart the fundamentals of servers and clouds
- To familiarize the students with some of the important and advanced topics in IoT

UNIT I INTRODUCTION TO IOT **9**

Definition and Characteristics - IoT enabling technologies – Levels of deployment – Domain specific IoTs - SDN and NFV for IoT – Overview of IIOT and M2M

UNIT II INTERNET PRINCIPLES **9**

ISO/OSI model – MAC address and IP address -Overview of TCP/IP and UDP -Basics of DNS - Classes of IP addresses - Static and dynamic addressing –Salient features of IPV4 – Specifications of IPV6 and 6LoPAN.

UNIT III IOT DESIGN METHODOLOGY **9**

Requirements and Specifications – Device and Component Integration – Logical Design using open source Operating System –Physical design using prototyping boards - Sensors and actuators, choice of processor, interfacing and networking - Techniques for writing embedded code - Case studies and examples using Python programming and Arduino/Raspberry Pi prototyping boards.

UNIT IV SERVERS AND CLOUDS FOR IOT **9**

Introduction to cloud storage models and communication APIs – Web application framework – Designing a web API – Web serices - IoT device management –Application layer protocols for IoT.

UNIT V ADVANCED TOPICS **9**

Big Data analytics for IoT – Batch data analysis and Real time data analysis – Security in IoT – Security levels – Ethics in IoT Design - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Acquire knowledge about the basics of IoT enabling technologies and the levels of IoT deployments
- Understand the characteristics of Internet protocol
- Ability to design and develop simple IoT applications
- Acquire knowledge about Clouds and Servers that are used in IoT design
- Familiarize with advanced topics in IoT design such as Data analytics, Security and Ethics

REFERENCE BOOKS

1. "Internet of Things A Hands-on Approach", ArshdeepBahga and Vijay Madisetti, Universities Press (India), 2015.
2. "Designing the Internet of Things", Adrian McEwen and Hakim Cassimally, John Wiley &Sons, 2014.
3. "Rethinking the Internet of Things, Francis Dacosta, Apress Open, 2013.

PTEI7014 MICRO CONTROLLER BASED SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on PIC microcontroller and ARM processor.
- To introduce the architecture and instruction set of PIC 16F87x.
- To make them familiar with ports, timer, CCP modules, interrupts, peripherals and interfacing of PIC 16F87x.
- To introduce the architecture and assembly language programming of ARM LPC 2148.
- To make them learn the ARM organization and instruction set.

UNIT I PIC INTRODUCTION 9

Introduction to PIC Microcontroller – PIC 16F87x Architecture –Instruction Set – Simple Operations.

UNIT II PORTS, COUNTERS, TIMER, CCP MODULE AND INTERRUPTS 9

PIC16F87I2C I/O Ports, Counters, Timers CCP Modules –Interrupts.

UNIT III PERIPHERALS AND INTERFACING 9

16F87xI2C Bus Peripherals Chip Access – Analog to Digital Converter – UART.

UNIT IV ARM LPC2148 INTRODUCTION 9

ARM LPC2148 Architecture – ARM LPC2148 Development tools – ARM Assembly Languages Programming – Simple Examples.

UNIT V ARM LPC2148 ORGANIZATION 9

3-Stage Pipeline ARM Organization – 5-Stage Pipeline ARM Organization – ARM Implementation – ARM Instruction Set.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Able to apply the knowledge of PIC microcontroller and ARM processor to solve simple operations.
2. Able to apply the microcontroller programming skills to design and carry out projects which will be useful for the society.
3. Ability to identify and formulate engineering problems and should be in a position to use the microcontrollers appropriately.
4. Ability to formulate and work in multidisciplinary projects.
5. Capability to learn and keep in pace with latest microcontrollers .

TEXT BOOKS

1. Peatman, J.B., “Design with PIC Micro Controllers”, Pearson Education, 3rd Edition, 2004.
2. Furber, S., “ARM System on Chip Architecture”, Addison Wesley trade Computer Publication, 2000.

