INSTRUMENTATION & CONTROL ENGG.

ELECTIVE – I

1. TEC011 Digital System Design using VHDL
2. TIC011 Optoelectronics
3. TIC012 Control system components
4. TIC013 Computerised process control

ELECTIVE – II

1. TIC021 Robotics & Mechatronics
2. TIC022 Optical Instrumentation
3. TEC023 Filter design
4. TEC024 Satellite Communication

ELECTIVE – III

1. TIC031 Remote sensing
2. TEC032 Adaptive Signal Processing
3. TEC033 Reliability and Quality Management
4. TEC034 Biomedical Signal Processing

ELECTIVE – IV

1. TIC041 Analytical instrumentation
2. TEC042 VLSI design
3. TIC042 Power plant Instrumentation
4. TIC043 Intelligent Instrumentation

TIC 701 BIO-MEDICAL INSTRUMENTATION

Unit	TOPIC	BOOK/CHAPTER	LECTURES
I	**Introduction:** Specifications of bio-medical instrumentation system, Man-Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body.	**1/1 , 2/ 1 & 2**	**3**
	Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses	**1/ 2 , 2/ 3**	**3**
	Electrodes and Transducers: Electrode theory, Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes. Biomedical Transducer	**2/ 4 & 16 , 3/ 4**	**2**

II	**Cardiovascular Measurements:** Electrocardiography –ECG amplifiers, Electrodes and Leads,ECG recorders –Single channel, Three channel, Vector Cardiographs,ECG System for Stresses testing,Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators.	2/ 7 &10 , 3/ 5&6	6
	Patient Care & Monitoring: Elements of intensive care monitoring, displays, diognosis, Calibration & Reparability of patient monitoring equipment.	1/ 6	2
III	**Respiratory system Measurements:** Physiology of Respiratory system .Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments: Inhalators, Ventilators &Respirators, Humidifiers, and Nebulizers & Aspirators.	2/ 8 , 3/ 8	5
	Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.	3/ 10	3
IV	**Ophthalmology Instruments:** Electroretinogram, Electro-oculogram, Ophthalmoscope, Tonometer for eye pressure measurement.	2/ 7 & 13	2
	Diagnostic techniques: Ultrasonic diagnosis, Eco-cardiography, Eco-encephalography, Ophthalmic scans, X-ray &Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI.	1/19,22&23 , 2/12 &14	
V	**Bio-telemetry:** The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring.	1/ 9 , 3/ 12	4
	Prosthetic Devices and Therapies: Hearing Aides, Myoelectric Arm, Dia-thermy, Laser applications in medicine.	1/ 17, 2/7, 10&13	4

TEXT BOOKS:

1. Khandpur R.S.- Biomedical Instrumentation- TMH
2. Venkata Ram,S.K.-Bio-Medical Electronics&Instrumentation (Revised)- Galgotia.

REFERENCE BOOKS:

3. Cromwell- Biomedical Instrumentation and Measurements- PHI
4. Webster,j.g. –Bio- Instrumentation ,Wiley (2004)
5. Ananthi,S. –A Text Book of Medical Instruments-2005-New Age International
6. carr&Brown –Introduction to Biomedical Equipment Technology – Pearson
7. Pandey & Kumar-Biomedical Electronics and Instrumentation. – Kataria

TIC – 702 DIGITAL CONTROL ENGINEERING

Unit	Topic	TextNo./ Chapter	Lectures
1	**Sampling and Signal Conversion** Sampled-Data Control Systems, Digital to Analog Conversion, Sample and Hold operations, Sample and Hold Devices, frequency –Domain Characteristic of Zero order Hold.	1/1, 2/2	4
	The Z-Transform Linear Difference equations, The Pulse Response, The Definition of the Z-transform, Relationship between the Laplace transform and the Z-transform, Relationship between S-plane and the Z-plane, The	1/2, 2/3	6

	constant-Damping Loci, , The constant-Frequency Loci, , The constant-Damping Ratio Loci, The Inverse Z-Transform, Theorems of the Z-transform, Limitations of the Z-transform, Application of the Z-transform ,Stability Analysis, Systems with Dead-Time.		
2	**Transfer Functions, Block Diagrams, and Signal flow Graphs** The Pulse Transfer Function and The Z-Transfer Function ,The Pulse Transfer Function of the Zero-Order Hold and the Relation Between G(s)and G(z),Closed loop systems, The Sampled Signal flow Graph, The Modified Z-transfer function, Multirate Discrete Data System. **Transform Design of Digital Controls** Design of position Servo Design Specifications, Design on the W-plane, Design of the W'-plane, the Digital PID Controllers.	2/4 1/3	6 4
3	**State Space Analysis of Sampled Data Systems** Discrete time state equations. Similarity Transformations, The Cayley-Hamilton Theorem, Realization of Pulse Transfer function, State Equations for sampled Data Systems, Concepts of Controllability and Observability, Liapunov Stability Analysis Systems with Dead time.	1/4, 2/6	7
4	**Design of Digital Controls Using State Space Analysis** Formulation of the optimal control Problem Optimal State Regulator, Use of State Regulator results, Eigenvalue Assignment by State feedback, State observers Stochastic optimal State Estimation.	1/5	6
5	**Mechanization of Control algorithms Using Micro Processors** General Description of Microcontrollers, Digital quantization, Microprocessor based Position Control System	1/7	7

