COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF INSTRUMENTATION

Regulation and Curriculum for M.Sc. Degree course in Instrumentation
Effective from 2011 - 2012 academic year

The M. Sc. Degree course in Instrumentation is a regular, four semester professional PG programme with an intake of 15.

1. Admission requirement:

B.Sc. Degree in Instrumentation/Physics/ Electronics with not less than 60% aggregate marks. Admission shall be based on the common admission test conducted by the University. Reservations as per University rule shall be applicable.

2. The course shall be conducted as per the regulations for Post Graduate Programmes in the Departments/schools of the University.

3. Course Scheme and Structure.

First Semester

Coruse code	Name of the course	C/ E	Cr edi t	Hourse / Week			Marks	
				Lect.	Lab.	Tuto .	Sessi onal	Uty. Ex.
INS 2101	Applied Mathematics	C	3	4	-	1	50	50
INS 2102	Introduction to Instrumentation systems	C	3	4	-	1	50	50
INS 2103	Sensors, Transducers and Actuators	C	3	4	--	--	50	50
INS 2104	Electronic Devices and Circuits	C	3	4	--	--	50	50
INS 2105	Digital Electronics	C	3	4	--		50	50
INS 2101L	Computer Science Lab.	C	2	--	4	--	100	--
INS 2102L	Analog Electronics Lab.	C	2		4	--	100	--

Total Credits - 19

Second Semester

Coruse code	Name of the course	C/ E	Cr edi t	Hourse / Week			Marks	
				Lect.	Lab.	Tuto .	Sessi onal	Uty. Ex.

INS 2201	Microprocessors and Instrumentation	C	3	4	-	1	50	50
INS 2202	Optical Instrumentation	C	3	4	-	1	50	50
INS 2203	Control System	C	3	4	--	--	50	50
INS 2204	Elective - 1	E	3	4	--	--	50	50
INS 2205	Elective - 2	E	3	4	--	--	50	50
INS 2201L	Sensors and signal conditioning Lab	C	2	--	4	--	100	--
INS 2202L	Digital Electronics Lab.	C	2		4	--	100	--

Total Credits – 19

Third Semester

Coruse code	Name of the course	C/ E	Cr edi t	Hourse / Week			Marks	
				Lect.	Lab.	Tuto .	Sessi onal	Uty. Ex.
INS 2301	Signal Processing	C	3	4	-	1	50	50
INS 2302	Analytical Methods and Instrumentation	C	3	4	-	1	50	50
INS 2303	Elective -3	E	3	4	--	--	50	50
INS 2304	Elective - 4	E	3	4	--	--	50	50
INS 2305	Elective - 5	E	3	4	--	--	50	50
INS 2306	Seminar	C	1	2	--	--	50	--
INS 2301L	Control Systems and process control Lab.	C	1	--	3	--	50	--
INS 2302L	Microprocessor and Interfacing Lab.	C	1		3	--	50	--

Total Credits - 18

Fourth Semester

Coruse code	Name of the course	C/ E	Cr edi t	Hourse / Week			Marks	
				Lect.	Lab.	Tuto .	Sessi onal	Uty. Ex.
INS 2401	Project work and Viva-Voce	C	16	--	16		100	200

Total Credits - 16

Credits for Core (C) courses:	16 + 16 + 9 + 16 = 57
Credits for Elective (E) courses:	0 + 6 + 9 = 15
Total credits for the course:	72

List of Electives

1. Materials Science
2. Vacuum Techniques and Instrumentation
3. Biomedical Instrumentation
4. MEMS and Microsystems
5. Modern Control Systems
6. Process Cntrol
7. Microcontroller and Computer based Instrumentation

Syllabus

INS 2101 Applied Mathematics

1. Ordinary differential equations- First order differential equation, Bernoulli equation, exact equations, Second order linear differential equation- equations with constant coefficient, variable coefficient. Legendre differential equations-Generating function, recurrence relation, Rodrigues formula, orthogonality, Bessel's differential equation, Generating function, recurrence relation, Integral represenation, Orthogonality.