REFERENCES

1. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer’s Guide: Designing and Optimizing System Software”, Elsevier Inc., 2013.
2. Trevor Martin, “The insider’s guide to the Philips ARM 7 – based Microcontrollers: An Engineers Introduction to the LPC 2100 Series” Hitex (UK) Ltd., 2005.
3. Muhammed Ali Mazidi, RolinMckinlay and Danny Causey, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC18”, Prentice Hall Publications, 2007.
4. Martin Bates, “Interfacing PIC Microcontrollers-Embedded Design by interactive simulation”, Newnes Publication, 2006.
5. Tim Wilmshurst, “Designing Embedded Systems with PIC Microcontrollers – Principles and Applications”, Newnes Publication, 2007.
6. Julio Sanchez Maria P. Canton, “Microcontroller Programming: The microchip PIC”, CRC Press, Taylor & Francis Group, 2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

CO/PO	a	b	c	d	e	f	g	h	i	j	k	l
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PTEI7015 MODEL PREDICTIVE CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

- To teach the students the general principles of model predictive control scheme.
- To provide a comprehensive description of model predictive control schemes namely as dynamic matrix control, generalized predictive control scheme and State space based model predictive control scheme.
- To highlight the key features of MPC for its Industrial Success.
- To introduce the skills required to formulate both unconstrained and constrained optimal control schemes.
- To develop the skills needed to design Model Predictive Control schemes to achieve the desired performance.

UNIT I MODEL PREDICTIVE CONTROL SCHEMES 9

Introduction to Model Predictive Control - Model Predictive Control Elements - Model Predictive Control Schemes: Dynamic Matrix Control and Model Algorithmic Control – Case Studies

UNIT II GENERALIZED PREDICTIVE CONTROL SCHEME 9

Generalized Predictive Control Scheme – Simple Implementation of Generalized Predictive Control Scheme for Industrial Processes – Multivariable Generalized Predictive Control Scheme – Case Studies

UNIT III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 9

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V ADVANCED TOPICS IN MPC 9

Robust Model Predictive Control Scheme – Adaptive Model Predictive Control Scheme – Multiple-Model based Model Predictive Control Scheme - Fast Methods for Implementing Nonlinear Model Predictive Control Scheme – Case Studies

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Ability to explain the advantages and disadvantages of various MPC schemes.
2. Ability to design both unconstrained and constrained model predictive controllers.
3. Ability to explain the advanced Features supported by the MPC Scheme.
4. Ability to Identify, formulate and solve problem in the field of Process Control domain using MPC.
5. Ability to implement MPC algorithms in MATLAB/SCILAB.

TEXT BOOKS:

1 Camacho, E.F., and Bordons, C., "Model Predictive Control", 2nd Edition, Advanced in Industrial Control Springer Verlag, 2013.

2 Liuping Wang, "Model Predictive Control System Design and Implementation Using MATLAB", Advanced in Industrial Control, Springer Verlag, 2009.

REFERENCES:

1 Wayne Bequette, B., "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004.

2 Seborg,D.E., Duncan, A. Mellichamp , Edgar,T.F., and Doyle,F.J., III, "Process Dynamics and Control", John Wiley and Sons, 3rd Edition, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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PTEI7016 NON-LINEAR CONTROL SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES :

- To understand the nature of non-linear systems and to analyze the stability of such systems
- To develop suitable models of non-linear systems and to develop suitable controllers for such systems
- To understand the chaotic and bifurcation behavior of non-linear systems
- To linearize the non-linear systems.

UNIT I NON-LINEAR SYSTEMS 9

Types of Non-Linearity – Typical Examples – Properties of nonlinear systems – Nonlinear differential equations – Numerical solutions to nonlinear differential equations – Equilibrium points – free and forced responses – Input and output multiplicities.

UNIT II STABILITY OF NON-LINEAR SYSTEMS 9

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) – Lyapunov Stability Criteria – Krasovskil's method – Variable Gradient Method – Stability Analysis by Describing function method.

UNIT III MODELLING AND CONTROL OF NON-LINEAR SYSTEMS 9

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification – On-line parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies

UNIT IV CHAOS AND BIFURCATION BEHAVIOR 9

Introduction to Chaos - The Lorenz Equations – Test for chaos - Bifurcation Behavior of ordinary differential equations - Types of Bifurcations - Limit Cycle Behavior and Hopf Bifurcation.

UNIT V LINEARIZATION 9

Methods of linearization – Taylor's series expansion – Jacobean method - state model for systems – Role of Eigen values and Eigenvectors – State transition matrix and its properties – Controllability and observability – Stabilizability and Detectability

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs) :

1. Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
2. Ability to analyze non-linear system based on the first principle model.
3. Ability to come out the solution for complex non-linear system.
4. Ability to develop various control schemes for non-linear systems.
5. Ability to linearize non-linear system for developing linear control,

TEXT BOOKS:

1. Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process systems".