Text Books :

1. M. Gopal, "Digital Control Engineering", New Age International Publishers.
2. B.C. Kuo ,"Digital Control Systems", Oxford University Press

TIC 751 Instrumentation Lab

Biomedical

1. Pulse measurement
2. Heartbeat measurement
3. Automatic BP measurement
4. Heart sound study using electronics stethoscope
5. ECG measurement

Following experiments to be done on the breadboard

6. Design of low noise and low frequency amplifier for biomedical application
7. Design of Instrumentation amplifier
8. Construction of chopper amplifier

Digital Control System

At least four experiments to be done on MAT LAB

1. Discrete Time LTI model
2. Discrete pole locations & transients response
   Small damping (ε= 0.1 W_n= 4π/5T)
   Medium damping (ε= 0.4 W_n= 11π/5T)
   Large damping (ε= 0.8 Wn= π/4T)
3. Digital Dc motor Speed control with PID controller
4. Designing Lead & Lag Compensators
5. Kalman Filter design
6. State space design for the Inverted pendulum

TIC – 801 Optimal Control

Unit	Topic Name	Book/ Chapter	Lectures
I	**General Mathematical Procedures** Formulation of the optimal control Problem, Calculus of variations, Minimum principle, Dynamic Programming, Numerical Solution of Two-point Boundary value problem.	1/10, 2/11	8
II	**Optimal Feedback Control** Discrete-Time linear State regulator, Continuous-Time Linear state Regulator results of solve other linear problems, Suboptimal Linear regulators, Minimum-time Control of Linear Time-Invariant System	1/11	8
III	**Stochastic Optimal Linear Estimation and Control** Stochastic processes and linear systems, Optimal Estimation for Linear Discrete time Systems Stochastic Optimal Linear Regulator,	1/12	8
IV& V	**Micro Processor and DSP control** **Basic computer** Architecture, Microprocessor Control of Control System, Single Board Controllers with Custom Designed Chips, Digital Signal Processors, Effect of finite World Length and Quantization on Controllability and Closed Loop –Pole Placement, Effects of Quantization, and Time Delays in Microprocessor Based control systems.	2/12	16

Text Books :

1. M. Gopal, “Modern Control Engineering”, New Age International Publishers.
2. B.C. Kuo ,“Digital Control Systems”, Oxford University Press

Reference Book:

3. Brain D.O. Anderson, John B. Moore, “Optimal control Linear Quadratic Methods”, Prentice Hall of India Private Limited

TIC-802 Digital Measurement Techniques

Unit	Topic	Chapter	Lectures
I	Philosophy of digital measurements. **Digital Time Measurement Techniques:** Measurement of time interval between two events, error in time	1	8

	interval measurement, vernier technique for small time measurement, measurement of time interval with constraints, measurement of periodic time, phase, time interval between two events defined by voltage levels, capacitance, quality factor of ringing circuit, decibel meter, logarithmic A/D converter.		
II	**Digital Frequency Measurement Techniques:** Measurement of frequency, ratio of two frequencies, product of two frequencies, high frequency, average frequency difference, deviation of power frequency, peak frequency. Fast low-frequency measurement.	2	8
III	**Digitally Programmable Circuits:** Resistor, potentiometer, amplifiers, Schmitt trigger, dual polarity gain amplifiers. Programmable gain amplifier with dual output, two stage programming, programmable biquads.	3	8
IV	**Digital to Analog Converters:** Output input relation, DACs derived from programmable gain amplifiers, Weighted-resistor DAC, Weighted current DAC, Weighted reference voltage DAC, Ladder DAC, switches.	4	8
V	**Digital Voltage Measurement Techniques:** Sampling theorem, time-division multiplexing, quantization, indirect type A/D converters, direct type A/D converters, Input circuitry of a digital voltmeter.	5	8

Text Book: T. S. Rathore, "Digital Measurement Technique", Narosa Publishing House, 1996.

TEC - 011 Digital System Design Using VHDL

Unit	Topic	Text/Chapter	Lectures
I	**INTRODUCTION TO VHDL:** VHDL description, combinational networks, modeling flip flop using VHDL, VHDL model for multiplexer, comliance and simulation of VHDL, codes, modeling a sequential machine, variables, signals and constants, arrays VHDL operators, VHDL functions, VHDL procedures, packages and libraries, VHDL model for a counter. **ADVANCED VHDL:** Attributes, transport and inertial delays, operator over loading, multi valued logic and signal resolution, IEEE-1164, standard logic, generic, generates statements, synthesis of VHDL codes, synthesis examples, file handling and TEXTIO.	1/ 2,8	10
II	**DESIGN OF NETWORKS FOR ARITHMATIC OPERATIONS:** Design of serial adder with accumulator, state graph for control networks design of binary multiplier, multiplication of signed binary numbers, design of binary divider. **DIGITAL DESIGN WITH SM CHART:** state machine charts, derivation of SM charts, realisation of SM charts, implementation of dice game, alternative realisation of SM charts using	1/ 4,5	10

	microprogramming, linked state machine.		
III	**FLOATING POINT ARITHMETIC:** Representation of floating point numbers, floating point multiplication, other floating point operations. **DESIGNING WITH PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC DEVICES:** Xinx 3000 series FPGAs, Xinx 4000 series FPGAs, using one hot state assignment.	1/ 6,7	8
IV	**MEMORY MODELS FOR MEMORIES AND BUSES:** Static RAM, a simplified 486 bus model, interfacing memory to microprocessor bus.	1/9	6
V	**DESIGN EXAMPLES:** UART design, description of MC68HC05 microcontroller, design of microcontroller CPU, complete microcontroller design.	1/10	6

Text Book:

1. Charles H Roth Jr, "Digital System Design using VHDL", Thomson Learning, 2002.

Reference Books:

2. Stephen Brown & Zvonko Vranesic, "Fundamentals of digital logic design with VHDL", TMH, 2nd Ed., 2007.
3. Jhon F Wakerly, "Digital design", PHI, 4th Ed.

