STUDY AND EVALUATION SCHEME
FOR
M.E. INSTRUMENTATION AND CONTROL
(INDUSTRY-ORIENTED AND PRACTICE-BASED)
REGULAR AND MODULAR PROGRAMMES

OFFERED BY

NATIONAL INSTITUTE OF TECHNICAL TEACHERS’ TRAINING
& RESEARCH, CHANDIGARH

AFFILIATED TO PANJAB UNIVERSITY, CHANDIGARH

DEPARTMENT OF ELECTRICAL ENGINEERING,
NATIONAL INSTITUTE OF TECHNICAL TEACHERS’ TRAINING
& RESEARCH, SECTOR-26,
CHANDIGARH – 160 019

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SCHEME FOR MASTER OF ENGINEERING (INDUSTRY ORIENTED AND PRACTICE BASED) PROGRAMME REGULAR AND MODULAR IN INSTRUMENTATION AND CONTROL

1. AIM

To offer Master of Engineering (industry oriented and practice based) Regular & Modular Programmes in Instrumentation and Control, for technical teachers and professionals working in industries.

2. RATIONALE

The rapid pace at which changes and advancements are taking place in technology pose a great challenge to training and supplying the right kind and quality of technical manpower. The training of technical personnel is largely influenced by the nature of curriculum, quality of instructional processes, management of instructional system and the role played by industry in their training.

In order to increase the relevance of technical personnel to the world of work, it has all along been felt that the nature of programmes offered by the technical institutes should be oriented towards technology applications and practices. These programmes should focus on learning of industrial practices, practical and generic skills of problem solving, learning to learn skill and entrepreneurship skill.

As per the latest recommendations of the AICTE regarding pay scales and qualifications for technical teachers, the minimum qualification for lecturers is prescribed as degree in Engineering or Technology or equivalent and they have to acquire Master's degree or such higher qualifications for promotions to higher grades. Majority of these teachers are fresh graduates and lack the knowledge of industrial practices and related practical skills, which in turn affects, the quality of technician engineers produced by the Polytechnics/Engineering Colleges. They, therefore, need a strong orientation in technological and field practices in the areas of fabrication, erection, construction, installation, operation, production, testing, maintenance and quality control.

The practice-based M.E. degree programme in Instrumentation and Control will provide the above education and training to the Polytechnic/Engineering College teachers specially to equip them with the necessary knowledge and skills related to industry and field practices. They will be in a position to transfer such knowledge and training to the students of Polytechnics, so that their effective contribution in the world of work is increased.

In order to meet the above long felt need for higher education of polytechnic/Engineering College teachers, it is necessary to offer practice based Masters degree programmes specially designed to incorporate credit based system of evaluation. The system will have all the inbuilt flexibility to allow for self pacing, taking up study of
courses in the sequence and at the time convenient to in-service graduate personnel and obtaining specialization in the areas specific to their profession and carrier development.

In view of the above, NITTTR (earlier known as TTTI) Chandigarh have started offering a practice based **M.E programme (Regular) in Instrumentation and Control** for technical teachers having a B.E. degree or an A.M.I.E qualification in Electrical/Electronics/Instrumentation & Control Engineering or equivalent, since August, 1998. The course aims to provide an in-depth knowledge of field practices and ability to innovate and conduct research in technology areas. This will not only change the orientation of technician programmes but will also reduce the widening gap between technician courses and field practices and will greatly improve the performance of industries. Limited numbers of seats are also available to professionals working in industries and field organizations.

An acute problem faced by technical institutions both for degree and diploma level is that they are not able to spare their teachers for two long years for higher studies away from their institutes. In order to face the above situation, the institute is also offering another **M.E. programme (Modular) in Instrumentation & Control** for technical teachers and professionals working in Industries. This programme has been structured modular in nature where the teachers could be relieved from their institute to this institute for attending classes during summer and winter vacations. They will however also have to undertake follow up study when they return to their institutions so as to prepare themselves for University examinations before the beginning of subsequent modules. The contact type ME programme which is of two years duration has been made modular without any dilution with respect to rigour of teaching learning practices as also University examinations. However, the duration of the programme has been increased to 3 years. Classes will begin from first week of June and second week of December having a contact period of 5 weeks each where the students will study two subjects simultaneously.