2. Gopal, M., "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata McGraw-Hill, 2012.

REFERENCES:

1. Shankar Sastry, "Nonlinear Systems: Analysis, Stability, and Control", Springer New York, 2013.

2. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.

3. Bequette, B.W., "Process Control: Modeling, Design and Simulation", Prentice Hall International series in Physical and Chemical Engineering Sciences, 2003.

4. Steven E. LeBlanc, and Donald R. Coughanowr, "Process Systems Analysis and Control", 3rd Edition, Chemical Engineering series, McGraw-Hill Higher Education, 2009.

5. Thompson, J. M. T., and Stewart, H. B.," Nonlinear Dynamics and Chaos", John Wiley & Sons, 2002.

6. William S. Levine, "The Control Systems Handbook", Second Edition: Control System Advanced Methods, 2nd Edition, CRC Press, 2010.

7. NPTEL Lecture on "Non-linear system Analysis" by Prof. Laxmidhar Behera, IIT Kanpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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PTEI7017 NUCLEAR POWER PLANT INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES

- To introduce students to the fundamentals of nuclear power reactor.
- The construction and principle of operation of the different sensing and indicating devices used at nuclear power plants will be explained to students.
- To study about the various types of Nuclear power Reactor.
- To characterize radioactive wastes based on the analysis of radioactive waste generation.
- To elaborate different types of control schemes involved in nuclear power plant.

UNIT I FUNDAMENTAL CONSIDERATIONS IN NUCLEAR POWER REACTOR 9

Nuclear and Fossil Fuels, Definitions: Nuclear Terms, Fission Process Terms, Nuclear Reactor Terms, Nuclear Reactor Kinetics: Point Kinetics without delayed neutrons – Point Kinetics with delayed neutrons, Reactivity, Inhour equation, Effects of reactivity Insertions, Reactivity changes –Three Dimensional Kinetics.

UNIT II MEASURING INSTRUMENTS AND ANALYZER IN NUCLEAR POWER PLANT 9

Nuclear Radiation Sensors – Out-of-Core – Neutron Sensors – In-Core – Process Instrumentation: Temperature Sensing, Pressure Sensing and transmitting, Flow Sensing, Level and Position Sensing, Steam Properties Sensing, Water Properties Sensing, Gas Properties Sensing – Special sensor for Sodium cooled reactors and gas cooled reactors.

UNIT III TYPES OF NUCLEAR POWER REACTOR 9

Pressurized Water Reactor – Boiling Water Reactor – Pressurized Heavy Water Reactor – Sodium Cooled Fast Reactor – Advanced Gas Cooled Reactor .

UNIT IV NUCLEAR WASTE DISPOSAL AND REACTOR SAFETY 9

Types of Radioactive Wastes : Exempt waste and very low level waste, Low level waste, Intermediate Level waste, High level waste – Treatment and conditioning of Nuclear waste - Waste Disposal Methods, Nuclear Reactor Safety: Introduction, Accident Prevention, Engineered safety features, Abnormal Event Analysis – Licensing design basis Evaluation.

UNIT V MODELING AND CONTROL OF NUCLEAR POWER REACTOR 9

Multipoint Kinetics modeling of Large reactors: Introduction, Derivation of Multipoint Kinetics model, Selection of suitable nodalization scheme, Application to the AHWR Thermal hydraulics model, Coupled Neutronics –Thermal Hydraulics model – Reactor Stability Analysis – Control of Nuclear Power: General features of Reactor control, Methods of control, control loops , Effectiveness of control rods, Output Feedback control design - Direct block diagonalization and composite control of Three time scale systems – Design of Fast output sampling controller for Three time scale systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to recognize and recall the basics of nuclear reactor terminology, definitions, and concepts associated with nuclear reactor physics.
2. Ability to understand the types of radiation measurement equipment and nuclear power plant instrumentation.
3. Ability to identify and analyze the specific features of different types of nuclear reactors.
4. Ability to understand the role and responsibility of effective nuclear waste disposal.
5. Ability to apply their mathematical knowledge and engineering principles to model the nuclear reactor and able to control the reactor.