TIC – 011 OPTOELECTRONICS

Unit-1 **(6)**

.**Introduction to Optical waveguide,Photo sources and detectors:** Optical waveguide modes-Theory of Dielectric slab waveguides-Symmetric and Asymmetric slab wave guide,Channel waveguide Light emitting diode (LED), materials, constructions, Drive circuity, Fundamentals of lasers and its applications

Unit-2 **(8)**

Electro Optic Effects: Birefringence phenomenon EO Retardation, EO Amplitude and Phase Modulator, Electro optic Intensity Modulators, Beam deflection, Acousto – optics, A-O Modulators, Integrated optic spectrum analyzer, Non linear optics second harmonic generation, Parametric amplification,.

Unit-3 **(10)**

Fourier Optics and Holography: Phase transformation of thin lens , Fourier transforming property of Lens, Image forming property of Lens, Interferometry, Principles of Holography On axis and Off Axis Holography, Holographic interferometry-Real time, Double exposure, Contour generation ,Optical data storage, Holographic optical elements, Speckle Phenomenon and methods of Measurements, Laser Interferometer.

Unit-4 **(6)**

Optical Fiber Sensors: Multimode fiber Sensors-Displacement ,pressure ,stress, strain Intensity modulated sensors, Active multimode FO sensors, Micro-bend optical fiber sensor, Current sensors, Magnetic sensors, Single mode FO sensors, Phase modulated, Polarization modulated, Fibre Optic Gyroscope.

Unit-5 **(12)**

Optical Computing: Analog Linear Optical processing, Halftone processing, Non linear processing, Analog Arithmetic operation-Addition/Subtraction, Multiplication and Division ,Averaging , Differentiation and Integration.

Digital logic: Modified Signed Digit Number system, Residue Number system, Logarithmic number system, Arithmetic Operations: MSD, Residue, Signed Logarithmic Arithmetic, Threshold logic, Threshold devices, Spatial light Modulators, Theta Modulation devices Shadow casting and symbolic substitution

References:

1- J.Wilson, J.F.B. Hawkes k/ Opto Electronics, An Introduction: /PHI; 2000.
2- I.P. Kaminov / A Introduction to Electro Optic Devices/ Academic Press New York, 1974.
3- A Yariv / Optical Electronics/C.B.S. Collage Publishing, New York, 1985.

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4- F.T.S. Yu, / Optical Information Processing/ Wiley, New York, 1983.

5- Optical Computing –An introduction Mohammad A.Karim,Abdul A S Awwal Wiley Publication

TIC - 012 CONTROL SYSTEM COMPONENTS

Unit	Topic	Book/Chapter	Lectures
I	**A.C & D.C Servomotor**: Analysis, Transfer function and Block Diagram, load-torque, speed torque characteristics, Electronic drive circuits, Applications in control. Synchros: Principles and applications.		6 2
II	**Stepper Motors**: Variable reluctance stepper motor, single stack & Multistack permanent magnet stepper motor, hybrid stepper Motors, Drive circuits and high speed operations Applications		8
III	**Control valve and sizing**: principles, types, characteristics, pneumatic & hydraulic actuated valves, Quick exhaust valve, Time delay valve, Shuttle valve, Twin pressure valve, Solenoid operated valve.		8
IV	**Electro-pneumatics**: Actuating magnets, Contractors and switches, relays, limit switches, Miniature motors, Electro-pneumatic circuits, Actuators & positioners for valves I/P & P/I converters **Fluid control**: Principle of operation of fluid control devices, fluidic logic gate, relays and actuators.		8
V	**Special Machines**: Linear induction motors, their applications reluctance motors , Brakes and clutches, Gyroscopes, Servo-Mechanism.		8

Text Books

1 T.E Gibson & F.B Teuter/Control System Components/Mc Graw Hill, NY
2 Nagrath I.J and Gopal M./Control System Engineering/PHI

References:

3 Anderson/Analsys and design of pneumatic systems.
4 Rogers Hains / Control Systems for HVAC
5 Takashi Kenjo / Stepper Motors & there Microprocessr control / Clarendon Press - Oxford
6 Kenjo,T. and Nagamori,S./Permanent Magnet and Brushless DC Motors Clarendon Press -Oxford

