**M.Tech(Instrumentation) Program**

In this M.Tech.(Instrumentation) program, there are a total of 12 theory subjects, each of 150 marks (including sessional of 50 marks), a preliminary thesis based project of 100 marks (only sessionals), and a thesis work of 100 marks (only sessionals), a total of 2000 marks.

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

**Instructions to the Examiners/Paper-Setters**

1. Examiners are to set eight questions for the paper, equally distributing the whole syllabus for all questions.
2. All questions should carry equal marks.
3. Students would be required to attempt any five questions out of these eight questions.
<table>
<thead>
<tr>
<th>S.No.</th>
<th>SUBJECT</th>
<th>SCHEDULE FOR TEACHING</th>
<th>THEORY</th>
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<th>Exam. Sess. Total</th>
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<tr>
<td>1.</td>
<td>Signal Processing-I</td>
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- *Photonics 3 - - 3 75 25 100 - - -
  INS 61.05
- *Design of Mechanical Elements. 3 - - 3 100 50 150 - - -
  INS 61.06
- *Process Dynamics 4 - - 4 100 50 150 - - -
  & Control INS 61.07
6. Analog & Digital - - 2 2 - - - 30 20 50
   Electronic INS 61.51
7. Signal Processing-I - - 2 2 - - - 30 20 50
   INS 61.52
8. Transducers-I - - 2 2 - - - 30 20 50
   INS 61.53
9. *Photonics - - 2 2 - - - 30 20 50
   INS 61.54

TOTAL MARKS : 750

* Subject to the availability of the faculty.
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<tr>
<th>S. No.</th>
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<td>7. Automatic Control System</td>
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<td>9. <em>Medical Instruments</em></td>
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**TOTAL MARKS: 750**

* Subject to the availability of the faculty.
# THIRD SEMESTER

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<td>Marks</td>
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1. Elective-I
2. Elective-II

Elective subjects: (Any two of the followings)

- **Computer Aided Design & Computer Aided Manufacturing**
  - *INS 71.01*
  - **Computer**
  - **Aided Design & Computer Aided Manufacturing**
  - **75 25 100**
  - **- - -**

- **Instrumentation**
  - **for Special Applications**
  - **INS 71.02**
  - **Instrumentation**
  - **INS 71.03**
  - **Selected Topics**
  - **INS 71.04**
  - **Virtual Instrumentation**
  - **INS 71.04**
  - **75 25 100**
  - **75 25 100**
  - **75 25 100**
  - **- - -**

* - Subject to the availability of faculty.
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<td>3. *CAD/CAM</td>
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<td>4. *Instrumentation for special applications</td>
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<td>30</td>
<td>20</td>
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<td>5. *Selected Topics</td>
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<td>20</td>
<td>50</td>
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<tr>
<td>6. *Virtual Instrumentation</td>
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<td>7. Major Project</td>
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**TOTAL MARKS: 400**

**FOURTH SEMESTER**

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<tr>
<td>1. Major Project &amp; Thesis</td>
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**TOTAL MARKS: 100**

**GRAND TOTAL = 2000**

* - Subject to the availability of faculty.
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:
8. Introduction of Fourier Optics by J.W. Goodman

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 and 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:

1. Instrument Engineers’ Handbook of Process Control; Bela G. Liptak; 3rd Edn. Chilton Book Company Randor Pennsylvania
2. Process Control Instrumentation Technology; CD Johnson 8th Edn; PHI 2006
4. Industrial Instrumentation; D.P. Eckman; Wiley Eastern Ltd.
5. Principles of Industrial Process Control; D.P.Eckman; Wiley Eastern Ltd.
8. Process Control; Peter Harriot; 2000, TMH
9. Chemical Process Control; G. Stephanopoulus; 2002; PHI

Ins 61.51 SIGNAL PROCESSING (Practical)
Practical based on the contents given above in theory.

INS 61.52 Analog And Digital Electronics (Practical)
Practical based on the contents given above in theory.

INS 61.53 TRANSDUCER (Practical)
Practical 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.

SECOND SEMESTER

MICROPROCESSORS IN INSTRUMENTATION INS 62.01:

Architecture of 8 bits/16 bits Microprocessors and 8 bit Micro Controllers, 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:

3. Microprocessors Architecture, Programming and Application with the 8085/8080 by R.S. Gaonkar.

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:

1. Robotics - Control, sensing, vision and intelligence
3. Industrial Robotics - Technology, Programming &
   Applications. Mikell. P. Groover, Roger N. Nagel, N.G.

MEDICAL INSTRUMENTATION INS 62.05:

Anatomy and physiology, an introduction. Physiological
signals and transducers. Bioelectric signals and their
electrodes. Patient monitoring system and biomedical
recorders, computers in medicine. Modern imaging
techniques and image processing. Fiber optics and laser
applications in medicine. Therapeutic equipment. Patient
safety. Wireless applications (WAP) in telemedicine.

BOOKS SUGGESTED:

   Geddes & Baker; 3rd Edn; 1989; Wiley.
2. Biomedical Instrumentation & Measurements; Leslie
   Cromwel,Fred J. Weibell, Erich A. Pfeiffer; 2nd Edn;
   2005; Pearson Education.
3. Handbook of Biomedical Instrumentation; R.S.Khandpur; 2nd
   Edn; 2006; TMH
4. Biomedical Instruments Theory & Design; 2nd Edn; Walter
   Welkowitz; SID Deutsch’ Metin Akay; 1976; Academic Press
   Inc.
5. Medical Instrumentation applications & Design; 3rd Edn;
   John G. Webster; 1998; John Wiley & Sons.
6. Introduction to Biomedical Equipment Technology; 4th Edn;
   Joseph J. Carr, John M. Brown; 2001; Pearson Education
   Asia.
Signal Processing–II, INS 62.06


BOOKS SUGGESTED:

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, Chemiorption 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:

3. ‘Hand Book of transducers’ By H.N.Norton; Prentice Hall, 1988
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.

SEMESTER – 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
2. Computer Aided Manufacturing; PN Rao, NK Tewari, T.K.
   Kundra; TMH; 2003
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) Miniaturised analytical systems
ii) Total analysis systems: hyphenated Techniques
iii) Biosensing and chemical detectors biological elements and immobilisation of biological component.

BOOKS SUGGESTED:

1. Micro Total Analysis systems, Van den Berg, A.,
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.)
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:**

1. Lab View Basic 1 course Manual, national Instruments
2. Lab View Measurement Manual, national Instruments
3. Lab View Users’ Manual, National Instruments
4. Learning with LabVIEW 7 Express; Robert H. Bishop; Pearson Education; 2005
6. [www.ni.com](http://www.ni.com)
7. [www.natinst.com](http://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 departmental 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 persons 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”. 