### 2.1 Objectives
The specific objective of this course is Continuing Education and Training and Retraining of:
- in service technical teachers.
- industry personnel
- any other sponsored candidate desirous of pursuing a career in teaching.

### 2.2 Target Population
The envisaged target group includes:
- teachers with a B.E degree or an equivalent qualification such as A.M.I.E. etc, in Electrical/Electronics/Instrumentation and Control Engineering.
- working professionals from Industries and other organizations having a B.E. degree in Electrical/Electronics/Instrumentation and Control Engineering or an equivalent qualification such as A.M.I.E. etc. in Electrical/ Electronics/Instrumentation and Control Engineering.
3. **SPECIAL FEATURES OF THE PROGRAMMES**

i) Both the programmes are flexible, and allow self-pacing and taking up course of study in the sequence and at times convenient to the students:

ii) The courses focus on the mastery of minimum essential competencies and development of capabilities such as learning to learn, problem solving, human relations and management skills in addition to learning of Instrumentation Control Engineering subjects.

iii) These make use of a combination of instructional techniques such as group discussions, home assignments, individual and group projects, independent study, seminars etc.

iv) Assessment of student’s performance will be based on both continuous evaluation using variety of assessment techniques matching the learning objectives of the different courses of study and end of term University evaluation.

v) Completion of the course work is followed by Thesis work.

4. **STUDY SCHEME & SCHEME OF EVALUATION**

4.1 Duration of the Programmes

i) **For Regular Programme**

The normal duration of ME (I&C) Regular programme including Thesis will be 2 academic years (4 semesters). The maximum period of completion of the programme including Thesis shall be 4 academic years (8 semesters). 2 years (4 semesters) extension in genuine hardship cases is allowed by the Vice-Chancellor of Panjab University, Chandigarh for submission of thesis.

ii) **For Modular Programme**

The normal duration of ME (I&C) Modular Programme including Thesis will be 3 academic years, (6 spells, each spell of 5 weeks duration including Saturdays & Sundays). The maximum period of completion of the programme including Thesis shall be 6 academic years (12 spells). 2 years (4 spells) extension in genuine hardship cases is allowed by the Vice-Chancellor of Panjab University, Chandigarh for submission of thesis.

4.2 **Number of Theory Papers allowed in a Semester/Spell**

i) **For Regular Programme**

All students will be required to qualify twelve theory papers during the course. No student will be allowed to qualify more than 5 papers at the end of first semester and not more than 10 papers (including the papers passed in the first semester), at the end of second semester or first year. Two papers will be offered in the 3rd semester.

ii) **For Modular Programme**
All students will be required to qualify 12 theory papers during the course. No student will be allowed to qualify more than two papers at the beginning of the 2nd spell and not more than four papers (including the papers passed in the beginning of 2nd spell) at the beginning of 3rd spell and so on.

4.3 Conditions for Appearing in End-Semester Examination

i) Periodic Tests (for Regular Programme)

Every student has to appear in two periodic tests as decided by the Institute and must qualify the same. There will be only one make-up test for those students who are unable to appear in one or both mid-semester tests due to genuine reasons to the satisfaction of Coordinator.

Students, whose performance in the class-tests/sessionals is not satisfactory, are liable to be detained by the Director from appearing at the University Examinations. The detailed rules of the University Examinations are available at Panjab University, Chandigarh and all students are advised to get the latest copy for guidance and further information.

ii) Periodic Tests (for Modular Programme)

Every student has to appear in one periodic test as decided by the Institute and must qualify the same. There will be only one make-up test for those students
who are unable to appear in the test due to genuine reasons to the satisfaction of Coordinator.

Students, whose performance in the test/sessional is not satisfactory, are liable to be detained by the Director from appearing at the University Examinations. The detailed rules of the University Examinations are available at Panjab University, Chandigarh and all students are advised to get the latest copy for guidance and further information.