TIC 013 COMPUTERISED PROCESS CONTROL

Unit	Topic	Book/Chapter	Lectures
I	**Basics of Computer-Aided Process Control**: Role of computers in process control, Elements of a computer aided Process control System,. Classification of a Computer –Aided Process Control System Computer-Aided Process –control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control **Process related Interfaces:** Analog Interfaces, Digital Interfaces ,Pulse Interfaces, Standard Interfaces	1/4	8
II	**Industrial communication System:** Communicatin Networkin**g ,**Industrial communication Systems ,Data Transfer Techniques,Computer Aided Process control software,Types of Computer control Process Software, Real Time Operating System.	1/5	8
III	**Process Modeling for computerized Process control:Process model, Physical model, Control Model, Process modeling.** **Modeling Procedure:** Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	1/2	8
IV	**Advanced Strategies For Computerised Process control:**Cascade Control, Predictive control, Adaptive Contrl,,Inferential control, Intelligent Control,Statistical control.	1/7	8
V	**Examples of Computerized Process Control**: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant	1/10	8

Text Book

1. Singh,S.K /Computer Aided Process control /PHI - 2007

Reference **Books**

2. C.L Smith / Digital computer Process Control / Ident Educational Publishers, 72.
3. C.D. Johnson / Process Control Instrumentation Technology / PHI, 88.
4. Krishan Kant / Computer Based Industrial Control.
5. Pradeep B. Deshpande & Raymond. H.Ash / Element of Computer Process Control with Advance Control Applications / Instrument Society of America, 1981.
6. C.M. Houpis, G.B. Lamond / Digital Control System Theory / Tata Mc Graw Hill 85.

TIC-021 ROBITCS AND MECHATRONICS

Unit	Topic	Book / Chapter	Lectures
I	Robot Arm Kinematics: Introduction. The Direct Kinematics Problem. Rotation Matrices, Composite Rotation Matrix. Rotation Matrix about an Arbitrary Axis, Rotation Matrics with Euler Angles Representation, Geometric Interpretation of Rotation Matrics, Homogeneous Coordinates and transformation Matrix, Geometric Interpretation of Homogeneous Transformation Matrices ,Composite Homogeneous Transformation Matrix.	1/2	8
II&III	Links , Joints and Their Parameters, The David-Hhartenberg Representation, Kinamatic Equation for Manipulators, Other specifications of the Location of the End-Effector, Classification of manipulators, The Inverse Kinematics Problem, Inverse Transform Technique for Euler Angles Solution.	1/2	8
	Planning of Manipulator Trajectories: Introduction, General considerations on Trajectory planning, joint- Interpolated Trajectiries, Calculation of a 4-3-4 joint Trajectory, Cubic Spline Trajectory (five Cubics).	1/4	4
IV & V	Mechatronics : What is Mechatronics , Systems, Measurement systems, Control systems, Microprocessor- based controllers, Response of systems, The Mechatronics Approach.	2/1	3
	Actuators : Pneumatic and Hydraulic Actuation systems; Actuation systems, Pneumatic and Hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process Control Valves, Rotary Actuators.	2/5	
	Mechanical Actuation Systems: Mechanical systems, Types of motion, Kinematic chains, Cams, Gear trains, Ratchet and pawl, Belt and chain drives, Bearings, Mechanical aspects of motor selection.	2/6 2/7	8
	Electrical Actuation Systems: Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. Motors, A.C. Motors, Stepper Motors.		
	Programmable Logic Controllers : Introduction, Basic Structure, Input Output Processing, Programming, Mnemonics, Timers, Internal Relays and Counters, Shift Registers, Master and jump controls, Data handling, Analogue input/output, Selection of a PLC.	2/19	5
	Mechatronics Systems: Traditional and Mechatronics Designs, Possible Mechatronics Design Solutions, Case Studies of Mechatronic Systems.	2/22	2

Text Books:--

1 Robotics, Control, Sensing, Vision and Intelligence, K S FU, R C GONZALEZ, C S G LEE, McGraw Hill, 1987.
2 Mechatronics, W BOLTON , Pearson Education Ltd,2003.

Reference Books:--

1 Introduction to Robotic Mechanics and Control, JOHN J. CRAIG, Pearson Education Ltd. 2003
2 Introduction to Robotics, SYED V NIKU, PHI, Pearson, 2003
3 Robotics and Control, R K Mittal, I J Nagrath, TMH, 2003
4 Mechatronics, Principles Concepts and Applications – N.P. Mahalik TMH 2005
5 Introduction to Mechatronics and Measurement systems – David G. Alciator and Michael B. Histand TMH 2005

TIC-022 Optical Instrumentation

Unit -1

Light Sourcing, Transmitting and Receiving

Concept of Light, Classification of different phenomenon based on theories of light, Basic light sources and its Characterization, Polarization , Coherent and Incoherent sources, Grating theory ,Application of diffraction grating, Electro-optic effect ,Acousto-optic effect and Magneto-optic effect.

Unit-2

Opto –Electronic devices and Optical Components

Photo diode, PIN, Photo-Conductors, Solar cells, ,Phototransistors, Materials used to fabricate LEDs and Lasers Design of LED for Optical communication, Response times of LEDs ,LED drive circuitry, Lasers Classification :Ruby lasers, Neodymium Lasers, He-Ne Lasers,CO_2 Lasers, Dye Lasers, Semiconductors Lasers ,Lasers Applications.