TEXT BOOKS:

1. Joseph M. Harrer and James G. Beckerly, “Nuclear Power Reactor Instrumentation Systems Handbook”, Office of Information Services, U.S. Atomic Energy Commission, 1973.

2. Samuel Glasstone and Alexander Sessonske, ”Nuclear Reactor Engineering”, CBS publishers and Distributors Pvt. Ltd., 2004.

REFERENCES:

1. Shimjith, S.R., Tawari A.P., and Bandyopathy, B. “Modeling and Control of a Large Nuclear reactor”, BARC Mumbai, India.

2. Yoshiaki Oka and Katsuo Suzuki, “Nuclear Reactor Kinetics and Plant Control”, An Advanced

Course in Nuclear Engineering, Springer Japan.

3. James J. Duderstadt and Louis J. Hamilton, "Nuclear Reactor Analysis" Wiley, 1st Edition, 1976.

4. NPTEL Video Lectures on "Nuclear Reactors and Safety - An Introduction" by Dr. G. Vaidyanathan.

5. NPTEL Video Lectures on "Nuclear Science & Engineering" by Dr. Santanu Ghosh.

6. NPTEL Video Lectures on "Nuclear Reactor Technology" by Dr. K.S. Rajan.

7. NPTEL Video Lectures on "Nuclear Physics: Fundamentals and Applications" by Prof. H.C. Verma

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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PTEI7018 POWER ELECTRONICS DRIVES AND CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- Detailed knowledge on Classifications, structure, operating principle of dc choppers
- Introduction to different types of Inverters , their principle of operation and waveform control
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

Operating principle and switching Characteristics : Power diodes - Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO,MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation–Simulation tools.

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 9

Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cycloconverters, Matrix

converters.

UNIT III DC TO DC CONVERTERS 9

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT IV INVERTERS 9

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control – PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters :Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNIT V DRIVES AND CONTROL 9

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Control rectifier, chopper and inverter.
3. Will have ability to apply power electronic circuits for the control of popular applications.
4. Exposure to design and analyze PE circuit using simulation software.

TEXT BOOKS:

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., “Power Electronics”, John Wiley and Sons, New York, 1995.

REFERENCES:

1. Singh, M.D., and Khanchandani, K.B., “Power Electronics”, 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., “Modern Power Electronics and AC Drives”, Pearson Education, 2002.
3. Bimbra, P.S., “Power Electronics”, Khanna Publishers, 2006.
4. Moorthi, V.R., “Power Electronics - Devices, Circuits and Industrial Applications”, Oxford University Press, 2005.
5. NPTEL Lecture Series on “Power Electronics” by Dr.B.G.Fernandes, IIT Bombay.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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PTEI7019 ROBOTICS AND AUTOMATION L T P C
3 0 0 3

COURSE OBJECTIVES

The student should be made to:

- To study and understand the evolution of robot technology and their classification.
- To introduce the methodology for mathematical representation of different types of robots.
- To acquire knowledge on construction of manipulators and their types.
- To learn the procedure for carrying out kinematics and path learning techniques.
- To expose knowledge on the case studies and design of robot machine interface.

UNIT I BASIC CONCEPTS 9

Brief history -Types of Robot – Technology - Robot classifications and specifications - Design 113 and control issues- Various manipulators – Sensors - work cell - Programming languages

UNIT II DIRECT AND INVERSE KINEMATICS 9

Mathematical representation of Robots - Position and orientation - Homogeneous transformation - Various joints - Representation using the Denavit Hattenberg parameters - Degrees of freedom - Direct kinematics - Inverse kinematics - PUMA 560 & SCARA robotsSolvability - Solution methods- Closed form solution

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS 9

Linear and angular velocities - Manipulator Jacobian - Prismatic and rotary joints – Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance

UNIT IV PATH PLANNING 9

Definition - Joint space technique - Use of p-degree polynomial - Cubic polynomial - Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation

planning

UNIT V DYNAMICS AND CONTROL 9

Lagrangian mechanics - 2 DOF Manipulator - Lagrange Euler formulation - Dynamic model - Manipulator control problem - Linear control schemes - PID control scheme - Force control of robotic manipulator T

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to:

- understand the evolution of robot technology and mathematically represent different types of robot.
- Get exposed to the case studies and design of robot machine interface.

