COURSE CONTENTS FOR M.TECH (INSTRUMENTATION)

SEMESTER – I

Signal processing-I, Ins 61.01

Introduction:
Classification of signals, spectrum representation, sampling and aliasing, convolution – Description properties.

Transformations:

Spectrum estimation:
(b) Power spectrum estimation - Non-parametric methods and parametric methods.

Design of Digital Filters:
(a) Finite Impulse Response (FIR) filter, Design techniques for FIR filters.
(b) Infinite Impulse Response (IIR) Filters, Design techniques – Approximation of derivative, impulse in-variant method and bilinear transformation, Butterworth filters, chebyshev filters, inverse chebyshev filters, Elliptic filters

Applications:
DSP – applications for Audio, telecommunication, Biomedical

Digital Signal Processors:
TMS-320 Family architectures – CPU operations, memory configuration, peripherals and input-output software development tools, Hardware configurations, Hardware tools

Books suggested:
Analog and digital electronics  Ins 61.02

Amplifiers for instrumentation applications, their design and characterization, analog multiplexers, analog filter design, power supplies; [Regulated power supply, stabilization, voltage regulator & op-amp based regulated power supply, an overview of SMPS and UPS], oscillators and waveform generators. Combinational circuit design, sequential circuit design, digital filters, multiplexers, A/D and D/A converters, memories, computers circuits, an overview of Micro-processors and Micro-controller.

Books suggested:


Transducers-I, Ins 61.03:


Books suggested:


**Foundations Of Measurement Ins 61.04**


**Books suggested:**


**Photonics INS 61.05:**

Nature of Light: coherent, incoherent and partially coherent, generation of light, incandescent, Spectral Lamps and Laser, detection of light, detectors recording and storage media. The eye optical materials, optical device and module, theory of imaging, optical
design concept, interferometry, thin film filter, system transform concept, polarizing devices and modules, fiber optics, representative devices based on electro-optics, magneto-optics and acousto-optics, principles of photometry and instrumental aspects, system design concept.

BOOKS SUGGESTED:

Design of mechanical elements INS 61.06:

Fundamentals of designing Mechanical Elements, Mechanical element joints, Mechanical Power transmission systems, Bearings, Springs, Housings, Couplings, Ergonomic design of Displays, controls,

Books Suggested:
**Process dynamics and control INS 61.07:**

Process Characteristics:
Process, Process variable, mathematical modeling of liquid, gas, thermal, mechanical and chemical system. Linearizing techniques, liquid level control in a tank. Dynamics of manometer, response of non-interacting and interacting first order elements in series.

Controller characteristics:
Characteristics of on-off, proportional, integral, derivative modes and their combinations.

Automatic control:
Single and combined modes in closed loop, static error, velocity error. Dynamic behavior of feedback control processes for different modes. IAE, ISE, IATE criteria. Tuning of controllers.

Controllers:
Electronics, pneumatic, hydraulic controllers implementing. Single and composite mode of controllers. Latest trends in industrial controllers employing PLCs & other logic devices such as fuzzy logic control DCS & Computer based systems etc.

Final control elements:
Types & function of Control valves. Electrical, Pneumatic, hydraulic actuators.

**Books recommended:**

2. Process Control Instrumentation Technology; CD Johnson 8th Edn; PHI 2006
4. Industrial Instrumentation; D.P. Eckman; Wiley Eastern Ltd., 1951.
**INS 61.51 SIGNAL PROCESSING (Practical)**

Practicals based on the contents given above in theory.

**INS 61.52 Analog And Digital Electronics (Practical)**

Practicals based on the contents given above in theory.

**INS 61.53 TRANSDUCER (Practical)**

Practicals based on the contents given above in theory.

**INS 61.54 PHOTONICS (Practical)**

- Practical based on following topics spectral attenuation of optical fibre, Numerical aperture of optical fibres, Audio, video and data transmission through optical fibers, thin film deposition.
SEMESTER-II

MICROPROCESSORS IN INSTRUMENTATION  INS 62.01:

Architecture of 8 bits/16 bits Microprocessors and 8 bit Microcontrollers, peripheral interfacing. Chips- PPI, PCI, DMA Controller, Programmable interval timer, programmable interrupt. Assembly Language Programming Instruction Formats, Addressing Modes, Interfacing Memory and input/output devices. The concept of Bus contention, Microprocessors/Microcontrollers in measurement of voltage, current, frequency, velocity, temperature, etc. Latest trends in Microprocessors.