Unit-3

Interferometry

Interference effect, Radio-metry, types of interference phenomenon and its Application, Michelson's Interferometer and its application Fabry-perot interferometer, Refractometer, Rayleigh's interferometers, Spectrographs and Monochromators, Spectrophotometers, Calorimeters, Medical Optical Instruments

Unit-4

Holography

Principle of Holography,On-axis and Off axis Holography, Application of Holography,Optical data storage,

Optical Fiber Sensors

Active and passive optical fiber sensor,Intensity modulated ,displacement type sensors,Multimode active optical fiber sensor (Microbend sensor)Single Mode fiber sensor-Phase Modulates and polarization sensors

Unit -5

Fiber optic fundamentals and Measurements

Fundamental of Fibers,Fiber Optic Communication system,OpticalTime domain Reflectometer(OTDR),Time domain dispersion measurement, Frequency Domain dispersion measurement,Laser Doppler velocimeter,

Text Book:

1- J.Wilson &J F B Hawkes,Opto Electronics:An Introduction PHI,Edition
2-Wave Optics and its Application, Rajpal S.Sirohi
3-A Yariv / Optical Electronics/C.B.S. Collage Publishing, New York, 1985.
4-Fundamentals of OPTOELECTRONICS by Pollock

TEC 023 Filter Design

Unit	Topic	Book
1	Review of op-amps circuits, Categorization of filters-Low-pass filter, High-pass filter, band-pass filter, band-reject filter, Gain equalizers, and Delay equalizers.	1
2	Approximation Theory: Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Basic of sensitivity, Frequency Transformations.	1
3	Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR.	[1]
4	Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.	[2]
5	Switched capacitor filters: The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation.	[2]

Text Book:
[1] Gobind Daryanani, “Principles of active network synthesis and design”,John Wiley and Sons.
[2. R.Schaumann, M.E.Van Valkenburg, “Design of analog filters”, Oxford University Press.

TEC 024 SATELLITE COMMUNICATION

Unit	Contents	Book/ Chapter	No. of Lect.
I	Elements of Satellite Communication Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.	02 / 01 02/ 02-03	6
II	Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth	01 / 03 01 / 04	10

	station, design for specified C/N.		
III	Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access: FDMA, TDMA, DAMA and CDMA.	01 / 05 01 / 06, 02/14	8
IV	Error control for digital satellite links: error detection and correction, channel capacity, error control coding, convolutional codes, linear and cyclic block codes. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.	01 / 07 01 / 08	08
V	Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems.	01	08

Text / Reference Books:
1. Satellite Communications / Pratt, Bostian, Allnutt / John Wiley & Sons.
2. Satellite Communications / Dennis Roddy / McGraw-Hill
3. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill.

TIC-031 Remote Sensing

UNIT-1 Principles of remote sensing

Remote sensing system and its components, Electromagnetic spectrum, definition of emissivity, reflectance, absorbance and transmittance. Spectral signature, atmospheric window, active and passive remote sensing systems, Interaction of electromagnetic energy with atmosphere and earth features, factors affecting the reflectance (8)

UNIT-2 Platforms and sensors

Airborne and space platforms, Advantages and disadvantages of each, principle and functioning of camera, films, multi-spectral, thermal & line scanners, side looking air borne radars, and hyperspectral sensors, Different satellite and sensor combinations: LANDSAT, SPOT, IRS series of satellites and sensors. Their important characteristics such as flight altitude, IFOV, spatial resolution, swath, spectral bands, and repetivity. (8)

UNIT-3 Image Characteristics and interpretation

Differences between aerial and space borne imagery, Elements of visual interpretation of images, radiometric processing including correction of instrumental artifacts and atmospheric corrections; geometric corrections and registration. Geometric enhancement including spatial filtering, edge detection and enhancement. (8)

UNIT-4 Digital image processing

Image Transformations such as subtraction, ratioing, NDVI and PCA, Thematic classification and clustering to include unsupervised and supervised classification based on

minimum distance and maximum likelihood classification; accuracy assessment of classification. Concepts of hyderspectral image analysis. (8)

UNIT-5 Ancilliary data sources and integration

Ground truth, Geographic and Radiometric, Introduction of GIS, Integration of Remote sensing and GIS, Digital terrain models, GPS and its role to remote sensing data. (8)

References:

1. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation.
2. Curran, Paul J., Principles of Remote sensing
3. Campbell, J.B., Introduction of Remote Sensing
4. Sabins,F.F., Remote Sensing: Principles and Interpretations
5. Reddy, M. Anji, Remote sensing and Geographic Information System

TEC-032 ADAPTIVE SIGNAL PROCESSING

Unit	Topic	Text Book / Chapter	Lectures
1 & 2	1. Introduction: Definition and characteristics, general properties open and closed loop adaptation.	1/1	1
	2. Adaptive Linear Combiner: General description, input signal and Weight vectors, desired response and error performance function, gradient and minimum mean square, alternative definition of gradient, decorelection of error and input components.	1/2	3
	3. Theory of Adaptation with Stationary Signals: Input correlation matrix, Eigenvalues and eigenvectors of the correlation matrix, and their geometrical significance. Basic ideas of gradient search methods, gradient search by newton's method and method of steepest descent, gradient component estimation by derivative measurement, effects of gradient noise, on weight vector solution, excess MSE, time constant and misadjustment, performance comparison of Newton and S.D. methods.	1/3,1/4 & 1/5	12
3	4. Adaptive Algorithms: Least mean square algorithm, convergence, learning curve noise in Weight vector misadjustment and performances of LMS algorithms, sequential regression algorithm, adaptive recursive LMS algorithm, random search algorithm.	1/6, 1/8	8