2. Partial differential equations- Vibrating string, one dimensional wave equation, D'Alemberts solution, solution by separation of variables, one dimensional heat equation, solution by separation of variables, solution of Laplace equation over rectangular and circular region by separation of variables

3. Integral transforms – Laplace transform, properties, Integral and derivatives Laplace transform of periodic functions, Inverse Laplace transform, Application- Solutions of differential equations. Fourier transform- Sine, cosine transforms, Convolution theorem, applications- evaluation of integrals, boundary value problem.

4. Numerical Analysis- Numerical computations, sources of errors, Numerical solutions of algebraic and transcendental equations, bisection method, Newton-Raphson method, Iteration methods, Polynomial interpolation-Lagrange interpolation polynomial, divided differences, Newton's divided differences interpolation polynomial.

5. Numerical Integration and differentiation – Trapeziodal rule, Romberg integration, Simpson's rule, numerical differentiation, finite difference methods. Numerical solutions of ordinary differential equations, Euler methods Runge-Kutta methods

Text Books

B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2006
E. Kreyszig, Advanced Engineering Mathematics, Wiley India Ltd, 2006
S.S.Shastry, Introductory Methods of Numerical Analysis, Phi Learning, 2009

References

S. Narayanan, T.K.Manichavachagom Pillai and G. Ramanian, Advanced mathematics for Engineering students, Viswanath Ltd. 2005
M. K. Jain, S.R.K. Iyengar and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, 2005
P. Kandaswamy and K. Thilagavathy, Numerical Methods, S. Chand and Co. 2000

INS 2102 Introduction to Instrumentation systems

1. Generalized instrumentation system, Static and dynamic characteristics, Mathematical model of generalized system, Transfer function, zero, first and second order system, step, ramp, impulse and frequency response, calibration.

2. Measurement errors, Types and sources of errors, error reduction techniques, Graphical representation of data, curve fitting, statistical concepts, mean and median values, standard deviation, frequency distribution, normal and Gaussian distribution, confidence level.

3. Signals and noise, Deterministic and random signals, periodic and aperiodic signals, Bandwidth, signal conditioning and processing, Filtering, passives and active filters, Types of filters, Frequency transformation, frequency analysis, applications

4. Data presentation elements, Oscilloscope, block diagram, circuits and working, Chart recorders, digital storage oscilloscope, block diagram, sampling techniques, Digital voltmtter, frequency meter

5. Data transmission and telemetry, characteristics of telemetry systems, Modulation, radio telemetry, frequency division multiplexing, time division multiplexing.

Text Book

W. Cooper, Electronic Instrumentation and Measuring Techniques, Prentice Hall, 2004
E. O. Deoblin, Measurement systems Application and Design, Tata McGraw Hill, 2002

References

J. Bently, Principles of Measurement Systems, Pearson, 2004
D.V.S. Murthy, Transducers and Instrumentation, Phi Learning, 2009

INS 2103 Sensors, Transducers and Actuators

1. Temperature Mesurement, Thermocouples, RTD, thermistor, semiconductor sensors, Pyrometry, Principles, measuring circuits, characteristics, applications

2. Pressure measurements, Elastic type, strain gauge, capacitive, inductive piezoelectric type, Measurement of low pressure, McLeod gauge, Thermal conductivity gauges, Ionization gauge, Solid state pressure gauges.

3. Flow measurement, Differential pressure type, variable area type, Rotameters, Electromagnetic, Mass flow meters, Turbine type, Anemometer, Ultrasonic type.

4. Chemical sensors, pH meters, types of electrodes, conductivity meters, cell construction, operation and measurement, Measurement of humidity and moisture content

5. Actuators, principle and application of mechanical, electrical, hydraulic, pneumatic actuators, valves, relays, solenoids, motorized valves, fluidic gates.