4.4 Examination and Result (For both Regular and Modular)

- Minimum marks to pass examination: 50% in the sessional in each subject and 40% in each theory paper. Both the theory and sessional marks will be considered independent of each other. Aggregate pass percentage will be 50%.

- Weightage in each subject
  
- 50 marks : Sessional
- 100 marks: Final theory examination

- The students who obtain in first attempt 75% or more of the aggregate marks in both theory and sessionals and also if the thesis has been adjudged to merit distinction are awarded **First Division with Distinction**. If the thesis has not been adjudged to merit distinction then the students are awarded first division.

- The students who obtain 60% or less than 75% of the aggregate marks in all theory papers and the sessionals are awarded **First Division**.

- The students who obtain less than 60% of the aggregate marks in all the theory papers and the sessionals but not less than 40% in each theory paper and 50% in the sessionals will be awarded **Second Division**.

- **Preliminary Thesis/Thesis**
  
  Four neatly typed or printed copies of Thesis properly bound, shall be submitted to the University through Guide and ME Cell of the institute.
No numerical marks are to be assigned to thesis work. It is either “Accepted” or “Rejected”. Quality of work reported in the thesis can be graded in terms of “Very Good”, “Good” or “Average”.

### 4.5 Courses of Study and Evaluation Scheme

#### i) Regular Programme

In the regular programme, there are a total of 12 theory subjects, each of 150 marks (including sessional of 50 marks), a thesis based project work of 100 marks (sessional only), and thesis work of 100 marks (sessional only), a total of 2000 marks. A candidate will study 05 theory subjects each in first & second semesters; two theory subjects & thesis based project work in third semester and thesis work in fourth semester. The courses of study and evaluation scheme in respect of ME (I&C) Regular programme are given here:

<table>
<thead>
<tr>
<th>Semester – I</th>
<th>Core Subjects</th>
</tr>
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<tbody>
<tr>
<td><strong>Code No.</strong></td>
<td><strong>Subject</strong></td>
</tr>
<tr>
<td>Subject – 1</td>
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<tr>
<td>Subject – 2</td>
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<td>Subject – 3</td>
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<tr>
<td>Subject – 5</td>
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<table>
<thead>
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<th>Semester – III</th>
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<td>Subject – 1</td>
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<td>Subject – 2</td>
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<tr>
<td>Thesis - Preliminary</td>
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<th>Semester – IV</th>
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<tr>
<td><strong>Total</strong></td>
</tr>
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</table>

#### ii) Modular Programme
In the Modular programme, there are a total of 12 theory subjects, each of 150 marks (including sessional of 50 marks), a preliminary thesis based project work of 100 marks (sessional only), and thesis work of 100 marks (sessional only) a total of 2000 marks. A candidate will study 02/03 theory subjects each in first to six spells; preliminary thesis based project work in fifth spell, and thesis work in sixth spell. The courses of study and evaluation scheme for Modular programme are the same as described for Regular programme and is detailed here:

### Spell – 1

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Subject</th>
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<th>T</th>
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<th>Theory</th>
<th>Sessional</th>
<th>Total</th>
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<th>Theory</th>
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<tbody>
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<td>150</td>
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<th>Theory</th>
<th>Sessional</th>
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<tr>
<td></td>
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<th>Theory</th>
<th>Sessional</th>
<th>Total</th>
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<tr>
<td></td>
<td>Subject – 2</td>
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<td>-</td>
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<td>5</td>
<td>100</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
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<td>Thesis-Preliminary</td>
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<tr>
<td></td>
<td>Total</td>
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<td>-</td>
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<th>Theory</th>
<th>Sessional</th>
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<tbody>
<tr>
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<td>-</td>
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<td>29</td>
<td>35</td>
<td>200</td>
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</tbody>
</table>

A member of the faculty of the institute coordinates each course of study. This faculty member is called the course-coordinator. He/she is fully responsible for the course instruction, coordinating the work of other faculty members involved in the course.
instruction, holding tests and assignments and awarding grades in respect of continuous assessment. For any difficulty, the student is expected to approach the course-coordinator for advice and clarifications.