4 & 5	5. Recursive Least Square Algorithm: Preliminaries, matrix inversion lemma, exponentially weighted RLS algorithm, update recursion for the sum of weighted error squares, convergence analysis of RLS algorithm	2/9	5
	6. Adaptive Filter Structures: Lattice structures, all poles and all zeroes versions, adaptive lattice predictor. Lattice LMS algorithms, and lattice SER algorithms, adaptive filters with orthogonal signals, DFT and lattice preprocessors.	1/8	6
	7. Adaptive Filter Applications: (i) Adaptive modeling and systems identification. (ii) Inverse adaptive modeling, equalization and deconvolution	1/9 & 1/10	8

Text Books:

1. Adaptive Signal Processing, Widrow and Stearns, Pearson Education
2. Adaptive Filter Theory, Simon Haykin, Pearson Education

Reference Books

1. Adaptive Filters, Cowan & Grant, Prentice Hall
2. Theory and design of adaptive filters, John R. Treichler, PHI.
3. Adaptive Signal Processing by Davisson.

TEC-033 Reliability & Quality Management

Unit	Contents	Book/ Chapter	No. of Lectures
I	Introduction: Definition of reliability, quality, availability, maintainability, types of failures, various parameters of system effectiveness, concept of failure modes, difference between MTTR and MTTF.	01 / 01	06
II	Reliability mathematics: Classical set theory, Boolean algebra, sample space, definition of probability, basic properties of probability, conditional probability, and random variables. Probability distribution: Exponential distribution, gamma distribution, binomial distribution, normal distribution and weibull distribution.	01 / 02	08
III	Reliability Data Analysis: The reliability function, bathtub curve, data collection, storage & recovery of data, component reliability from test data, linear hazard model & exponential hazard model. System Reliability: Systems with components in series, systems with components in parallel, series –parallel systems, Fault tree techniques, K-out of m systems.	02 / 05	08

IV	Electronics System Reliability: Reliability of electronic components, component types and failure mechanics, circuit and system aspects, reliability of electronic system design, parameter variation and tolerance.	01 / 09	08
V	Quality management system & TQC: Quality policy, cost & quality, concept of TQM, management of reliability & quality, elements of quality systems, essential steps in implementing quality system for ISO: 9000.	03	10

Text / Referencebook:

1. Practical Reliability Engineering/ *Patrick D.T., O'Connor* / John Wiley & Sons 4th edition).
2. Reliability Engineering/ *E. Balagurusamy* / Tata McGraw- Hill.
3. Quality control & Total quality Management / *P.L.Jain* / Tata McGraw- Hill.
4. Reliability and Maintainability Engineering / Charles E. Ebeling / TMH

TEC 034 BIOMEDICAL SIGNAL PROCESSING

Unit-1	BOOK/CHAPTERS	LECTURES
1. Introduction to Bio-Medical Signals: Classification, Acquisition and Difficulties during Acquisition.	3/ 1&3	2
2. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography	1/ 2 , 3/ 3	4
3. Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.	1/ 1 , 3/ 15	2
Unit-2		
4. ECG: Measurement of Amplitude and Time Intervals, QRS Detection(Different Methods), ST Segment Analysis, Removal of Baseline Wander And Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.	1/ 12&13 , 2/ 7	8

Unit-3		
5. Data Reduction: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.	1/ 10	8
Unit-4		
6. EEG:Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation.	2/ 5	2
7. EEG Analysis By Spectral Estimation: The Bt Method, Periodogram, -Maximum Entropy Method & AR Method, Moving Average Method. The ARMA Methods, -Maximum Likelihood Method.	2/ 4	6
Unit-5		
8. EP Estimation: by Signal Averaging, Adaptive Filtering:- General Structures of Adaptive filters, LMS Adaptive Filter, Adaptive Noise Canceling, Wavelet Detection:- Introduction, Detection By Structural features, Matched Filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets.	1/ 8&9 2/ 6&Appendix B	8

TEXT BOOKS

1. Biomedical Digital Signal Processing, Willis J Tomkin, Phi.
2. Biomedical Signal Processing, D.C Reddy McGrawhill
3. Biomedical Instrumentation and Measurement.,Crommwell,Weibel and Pfeifer,PHI

REFERENCE BOOKS:

4. Biomedical Signal Processing, Arnon Cohen, volume I & Licrc Press
5 Biomedical Signal Analysis A Case Study Approach, Rangaraj M. Rangayyan, John Wiley and Sons Inc.
6. Medical instrumentation Application and Design, john G. Webster, john Wiley & Sons Inc.