Text Book

G.S.Rangan, G.R.Sharma and V.S.V.Mani. Instrumentation Devices and Systems, McGraw Hill, 2006

E. O. Deoblin, Measurement Systems, Tata McGraw Hill 2006

D. Patranabis, Principles of Industrial Instruemntation, Tata McGraw Hill 2008

References

B.G Liptak, Instrumentation and Process Control Handbook, Vol. I and II, Butterworth-heinemann Ltd, 2005

C.D. Johnson, Process Control Instrumentation Terchnology, Dorling Kindersley India, 2007

INS 2104 Electronic Devices and Circuits

1. Semiconductor Devices, Power diodes, BJTs, MOSFETs, Thyristros, TRIAC Insulated gate bipolar transistors: Structure, Characteristics, Operation, Limitation and safe operating areas.

2. Feedback and Stability, negative feedback loop, General requirements of feedback circuits, Effect of feedback on amplifier, Performance, The four basic amplifier types, Four feedback topologies, Examples of real feed back amplifiers, Feed back loop Stability .

3. Operational Amplifiers, Characteristics, Op-amp architecture, differential, DC level and Input stages, Linear op-amp circuits, Non-inverting, Inverting, Difference, Instrumentation, Summation, Integration, Differentiation Amplifiers, Non linear op-amp circuits, Open loop comparator, Polarity Indicator, Schmitt Trigger, Non-ideal properties of op-amps, Output saturation, Offset and bias voltages and current, Skew rate, finite frequency response, Gain- bandwidth product.

4. Linear Wave shaping circuits, RC/RL/RLC circuits, Pulse Transformer, modeling switching characteristics of devices (dides, BJT, MOS, IGBT), Switch with capacitive load, inductive load, non saturating switches, multivibrators- stable, monostable, bistable, negative resistance switching circuits, time base generators – bootstrap, miller blocking oscillators, transient switching and characteristics

5. Converters and Inverters, Linear and switching inverters, DC-DC converters, Buck, Boost, Buck-Boost, CUK converters, switch mode inverters, Full bridge, Half bridge, 3 terminal switching devices.

Text Book

J.Millman and A.Grabel, Micro Electronics, McGraw Hill, 2006
P. C. Sen, Modern Power Electronics, S. Chand and Co, 2005

References

Horenstein, Mark N, Microelectronics circuits and Devices, Phi Learning, 2009
J.Millman and Taub, Pulse, Digital and switching waveforms, Tata McGraw Hill, 2001

INS 2105 Digital Electronics

1. Number System And Boolean Algebra: Review of Number System, Radix conversion, Complements 9's & 10's Subtraction using 1's & 2's complements, Binary codes, Error detecting and correcting codes, Theorems of Boolean Algebra, canonical forms, Logic gates.

2. Digital Logic Families: Introduction to bipolar Logic families, RTL,DCTL, DTL,TTL,ECL,I L and MOS Logic families: NMOS, PMOS, CMOS, Details of TTL Logic family Totem pole, open collector outputs, TTL Subfamilie, Comparison of different logic families.

3. Combinational Logic: Representation of logic functions, Simplification using Karnaugh Map, Tabulation method, Implementation of combinational logic using standard logic gates, Multiplexers and Demultiplexers, Encoders and Decoders, Code Converters, Adders, Subtractors, Parity Checker and Magnitude Comparator.

4. Sequential Logic: Concepts and Components, Flip flops-SR, JK, D and T flip flops, Level triggering and edge triggering , Excitation tables- Counters-Asynchronous and type Modulo counters, design with state equation state diagram, Shift registers, type of registers, circuits diagrams, timing wave form and operations, Introduction to finite state machines

5. D/A and A/D Converters: Weighted resistor type D/A Converter, Binary ladder D/A converter, Steady accuracy test, D/A accuracy and resolution, Parallel A/D Converter, counter type A/D converter, Successive approximation A/D converter, single and Dual slope A/D converter, A/D accuracy and resolution, Semiconductor Memories: Memory organization, Classification and characteristics of memories, sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array, Magnetic core memories.