TEXTBOOKS

1. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005
2. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009 114 REFERENCES

REFERENCE BOOKS

1. Ashitava Ghoshal, Robotics - Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010
2. K. K. Appu Kuttan, Robotics, I K International, 2007
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003
4. R. D. Klafter, T. A. Chimielewski and M. Negin, Robotic Engineering – An Integrated Approach, Prentice Hall of India, New Delhi, 1994
5. M. P. Groover, M. Weiss, R. N. Nagel and N. G. Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996
6. B.K. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998

PTEI7020 **SAFETY INSTRUMENTED SYSTEM** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
- To make the students understand different layers of protection.
- To make students conscious about safety instrumentation applications.

UNIT I INTRODUCTION **9**

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs Safety Control.

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS **9**

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.

UNIT III SAFETY INTEGRITY LEVEL (SIL) **9**

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.

UNIT IV SYSTEM EVALUATION **9**

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.

UNIT V CASE STUDY **9**

SIS Design check list - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, Verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-startup Tests, Operation and Maintenance Procedures.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Able to understand the role of safety instrumented system in the industry.
2. Be able to Identify and analyze the hazards.
3. Able to select the safety integrity level for an application.
4. Able to understand the importance of safety environment in industry.

TEXT BOOKS:

1. Paul Gruhn and Harry L. Cheddie," Safety Instrumented systems: Design, Analysis and Justification", ISA, 2nd Edition, 2006.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle", Exida, 2012.

REFERENCES:

1. William M. Goble and Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.
2. Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis", ISA, 2002.
3. Standard - ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements", ISA, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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PTEI7021 UNIT OPERATIONS AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

- Study the unit operations involved for transportation, mixing and separation of solids.
- Study the unit operations involved for transportation, mixing and separation of fluids.
- Understand the basic operations involved with heat exchangers, Distillation and chemical reactions.
- Gain knowledge about the operations of evaporators and crystallizers, drying and cooling towers.
- Gain knowledge on the operation of dryers, distillation column, refrigerators and chemical reactors.

UNIT I MECHANICAL OPERATIONS- I 9

OPERATIONS ON SOLIDS: General Characteristics of solids, Storage and conveying of solids: bunkers, silos, bins and hoppers, transport of solids in bulk, conveyor selection, different types of conveyors. Estimation of particle size - Screening methods and equipment. Adjusting particle size: methods of size reduction, classification of equipment, crushers, grinders. size enlargement- Principle of granulation, briquetting, pelletisation and flocculation. Mixing: mixing of powders. Separation: Electrostatic and magnetic separators, applications.

UNIT II MECHANICAL OPERATIONS-II 9

OPERATIONS ON FLUIDS: Transport of fluids, Mixing and agitation: Mixing of liquids, selection of suitable mixers. Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation. Cyclones - Operation, equipment, control and applications.

UNIT III HEAT TRANSFER- I AND ITS APPLICATIONS 9

Heat exchangers: Single pass and multi pass heat exchangers, condensers, reboilers Combustion process in thermal power plant, Distillation: Binary distillation, Batch distillation, controls and operations, Chemical reactors.

UNIT IV HEAT TRANSFER- II 9

Theory of evaporation – single effect and multiple effect evaporators – Crystallization – nucleation and growth – classification of crystallizers. Drying: classification of Dryers, batch and continuous dryers, dryers for solids and slurries and cooling Towers, Refrigeration.

UNIT V CASE STUDY 9

Unit Operations and Control schemes applied to Thermal Power plant, Steel Industry, Paper and Pulp Industry, Leather Industry.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Apply the knowledge on solids & fluids to handle the raw materials.
2. Select and apply relevant handling techniques to convert the solids and fluids for specific applications.
3. Come out with solutions for simple/complex problems in heat transfer and design the heat exchange equipment for different applications such as distillation, boilers.
4. Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
5. Gain ability for lifelong learning of new techniques and developments in various types of unit operations in industries.

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York, 1988.

2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical Engineering", McGraw-Hill International Edition, New York, Sixth Edition, 2001.

3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment :Selection and Design", Gulf Professional Publishing, 2010.

REFERENCES:

1. Waddams, A.L., “Chemicals from petroleum”, Butler and Taner Ltd., UK, 1968.

2. Liptak, B.G., “Process measurement and analysis”, Chilton Book Company, USA, 1995.

3. Luyben W.C., “Process Modeling, Simulation and Control for Chemical Engineers”, McGraw-Hill International edition, USA, 1989.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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