Books suggested:


AUTOMATIC CONTROL SYSTEM INS 62.02:

Books suggested:


ANALYTICAL INSTRUMENTATION  INS 62.03.

Basics of Physical methods of chemical analysis, spectral methods of analysis, basic techniques, terminology, units. Interaction of e.m. radiations with matter, emission, absorption & scattering techniques. Instrumentation of X-Ray, UV-Vis and infrared techniques. Various light sources, spectrometers, detectors, data processing comparison of various spectral analytical techniques & Electron Microscopy.

Analytical techniques based on separation method:


BOOKS SUGGESTED:

ROBOTICS INS 62.04:

Robotics - Robot dynamics and control. Robot languages, Robotic vision and other sensory interfaces. Manipulator design, Robot locomotion etc.

BOOKS SUGGESTED:


MEDICAL INSTRUMENTATION INS 62.05:


BOOKS SUGGESTED:

2. Biomedical Instrumentation & Measurements; Leslie Cromwel, Fred J. Weibell, Erich A. Pfeiffer; 2nd Edn; Pearson Education; 2005.
Signal Processing-II, INS 62.06


BOOKS SUGGESTED:

1. 'Neural Networks' a comprehensive Foundation Simon Haykin 2nd Ed. Pearson Education Asia (LPE) 2001.
2. 'Neural Networks and Fuzzy systems' Bart Kosko, Prentice Hall of India, 2001
5. 'Fuzzy sets and Fuzzy logic; Theory and application George J.Klir/Bo Yuan, Prentice Hall of India (EEE) 2001

Transducers-II, INS 62.07:

Electrochemical transducer: - Conductivity cells, Lambda sensors, Anhydride sensors, Chlorine sensor, Hydrogen sensor.

Amperiometric sensor, Chemiabsorption sensors, Semi-conductor sensors, forstrain, temperature, pressure, acceleration monitoring, ISFET, MOSFET, Bio-sensors-Affinity sensors, metabolism sensors. Smart sensors - elements of smart sensors, primary sensor mechanisms, internal compensations and information encoding.

BOOKS SUGGESTED:


MICROPROCESSOR BASED INSTRUMENTATION (Practical) INS 62.51:
Practical based on the contents given above in Theory

INS 62.52 AUTOMATIC CONTROL SYSTEM (Practical)
Practical based on the contents given above in Theory.

INS 62.53 ANALYTICAL INSTRUMENTATION (Practicals)
Practical based on the topics given above in Theory.

INS 62.54 : MEDICAL INSTRUMENTATION (Practical)
Practical related to the theory topics given above.

INS 62.55 : SIGNAL PROCESSING - II (Practical)
Practical related to the theory topics given above.

INS 62.56 Transducers - II (Practical)
Practical related to the theory topics given above.

SEMMESTER - III

COMPUTER AIDED DESIGN & COMPUTER AIDED MANUFACTURING INS 71.01:
Computer aided design system software, operating system, graphics system. The overlay system, graphics data base structure and handling, operating features, symbols, Macros, editing facility, data selection, graphics transformation and plotting. Transformation system, windowing and clipping, two and three dimensional transformation, Linear transformations, display files for three dimensional data, visuals of three dimensional data. Eye coordination system. Joystick function. Geometric modelling dimensions of models, types of models, construction of solid models. Draughting for mechanical systems, annotation, arrows and pointers, dimensioning, text, cross-hatching, draughting examples. CAD for electronic circuits, fundamentals, design tables, general circuit analysis programme, circuit simulation, PC layout examples using SMARTWORK/similar software. Digital system checkout, levels of tests, field testing, production testing. Detailed flow, Input unit, output unit, memory unit, instruction register, computer
cycle, programme counter and index register. Test methods, maintenance panel, computer testing and computer trouble shooting.