Text Book

A.P.Malvino and D.P.Leach, Digital principals and applications, McGraw hill, 2000

R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 2010

Mano M Morris, M.D. Ciletti, Digital Design, Pearson, 2008

References

T. L. Floyd and R. P. Jain, Digital Fundamentals, Pearson, 2005

Flecther, An engineering Approach to Digital Design, Phi Learning, 2009

INS 2201 Microprocessors and Instrumentation

1. Microprocessor based microcomputer system- Organization, 8-bit processors External organization of memory, CPU timing and control unit, Register Organization, Programming 8085 – Address modes, Instruction sets and timing diagrams, Assembly Language programming, Programming techniques, Stack and subroutines.

2. Interfacing Memory and I/O Devices- Memory Interfacing, Data transfer scehemes, DMA transfer, Address portioning schemes Interfacing output devices, Input devices.

3. Peripheral Interfacing- Interrupts, General purpose Programmable peripheral devices 8255, 8254, 8257, 8259, Interfacing data converters, Serial I/O and data communication, ADCs – successive approximation, integrating type, Falsh type.

4. 16-bit Microprocessor- 8086 internal architecture, registers, memory address space, segment registers, memory segmentation, stack, I/O space, addressing modes, instruction sets and assembly language programming.

5. 8086 – Digital and analog interfacing, Parallel ports and handshake, Iinput/output Interfacing of keyboards, Displays, Optical encoders, high power devices, sensors and transducers, D/A converters, A/D converters, specifications, interfacing applications.

Text Book

R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Preintice Hall, 1999

A. P. Mathur, Introduction to Microprocessors, Tata McGraw Hill, 2009

Douglas Hall, Microprocessors and Interfacing -Programming and Hardware, McGraw Hill, 2008

References

K.Ayala, 8086 Microprocessor:Programming and Interfacing, Delmar Cengage, 2007

Wadhwa and Ajay, Microprocessor 8085: Architecture, Programming and Interfacing, Phi Learning, 2010

INS 2202 Optical Instrumentation

1. Interferometers- Fabry-Perot and Michelson interferometers, Interference filters, Optical spectrum analyzer, Modulation of light, Modulation of light, Electro-optic, Magneto-optic and acousto-optic type.

2. Lasers – Principle of operation, Einstein relations, Population inversion, Optical feedback, resonant cavity, laser modes, Q-switching and mode locking, 3 level and 4 level systems, properties of laser light.

3. Classes of lasers – Solid state, gas and dye lasers, operation and working, Semiconductor lasers, quantum well lasers. Applications- holography, Industrial, Biomedical and pollution monitoring applications

4. Optical fibers – Light guidance through fibers, step index and graded index fibers, multimode single mode fibers, numerical aperture, fiber dispersion, loses in fiber, measurement of fiber characteristics, OTDR Couplers, splicers and connectors.

5. Optical fiber sensors – Measurement of temperature, pressure, displacement acceleration strain, level, current and voltage, Optical fiber communication, Fiber bragg grating and photonic band gap materials –basic ideas and sensing application.

Text Book

J. Wilson and J.F.Hawkes, Optoelectronics – An Introduction, Prentice Hall, 1996
K. Thyagarajan and A. K. Ghatak, Lasers – Theory and Applications, Springer, 2001

References

O. Svelto, Principles of Lasers, Springer, 2009
T. Ray, Otoelectronics and Fibre Optic Technology
R. Kashyap, Fiber Bragg Gratings, Academic press, 2009

INS 2203 Control Systems

1. Basic control system components: Block diagram description - Reduction of block diagram- Signal flow graphs - Open loop and closed loop systems - Feedback characteristics of control systems.

2. Properties of physical systems: Linearity, time invariance, stability and causality - Secial properties of Linear Time Invariant (LTI) Systems- transfer function- Impulse response - Differential equations of physical systems- Mechanical, electrical and electromechanical systems- Analogous systems- AC and DC servomotors.

3. Transient and steady state analysis: Standard test inputs- Transient response of first and second order systems - Steady state error and error constants - Specifications of second order system – Design considerations for higher order systems.