iii) Details of Courses for ME Programme in Instrumentation & Control

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the Subject</th>
<th>Hours/week</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>L  T  P</td>
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<tr>
<td>Core Subjects</td>
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<tr>
<td>MIC 6101</td>
<td>Measurement Sciences</td>
<td>3  - 2  5</td>
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</tr>
<tr>
<td>MIC 6102</td>
<td>Process Dynamics and Control</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6103</td>
<td>Digital Control</td>
<td>3  2  -  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6104</td>
<td>PC Interfacing and Data Acquisition</td>
<td>3  - 2  5</td>
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</tr>
<tr>
<td>MIC 6105</td>
<td>Industrial Instrumentation.</td>
<td>3  - 2  5</td>
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<tr>
<td>Elective Subjects (Group I)</td>
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<tr>
<td>MIC 6201</td>
<td>Microcontrollers and their Interfacing</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6202</td>
<td>Instrumentation for Environmental Engineering</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6203</td>
<td>Analytical Instrumentation</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6204</td>
<td>Power Plant Instrumentation</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6205</td>
<td>Industrial Electronics</td>
<td>3  - 2  5</td>
<td></td>
</tr>
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<td>MIC 6206</td>
<td>Opto-Electronic Instrumentation</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6207</td>
<td>Data-Communication and Computer Networks</td>
<td>3  - 2  5</td>
<td></td>
</tr>
<tr>
<td>MIC 6208</td>
<td>Artificial Neural Network and Fuzzy Logic</td>
<td>3  - 2  5</td>
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<tr>
<td>MIC 6209</td>
<td>Digital Signal Processing</td>
<td>3  - 2  5</td>
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<td>Elective Subjects (Group II)</td>
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<td>MIC 7101</td>
<td>Virtual Instrumentation</td>
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<td>Digital Communication</td>
<td>3  - 2  5</td>
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<td>MTE 7103</td>
<td>Technology Management</td>
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<tr>
<td>MIC 7105</td>
<td>Bio-Medical Instrumentation</td>
<td>3  - 2  5</td>
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<tr>
<td>Note: Any five out of the above nine subjects will be offered.</td>
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</table>

5. ACADEMIC RULES AND REGULATIONS

5.1 Eligibility for admission
The candidate must have a Bachelor’s degree of an Indian University, or an equivalent such as AMIE, IETE (after Diploma) etc. in Electrical/Electronics/Instrumentation and Control Engineering with a minimum of 50% of aggregate in an examination recognized as equivalent thereto. The candidate must have worked in the technical education system or in industry for at least two years (3 years for AMIE/IETE) and must be sponsored by the respective institute/organization.
5.2 Preparation of merit list
This institute prepares a merit list of all eligible candidates based on the following procedure and the admission is granted to candidates strictly according to the merit list.

i) Qualification               Multiplying factor
    %age of marks in BE or its equivalent   0.4

ii) Experience
    One score for each number of completed years of total experience gained after obtained minimum qualification subject to a maximum of ten.

5.3 Selection procedure
Application for admission to the M.E. programme in the prescribed form may be sent through the competent sponsoring authority. Only sponsored applications will be considered. The admission of this programme will be made on All India basis. The number of seats will be decided by AICTE.

Reservation: As per Govt. of India rules and AICTE norms.
The selection of the candidates will be made according to the merit list prepared based upon the marks obtained by them in their Bachelor’s degree or equivalent examination and years of experience.

5.4 All other rules and regulations will be as per the University.

6. FACILITIES AT THE INSTITUTE

6.1 Library
The institute has a very well equipped modern library having over 30,000 books, 10,000 Indian Standards and 2,000 volumes of bound periodicals. The library subscribes to 140 journals, out of which about 50% are from abroad. The books recommended for each course of study are available in the library in adequate numbers. In addition, there are a number of journals in the subject areas which include.

1. IEEE Transactions on Instrumentation and Measurement
2. IETE Tech Review
3. IRRMA Journal
4. Instrumentation and Control
5. Industrial Automation
6. Electrical India
7. Electronics Product Finder
8. Electronics for you
9. Vidyut Bharati

The library has computerized lending services. There is a study area for about 70 readers. The library has highly qualified staff. The library provides current awareness service, documentation service and literature search.