BOOKS SUGGESTED:

1. CAD/CAM Computer Aided Design & Manufacturing
3. CAD/CAM Principles, Practice & Manufacturing
   Management; 2nd Edn; Chris, MC-Mohan & Jimmie Browne; Pearson Edu. Asia, 2000
4. Mastering Auto CAD-2000 for Mechanical Engineers;
   George Omura;BPB Publications; 2000

INSTRUMENTATION FOR SPECIAL APPLICATIONS (INS 71.02)

State-of-the-art instrumentation for the following areas:

   Environmental Sciences
   Life Sciences
   Analytical Sciences

Design concept, signal sensing, resultant output, analytical standards, calibration and applications of
   i) Miniatuised analytical systems
   ii) Total analysis systems : hyphenated Techniques
   iii) Biosensing and chemical detectors biological elements
        and immobilisation of biological component.

BOOKS SUGGESTED:

2. Micro System Technology in Chemistry and life
   Sciences, topics in current Chemistry, Manz, A.,
3. Biosensors: A Practical approach, Case A.E.G. (Ed.)
   York, 1988
5. Analytical Chemistry, R. Kelliner, J. Mermet, M. Otto,
SELECTED TOPICS : INS 71.03:

- Shape Memory Alloys (NiTiNOL), Applications of shape memory Alloys: Properties of Shape Memory Alloys. SMA Hybrid composites.
- Electrorheological and Magnetorheological fluids Mechanism and properties and applications.
- Smart structures - Actuators piezoceramic based, electrostrictive (Lead - Magnesium - Niobate) PMN based actuators, Electroceramic composite actuators, polyvinylidene Fluoride (PVDF) actuators, Magnetostrictive actuators (Terfenol-D)
- Molecular Electronics Devices -, Organic rectifiers, Molecular switching in Neuromal Membrane
- Integrated, smart and intelligent sensors, principles of intelligent sensor, applications of intelligent sensors.

Books suggested:


Virtual Instrumentation 71.04:

Introduction to Virtual Instrumentation, conventional vs. Virtual instrumentation, advantages and basic representations.

Introduction to software: Introduction to Lab view, front and back panel representations, graphics data base and structures handling, other operating features such as navigating and dataflow etc. The basic concept behind Lab View using examples.

Introduction to systems hardware:

Input devices & functions like data gloves, mice, joysticks etc. Output devices & functions like various types of graphical displays-CRT.

Applications of virtual instrumentation in various fields like Industrial applications, defense, Medical.
BOOKS SUGGESTED:

4. Learning with LabVIEW 7 Express; Robert H. Bishop; Pearson Education; 2005
6. www.ni.com
7. www.natinst.com

INS 71.51 COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING (Practical)

Practicals related to the topics given in above Theory.

INS 71.52: INSTRUMENTATION FOR SPECIAL APPLICATIONS (Practical)

Practical based on the topics given above in Theory.

INS 71.53 SELECTED TOPICS (Practical)

Practicals based on the contents given above in Theory.

Virtual Instrumentation Practical INS 71.54:

The practical based on the above mentioned theory.

INS 71.55 MAJOR PROJECT

Each student will be required to work on the major project approved by the department faculty. The project work will span over IIIrd and IVth semesters during which periodic progress reports will be monitored. At the end of the IIIrd semester, the project progress will be evaluated by the departmental faculty. At the end of IV semester, the student will submit the thesis based on his project research work conducted in the Department on the approved topic under the supervision of a faculty member of the Department. Students would be required to present one seminar on the thesis topic. These would be presented before the Department faculty and students of the Department. The evaluation will be done by a Board consisting of Supervisor, Chairman or his nominee and a
member of Faculty to be nominated by Board of Studies out of a panel of three Examiners suggested by the supervisor.

**SEMESTER – IV**

**INS 72.01: MAJOR PROJECT & THESIS**

Each student will be required to work on the major project approved by department faculty that will span III and IV semesters during which periodic progress reports will be monitored. At the end of III semester, project progress will be evaluated by the departmental faculty.

At the end of IV semester, the student will submit the thesis based on his project work.

The student will conclude his project work and submit the thesis as detailed under INS 71.55 (Major Project).

No numerical marks will be assigned to thesis work. It will be either accepted or rejected. However, quality of work reported in thesis can be graded in terms of “Very Good”, “Good”, “Average”.