4. Concept of stability: Poles, zeros and their significance in stability analysis, Tools and techniques for LTI control system analysis- Routh Hurwits criterion- Root locus method- Frequency domain analysis-Bode plot, Polar plot, Nyquist criterion, Nichols chart.

5. Design of control systems and compensation techniques: Electrical and electronic realization of lead, lag and lag-lead compensators- Cascade compensation in time domain- Cascade compensation in frequency domain.

Text Book

M. Gopal, Control System Principles and Design, Tata McGraw Hill, 2008
K. Ogata, Modern Control Engineering - Prentice-Hall of India Pvt. Ltd, 2009
B.C. Kuo, Automatic Control Systems. Phi Learning, 2009

References

N. S. Nise, Control Systems Engineering, Wiley India, 2009
S. Ghosh, Control Systems**:** Theory and Applications, Pearson, 2004

INS 2301 Signal Processing

1. Continuous time signal and discrete time signal – representation and general definitions, basic properties, System modeling, input out put relations, Convolution representation.

2. Transfer function representation, transform of input/output differential equation, Stability of continuous system, Frequency response, Two pole system. Z-Transform- Transfer function representation, Transform of input/output difference equation, stability of discrete time systems, frequency response.

3. Output Response via Fourier transform, analysis of ideal filters, LTI systems as frequency selective filters, Time domain sampling of continuous-time signals, Analog to Digital conversion, Digital to analog conversion, Frequency domain sampling of discrete time signals, Discrete fourier transform.

4. Implementation of discrete time systems- Structure of FIR and IIR systems, State space system analysis, Filter coefficients, round off effects in digital filters.

5. Design of digital filters- Design of FIR and IIR filters, Frequency transformation, Design of digital filters based on least-square method. DFT and its Properties-Linear filtering methods based on DFT, FFT algorithms, DFT-Linear filtering approach, Quantization effect.

Text Book
A.V. Oppenheim and A. S. Willsky, Signals and sytems, Prentice Hall, 1996
J. G. Proakis and D. G. Manolakis, Digital signal processing principles algorithms and applications, Pearson, 2007

References
E. W. Kamen, Introduction to signals and sytems, Macmillan, 2001
A. V. Oppenheim and R. W. Shafer, Discrete-time signal processing, Pearson, 2009

INS 2302 Analytical Methods and Instrumentation

1. Spectroscopical Methods of Analysis: Basics of Spectral methods of analysis, Various ranges of Electromagnetic Radiation. Interaction of E.M. radiation with matter. Absorbance Transmittance-relationship, Beer-Lambert's Law-its limitations. Concept of emission, absorption and scattering techniques.UV-Visible, & IR Spectroscopy. Instrumentation for UV-Visible and IR Spectroscopies, FTIR, Various light sources, Spectrometers, Detectors and Data Processing. Application of UV-Visible and IR spectroscopy

2. Magnetic resonance techniques, Nuclear Magnetic resonance – Principles, CW NMR spetrometer, FT NMR spectrometer, components and Instrumentation, Measurement techniques, data analysis and application. ESR spectrometer- Principle and Instrumentation.

3. X-ray methods of analysis- Basic principle, Source, Detectors, X-ray absorption methods, X-ray fluorescence techniques, X-ray diffraction methods, Electron probe analysis, X-ray and UV photoelectron spectroscopy

4. Thermal analysis methods- TGA, DTA and DSC, principle, Instrumentation, applications. Chromatrography techniques- Classification- basic principle, parameters and optimization, GLC and HPLC- Principle, Instrument components, detectors.

5. Electron Microscopy – TEM, SEM principle, Instrumentation, anlysis, Scanning tunneling microscopy, Atomic force microscopy –Principles, Instrumentation, analysis, applications.