TIC 041 ANALYTICAL INSTRUMENTATION

Unit	Topic	Book/Chapter	Lectures
I	UV – Visible Spectroscopy: Introduction, Electromagnetic Radiation, and Spectrum, Interaction of Radiation with Matter, Lambert Law, Beer Law, Bear –Lambert Law, Absorption Instruments, Radiation Sources, Optical Filters, Monochromator : Prism, Diffraction Gratings, Holographic Gratings, Materials of Optical Components. Detectors: Photovoltaic, High Vacuum Photo–Emission Cells, Photomultiplier Tubes, Silicon Diode Detectors, Photo Diode Arrays, Sample Holders. UV – Visible Spectrophotometers; Calorimeters, Single Beam (Spectronic – 21 type), Using Diode array detector, Double Beam spectrophotometer(Optical Diagram & Block Diagram); Microprocessor based Spectrophotometer (Block Diagram)	1/2	8
	Infrared Spectroscopy: Introduction, Near – Middle – Far IR range of Spectrum; Basic Components of IR Spectrophotometers: Radiation Source; Monochromaters; Mirrors, Entrance & Exit Slits, Detectors, Pre – amplifier, Optical Null and Ratio Recording Type Spectrophotometers, Sample Handling Techniques. Nuclear Magnetic Resonance (NMR) NMR Spectroscopy , Principle of NMR: Nuclear Spin, Nuclear Energy Levels, Resonance Conditions. Block Diagram for continuous wave NMR Spectrometer, Chemical Shift, Spin — Spin Coupling and relaxation Process.	1/3 1/10	4 4
	Flame Photometers (FP): Principle of Flame Photometry, Essential Parts of FP, Block Diagram for Flame Photometers, Emission System: Fuel Gases and their Regulation, Atomizer, Burner, Flame. Optical System: Filters, Monochromators, Other Optical Components, Photo Sensitive Detectors, Recording System: PMT and associated Amplifier Circuit. Type of FP: Single Beam, Double Beam, Recording Type FP, Clinical FP. Atomic Absorption Spectrometers (AAS): Atomic Absorption Spectroscopy, Atomic Absorption Instrumentation : Radiation Sources; Hollow Cathode Lamps, Electrodless Discharge Lamp, Burners and Flames. Nebulizers: Concentric, Cross–Flow, Ultrasonic, Babington and V – groove types. Optical System of A A S – its ray diagram , Block Diagram of the electronic Circuit of AAS including pre – amplifier and EHT for PMT Circuits and their working. Sampling System	1/4 1/5	4 4
	Mass Spectrometers (MS): Basic of Mass Spectrometer(MS): Principle of operation Type of MS : Magnetic Deflection MS, Time of Flight MS, Radio Frequency MS, Quadruple Mass Spectrometer. Sample Ionization Methods: Electron Impact, Chemical Ionization, Field Ionization, Field Desorption and Fast Atomic Bombardment. Ion Detectors: Faraday Cup, Electron Multiplier, Micro Channel Plate. Chromatography : Various Types of Chromatography, Basic definitions, Gas Chromatography, Block Diagram of Instrument. Mobile phase, Sample Injection System, Chromatography Columns, Thermal Compartment Oven, Temperature Programming, Detector Systems (TCD, FID, FPD, ECD). A typical Chromatogram. Electronic Integrator circuit for Chromatogram peaks.	1/19 & 2/16 1/16	4 4
	X Ray Spectrometers: Introduction, X-ray Spectrum, Block diagram of X-ray Spectroscopy Instrument, X-ray Generating Equipment, Collimators, Monochromators. Detectors: Photographic Emulsion, Ionization Chamber, The Geiger Muller Counter, Proportional Counter, Scintillation Counter. X-ray Diffrcatometer, X-ray Absorption Meter. X-ray Fluorescence Spectrometry	1/14 & 2/13	6

Text Books :-

1. Handbook Of Analytical Instruments: R S Kandpur, TMH 2nd Edition,2003.
2. Instrumental Methods of Analysis: Willard, Merritt, Dean and Settle, Seventh Edition, CBS Publishers.

TEC 042 VLSI DESIGN

Unit	Topic	Text Book	Lectures
1.	Introduction to integrated circuit technology. CMOS fabrication, the p-well process, n-well process, twin tub process. Bi-CMOS technology. Basic electrical properties of MOS circuits, I_{ds}-V_{ds} relationship, MOS transistor threshed voltage $V_{t,}$ Trans conductance and output conductance, MOS transistor figure of merit.	1	8
2.	The n-MOS inverter, pull-up to pull-down ratio, CMOS inverter and its characteristics, latch –up in CMOS circuits, stick diagrams, n-MOS design style, CMOS design style, lambda based design rules , Body effect, sheet resistance, capacitances of layers, Gate delays, Delay estimation, logical efforts, Scaling models and scaling factors, limitation of scaling, , Limits of miniaturization.	1	8
3.	n-MOS, CMOS NAND Gates, n-MOS, CMOS NOR gates. Combinational circuit design, sequential circuit design, design considerations, problems associated with VLSI Design, Design Methodology and Tools, Standard Cell Based Design, Design Flows, Automated Layout Generation, Placement, Floor planning, Routing, Parasitic Extraction, Timing Analyses.	1&2	8
4.	Full Custom Design, Semi Custom Design, Programmable Logic structures, Field Programmable Gate arrays (FPGA) , Configurable Logic Block (CLB), Application-Specific Integrated Circuits (ASICs)	2	8
5.	Design for Testability, Faults types and Models, Controllability and Observability, AD HOC Design Techniques, Scan-Based Techniques , Built-In self Test (BIST) Techniques, Current Monitoring I_{DDQ} Test. Packaging, Package Parasitics, Heat dissipation, Design Economics, Parametric yield.	2&3	8

Text Books:

1. Basic VLSI Design by Douglas A. Pucknell & Kamran Eshraghian, Prentice-Hall of India.
2. CMOS VLSI Design, A Circuits and Systems Perspective by Neil H.E. Weste, David Harris, Ayan Banerjee, Pearson Education.
3. CMOS Digital Integrated Circuits Analysis and Design by Sung-Mo Kang, Yusuf Leblebici. Tata Mc-Graw-Hill.