6.2 Computer Centre
Adequate facilities are available in the department of Computer Science for education and training in the areas of computer hardware and software.
6.3 Media Centre
Besides the acquisition and storage of learning resources, media centre provides adequate facilities for reprography and model fabrication.

6.4 ETV Centre
The department has sophisticated equipment for production of educational video films. Over 300 educational video films have been so far produced at this institute.

6.5 Workshops and Laboratories
Workshop and laboratory facilities are available in different areas in the field of Mechanical, Civil, Electrical, Applied Sciences, Electronics and Communication Engineering, Computer Science (Hardware and Software), Rural Development etc.

6.6 Hostel and Students Amenities
The Institute has a hostel having 100 single seated rooms and also a Post Graduate hostel having a facility of 45 family accommodations equipped with all necessary accessories.

Besides the academic facilities, various sports and recreational activities is also a regular feature of this institute. The student centre has a TV-cum-reading room. Indoor and outdoor game facilities for table tennis, badminton, carom, cricket, lawn tennis, football, hockey etc are available. Besides annual tournament for a number of indoor and outdoor sports, including athletics are held every year.

7. FACULTY
The faculty of Electrical Engineering Department of NITTTR (earlier known as TTTI), Chandigarh will undertake the instruction of the various courses of study. Experts will be invited from the institutes of higher learning and industries for delivering expert lectures to the students on relevant topics. The faculty student ratio stands at 1:3.

8. DETAILED SYLLABUS FOR SUBJECTS

MIC 6101 MEASUREMENT SCIENCES

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Generalized Performance Characteristics

Static and Dynamic performance characteristics, Characteristic of periodic and transient inputs and the response of measuring system to these inputs. Response of measuring system to random inputs, Frequency spectra, auto correlation, cross correlation spectral density, Experimental determination of system parameters, requirement of instrument transfer function to ensure accurate measurement.

Measurement System

Classification of various types of transducers, fiber optic sensors, AC/DC signal conditioning, Analog to Digital and Digital to Analog converters, modulation – types, filters – active, passive, digital, Data transmission and telemetry-classification, Recorders – Types of recorders, XY-Plotters, Ultraviolet, magnetic and digital recording.

LABORATORY/FIELD EXPERIENCES

1. Experimental determination of system parameters.
2. Study and verification of transducer characteristics.
3. Study of signal conditioning techniques.
4. Verification of dynamic performance characteristics of a given system.
5. Case study of a real life measuring system in an industry.
6. Various data acquisition software.

BOOKS RECOMMENDED

3. Principles of Measurement and Instrumentation, Alan S Morris, Prentice Hall of India
4. Tranducers and Instrumentation, DVS Murthy, Prentice Hall of India

MIC 6102 PROCESS DYNAMICS AND CONTROL

CONTENTS

Review of Process and Control systems
**Design aspects of Process Control System**


**Dynamic Behaviour of Feedback Controlled Process**


**LABORATORY/FIELD EXPERIENCES**

1. Study and analysis of a feedback controller
2. Simulation of control schemes
3. Verification of desired characteristics of P,I,D, and PID controllers
4. Design fabrication and testing of an electronic controller
5. Case study of digital computer controlled system in industry

**BOOKS RECOMMENDED**

1. Techniques of Process Control P.S. Buckley, John Wiley and Sons, NY.
3. Principles of Measurement and Instrumentation, Alan S Morris, Prentice Hall of India
4. Tranducers and Instrumentation, DVS Murthy, Prentice Hall of India
5. Digital computer process control, C.L. Smith, Intext Educational Publishers, Scranton, P.A.
6. Chemical Process Control, George Stepohonopoulos, Prentice Hall of India
MIC 6103  DIGITAL CONTROL

CONTENTS

Introduction

Control system terminology, control theory history and trends, computer-based control. An overview of classical approach to analog controller design. Basic digital control scheme.

Signal processing in digital control


Models of Digital Control Devices and Systems

Z-domain description of sampled continuous-time plants and systems with dead-time, Digital Controller design using direct synthesis procedures.