Text Book

A. Skoog and M. West, Principles of Instrumental Analysis, Thomson Learning, 2002
Willard, Merrit, Dean and Settle, Instrumental methods of analysis, CBS Publishers, 2001

References

G. W. Ewing, Instrumental Methods of chemical analysis, McGraw Hill, 2001
R. S. Khandpur, Hand Book of Analytical Instruments, Tata McGraw Hill, 2006

ELECTIVES

1. Materials Science

1. Bonding in solids – Ionic, covalent and metallic bonding, Van der Waal and Hydrogen bonding, Crystal structure, Structure of ionic, covalent and metallic materials, Structre determination, X-ray diffraction, Defects in solids-different types, Diffusion in solids, Fick's law, Thermally activated process.

2. Mechanical properties of solids, Relation with bonding, , Elastic behavior , Stress – strain relations, Viscous and visco-elastic behaviour, Polymer materials, Fracture mechanisms, Thermal properties – Thermal conductivity and thermal expansion.

3. Electrical properties of materials- Free electron theory, metallic conductivity, resistivity, Band theory of solids, Semiconductors, Intrinsic and extrinsic semiconductor, p-n junction, band picture, Superconductivity- Meisner effect, Type I and Type II, energy gap
4. Magnetic materials – Diamagnetism, para-magnetism, ferro-magnetism, Langevins theory, GMR and CMR materials, Dielectric and ferro-electric materials, Polarization type, dielectric behaviour, ferroelectricity, spontaneous polarization, Piezoelectric and pyroelectric materials.

5. Nanomaterials – Different types of materials, Preparation techniques, Optical, electrical and magnetic properties with examples. Characterization methods-X-ray, SEM AFM, Carbon nanotube, Metal oxides - Sensing applications

Text Book

Van Vleck, Elements of Materials Science and Engineering, Pearson, 2006
W. D. Callister, Materials Science and Engineering, Wiley India, 2006
V. Raghavan, Materials Science and Engineering, Phi Learning, 2009
A.K.Bandopadhyaya, NanoMaterials, New Age, 2010

References

A. G. Guy, Essentials of Materials Science, McGraw Hill, 2001
K.E.Geckeler, Functional Nanomaterilas, American Scientific Publishers, 2006

2. Vacuum Techniques and Instrumentation

1. Definition of vacuum, Natural vacuum, Artificial vacuum, Pressure units. Classification of vacuum ranges. Applications of vacuum technology. Rarefied gas theory: perfect and real gas laws-kinetic theory of molecules-molecular velocities--mean free path. Transport phenomena in viscous state: viscosity of gases-diffusion of gases. Transport phenomena in molecular state: viscous and molecular state-molecular drag.

2. Gas flow at low pressures: different flow regimes-flow rate and conductance in vacuum systems- pumping speed – throughput. Production of vacuum: classification of vacuum pumps- Rotary vane vacuum pump-Roots pump-Diffusion pump-Turbo molecular pump- Cryo pump-Sorption pump-Getter Ion pump.

3. Low pressure measurement: Principles of low pressure measurement. Mechanical gauges: Bourdon gauge-McLeod gauge. Thermal conductivity (Transport phenomena) gauges: Pirani gauge-Thermo couple gauge. Ionization phenomena gauge: Bayard Alpert gauge. Recent developments in low pressure gauges.

4. High Vacuum Technology. Vacuum components: Vacuum seals-Vacuum valves-Traps. Selection of materials: mechanical strength-permeability to gases-vapour pressure and gas evolution-elastomer materials. Design considerations of High Vacuum systems and Ultra High Vacuum systems.

5. Leak detection in vacuum systems: Pressure test-Spark coil test-Tests using vacuum gauges-Halogen leak detector-Mass Spectrometer Leak Detector (MSLD). Identification of gases present in the vacuum system: Residual gas analyzers.

Text Book

A.Roth. Vacuum Technology. North-Holland Publishing company, 2005.