References:

1. Digital Integrated Circuits A Design Perspective by Jab M. Rabaey, Anantha Chandra kasan, Borivoje Nikolic, Prentice-Hall of India Pvt. Limited.
2. Principles of C-MOS VLSI Design A systems Perspective by Neil H.E. Weste, Kamrau Eshraghian, Pearson Education
3. Application-Specific Integrated Circuits by Michal John Sebastian smith, Pearson Education.

TIC 042 POWER PLANT INSTRUMENTATION

Unit-1	BOOK/CHAPTERS	LECTURES
1. **An overview**: Brief survey of methods of power generation. Hydro, thermal, nuclear, solar and wind etc. Dependence of instrumentation of the method of power generation-thermal power plants-general structures, pulverization and burners-fans, dampers and actuators-super heaters Stem traps-Economizers, Recirculators and regenerators, Cooling towers-feed water generators Turbine cooling systems, radiation detectors, types of boilers.		**10**
Unit-2		
2. **Control loops and inter and Annuncciation systems**: Combustion control of main header, pressure, air /fuel ratio control-furnace draft and excess control, drum level (three element control) main and re-heat systems temperature control, burner tilting up by pass damper super heater-spray and gas re-circulation controls, hot well level control-interlock-MFT Turbine trip conditions-Pulverized control.		**10**
Unit-3		
3. **Turbine monitoring and control**: Condenser vacuum control- gland steam exhaust pressure control-speed, vibration, shell temperature monitoring-lubricating oil temperature control hydrogen generator cooling system.		**07**
Unit-4		
4. **Analysis in power plant**: thermal conductive type, paramagnetic type-Oxygen analyzer, hydrogen purity meter-chromatography – PH meter, fuel analyzer, pollution monitoring and control		**07**
Unit-5		
5. **Computer in power plants**: load dispatching computer, generation station computer, mini computers, and supervisory control		07

Text Books

1. E.L Wakil, M.M./Power Plant technology/Mc Graw Hill 1984
2. J.Balasubramaniam & R.K Jain/Modern Power Plant Engineering/Khanna
3. Modern power station practice Vol.6:Instrumentation Control & Testing/Pergaman Press, Oxford 1971

Reference Books

4. Richard Dolezal & Ludrik Varcop/Process Dynamics Automatic control of Steam Generation Plant/Elsevier Publishing Co Amesternam,1972

Stephen Michael Elonka & Antony Lawrence Kohal/ Standard Boiler Operations: Questions and Answers/TMH.

TIC 043 Intelligent Instrumentation

Unit –1&2	BOOK/CHAPTERS	LECYURES
1. **Introduction**: Introduction to intelligent instrumentation, Historical Perspective, Current status, software based instruments. (2)		0 2
2. **Virtual Instrumentation**: Introduction to graphical programming, data flow & graphical programming techniques, advantage of VI techniques, VIs and sub VIs loops and charts, arrays, clusters and graphs, case and sequence structure, formula nodes, string and file I/O, Code Interface Nodes and DLL links.		**10**
Unit –3		
3. **Data Acquisition Methods**: Analog and Digital IO, Counters, Timers, Basic ADC designs, interfacing methods of DAQ hardware, software structure, use of simple and intermediate Vis. Use of Data Sockets for Networked communication and controls.		**08**
Unit –4		
4. **PC Hardware Review and Instrumentation Buses**: Structure, timing, interrupts, DMA, operating system, ISA, PCI, USB, PCMCIA Buses. IEEE488.1 & 488.2 serial Interfacing-RS 232C,RS422, RS423, RS485, USB, VXI, SCXI, PXI.		**08**
Unit – 5		
5. **Analysis Techniques:** DSP software, Measurement, filters and wavelets, windows, curve fitting probability & statistics.		05
6. **Communication:** Basic networking methods and their applications in instrumentation, use of Data sockets for distributed control.		03

TEXT bOOKS

1. G.C. Barney / Intelligent Instrumentation / Prentice Hall, 1995**ce:**

2. Lisa,K.Wells &Jeffery Travis / Lab VIEW For every one Prentice Hall,1997

Reference Books.

1. A.S. Morris / Principles of measurement and Instrumentation / Prentice Hall, 1993.

2..S. Gupta / P.C Interfacing for data Acquisition & Process Control, 2nd Edition / Instrument Society of America, 1994.

3.Gray Johnson / Lab VIEW Graphical Programming 2nd Edition / Tata Mc Graw Hill, 1997.

4.Bitter, Mohiuddin, Nawrocki / Advanced Cal VIEW Programming Techniques.

U.P. TECHNICAL UNIVERSITY

LUCKNOW

Syllabus

of

4th Year (Sem. VII & Sem. VIII)

B. TECH.

(1) Instrumentation and Control Engineering
(2) Applied Electronics & Instrumentation
(3) Electronics and Instrumentation
(4) Electronic Instrumentation and Control and
(5) Instrumentation Engineering