V.V.Rao,T.B.Ghosh and K.L.Chopra, Vacuum Science and Technology Allied Publishers Ltd. New Delhi, 2001

Refernces

N.Harris. Modern vacuum practice. McGraw Hill, 2001

3. Biomedical Instrumentation

1. Bioelectricity- Resting potential, Action potential, Wave forms, sensors and transducers for biomedical applications, Leads and electrodes, Equivalent circuits< functional blocks in biomedical equipments, power supplies, different types of amplifiers, Oscillators and demodulators.
2. Electrocardiograph- Abnormal wave forms, Electrodes, Instrumentation, Block diagram, instrument components, analysis, Computer based instrument, Cardiac pacemakers- defibrillators, Electroencephalograph, Eletcromyograph.

3. X-ray machine – Radiography and fluoroscopy, Image intensifiers, Conventional X-ray imaging, Angiography, Computed tomography, Linear tomographytomography scanner applications

4. Ultrasonic imaging systems – Physics of ultrasonic waves, medical ultrasound, Construction of an ultrasonic transducer, different modes of operation A-Scan, B-Scan, Echocardiograph, real time ultrasonic imaging system, computer controlled imaging, applications.

5. pH meter, biomedical applications, respiration rate-spirometer, pneumotactograph- Measurement of concentration of CO_2 and O_2 in exhaust air and blood, Blood gas analyzer, paramagnetic oxygen analyzer, Blood flowmeter.

Text Book

L.A Geddes and L.E.Baker, Principles of Applied biomedical Instrumentation, Wiley India, 2008

Leslie Cromwell, Biomedical Instrumentation and Mesurements, Phi Learning, 2010

References

B. Jacobson and J. G. Webster, Medicine and Clinical Engineering, Prentice Hall, 2001

R.S.Khandpur, Handbook of Biomedical Engineering, Tata McGraw Hill, 2003

Mackay Stuart, Biomedical Telemetry, IEEE, 1898

4. MEMS and Microsystems

1. MEMS and Microsystems overview- Typical MEMS and microsystem products, Microsystem and microelectronics, multi-disciplinary nature, Microsystem application areas.

2. Mictrosystems – Working principle, acoustic wave sensors, biomedical sensors and biosensors, Chemical optical, pressure and thermal sensors, Actuators using thermal, shape memory, piezoelectric and electrostatic behaviour, micro- grippers, micro-motors, micro-valves, micropumps microaccelerometers and microfluidics.

3. Materials for MEMS and Microsystems- Substrates and wafers, Silicon, Properties, Silicon compounds, Silicon oxide, Silicon nitride, Polycrystalline silicon, Gallium arsenide, quartz, polymers

4. Microsystem fabrication- Photolithography, photoresists and application, Ion implantation, diffusion, Oxidation, CVD, PVD, Epitaxy, Etching, Microsystem design-design considerations, process design, mechanical design, design of silicon die for micro pressure sensor, microfluidic and capillary electrophoresis systems

5. Micromanufacturing- Bulk micromanufacturing, surface micromachining, LIGA process, Microsystem packaging – Die- level, device- level, systm- level packaging, essential packaging technologies, packaging materials, pressure sensor packaging.

Text Book

Tai-ran Hsu, MEMS and Microsystems-Design and manufacture, Tata McGraw Hill, 2003

Marc Madau, Fundamentals of Microfabrication, CRC, Press, 1997

References

N.P.Mahalik, MEMS, Tata McGraw Hill, 2007

P.R.Chaudhury, MEMS and MOEMS Technology and Applications, Phi Learning, 2009

5. Modern Control Systems

1. Sampled data control systems: Spectrum analysis of sampling process-signal reconstruction- Difference equation- Z transform - Pulse transfer function - Inverse Z transform and response of linear discrete systems - Z transform analysis of sampled data control systems - Z and S domain relationships - stability analysis - Design of digital controllers by continuous network time domain and frequency domain techniques. Design by analytical methods.

2. State variable analysis: Concept of state, state variable and state model - State variable representation of SISO and MIMO systems - Electrical, mechanical and electromechanical systems - Phase variables and canonical forms - Simulation diagrams - Transformations into canonical forms - State transition matrix - Solution of state equations.

3. Design in state space: Concept of Controllability and Observability - Pole placement by state feed back - Estimator design - Reduced order estimator - Tracking systems - Liapunov stability criteria.

4. Optimal Control Systems: parameter optimization - Transfer function approach and state model approach - State regulator problem- Infinite time regulator problem - Quadratic optimal control problems.

5. Nonlinear systems: Common physical nonlinearities - Phase plane method - Singular points - Construction of phase trajectories - System analysis by phase plane method - The describing function method - Describing function of common nonlinearities - Limit cycles - Stability of nonlinear systems.

Text Book

K. Ogata, Discrete Time Control Systems - Pearson Education, 2009

I.J. Nagrath and M. Gopal, Control Systems Engineering - New age International Publishers, 2009

References:

K. Ogata, Modern Control Engineering - Prentice-Hall, 2009

C.L. Phillips and R. D. Harbor - Feedback control systems - Prentice-Hall, 2001

6. Process Cntrol

1. Process Dynamics:Process variables - Degree of freedom - Characterization of physical systems - Dynamics of liquid, gas and thermal processes - Interacting and non-interacting systems – Continuous and batch processes- Self regulation- Servo and regulation operation.

2. Control actions and controllers: Basic control actions - Characteristics of two position, multi position and floating modes - Proportional, Integral and Derivative modes, Composite control modes- PI, PD and PID control modes - Pneumatic and electronic controllers to realize various controller modes.

3. Optimum controller settings: Evaluation criteria - ¼th decay ratio -IAE, ISE, ITAE, ITSE – Process loop tuning- Process reaction curve method - Continuous oscillation method- Damped oscillation method - Frequency response methods.
4. Final control element: I/P converter - Pneumatic, electric and hydraulic actuators, Valve positioner - Control valves -Control valve characteristics- Globe, butterfly, diaphragm and ball valves - Valve sizing - Cavitation and flashing.

5. Complex control systems: Cascade control - Feed forward control - Ratio control - Multi-variable control - Relative gain array and pairing- Linear decoupling- Distillation column control – Combustion control and drum level control in a steam boiler.

Text Book
D.P. Eckman, Automatic process control, Wiley India, 2009
C.D.Johnson, Process control instrumentation Technology, Dorling Kindersley India, 2007
D. Patranabis, Principles of Process Control, Tata McGraw Hill, 1998

References:
B.G. Liptak, Process Control, Instrument Engineer's Handbook, Taylor and Francis, 2002
Donald R. Coughanowr, Process Systems Analysis and Control, McGraw Hill, 2003

7. Microcontroller and Computer based Instrumentation

1. 8051 architecture: 8051 microcontroller hardware- Input/Output pins, ports and circuits- External memory- Counter and Timers -Serial data Input/Output- Interrupts.

2. 8051 Programming: 8051 instruction syntax- Moving data- Logical operations- Arithmetic operations -Jump and Call Instructions.

3. 8051 based system design: Microcontroller based system design- testing he design- timing routines – Look-up table for 8051-serial data transmission.

4. PC Hardware: Computer components- PC expansion architecture- Design considerations for PC expansion cards- Interfacing standards for PC- General purpose Interface Bus (GPIB)- IEEE488 Protocol- IEEE4882 standard- GPIB hardware- Basic concepts of programming the IEEE-488 GPIB.

5. PC assembly language and programming: The general software environment for the PC- operating system- Boot processing- System program loader- program addressing- The DEBUG program- entering and executing program- Steps in assembling, linking and executing assembly language program- Writing COM program- Screen and keyboard processing in assembly language- Printing, reading and writing files in assembly language.

Text Book

Kenneth J. Ayala, The 8051 Microcontroller aechitecture, programming and applications, Pernam International Publishing (India), 2004

Peter Abel, IBM PC Assembly language and Programming, Prentice Hall, 2006

References

Peter Norton, Inside the PC, Prentice Hall India, 2008

Anthony J. Caristi, IEEE488 General purpose Instrumentation bus Manual, Academic Press, 2001