Control System Analysis using State Variable Methods for Digital Control Systems

State variable representation, Conversion of state variable models to transfer function and of transfer function to canonical state variable models, Eigen values and Eigen vectors, Solution of state difference equations, controllability and Observability, Multivariable system.

Pole-Placement Design and State Observers


Lyapunov stability analysis

Basic concepts, Stability definitions and theorems, Lyapunov functions for linear and non linear systems, A model reference adaptive system.

Linear Quadratic Optimal Control

Parameter optimization and optimal control, Quadratic performance index, control configurations, State regulator design through the Lyapunov equation, Optimal state regulator through the Matrix Riccati-equation for digital control systems.
TUTORIALS

Various simulation exercises on different digital control using MATLAB.

BOOKS RECOMMENDED

1. Digital Control Systems; B.C. Kuo, Prentice Hall of India.
3. Digital Control & State Variable Methods; M Gopal TMH.
CONTENTS

PC as a platform for Data Acquisition
Origin of PC, Software-Operating systems, programming languages, hardware components – Mother Board – Microprocessors , Chipsets and support circuits, functions, system control, peripheral control, memory control BIOS and its functions.

Buses and Communications
History, Architecture, Bus function, Various buses; ISA,PCI,PCI-X, PCI-Express, PCMCIA, Infiniband, Hyper Transport.

Memory and Mass Storage Devices

Data Transfer –I/O devices

Interfacing
Local Area Networking - Concepts, Topologies, Standards, Hardware, Telecommunication-Analog and Digital Services, Internet–Addressing, Domain Name Systems, Routing. Design of DAS around PC, different DAQ cards and software. Interfacing of Add-on DAQ cards with PC using various buses.

LABORATORY/FIELD EXPERIENCES
1. Interfacing for measurement of standard physical parameters
2. Experimental set up for LAN in a laboratory
3. Designing and implementation of a real life PC based interfacing system.

BOOKS RECOMMENDED
1. Hardware Bible – Winn. L. Rosch, Techmedia, New Delhi
2. The Complete PC maintenance and upgrade guide – Mark Minasi, BPB publications.
3. 8086/8088 Programming – John Uffenbeck, PHI.
4. Structured Computer Organisation – Tanenbaum, PHI.
CONTENTS

Measurement of Industrial parameters
Review of measurement and instrumentation system, Measurement of industrial parameters like: pressure, flow, level, temperature, displacement, velocity, acceleration, torque, Shaft power, humidity, moisture, viscosity, pH value measurement, sound level measurement.

Industrial data management and control
PLCs, Field bus concept, Data acquisition system, Data loggers, Supervisory control, DDC, DCS, SCADA, Instrumentation in hazardous situations, Robotics.

Unit Operation Monitoring
Instrumentation for optimization of unit operation e.g. heat exchanger, compressors, burners, weighing and batching, boilers, chillers, clean room, condenser, cooling towers, vapouriser, air handler etc.

Instrumentation in field
Study of instrumentation schemes for Thermal, Nuclear and Hydro power stations, Cement plant, Fertilizer, Chemical and Steel plant Paper industry etc.

LABORATORY/FIELD EXPERIENCES
1. Study of Instrumentation scheme at Thermal, Hydro, Nuclear Power station.
2. Study of instrumentation scheme at process industries e.g. cement, fertilizer, chemical, steel plant etc.
4. Case study of a PLC based instrumentation scheme in a process industry.
5. Experiments on PLC based instrumentation.

BOOKS RECOMMENDED
2. Structural synthesis of high accuracy automatic control systems; Meerov M.V. Pargaman Press, London.
3. Principles of Industrial Instrumentation; D. Patranabis, T.M.H.
MIC 6201 MICRO CONTROLLERS AND THEIR INTERFACING

CONTENTS

Overview of microprocessors

Microprocessor- Introduction, Basic architecture, differences between microprocessors and microcontrollers.

Micro Controllers

AT 89C2051 20 pin Microcontroller- Introduction, Architecture
8051 Microcontroller- Architecture, Memory Organization, Timer/Counters, Serial Ports, Parallel ports, Assembly language programming: Addressing Modes, Instruction set, Assemblers and Compilers, 8051 timer programming, Serial port programming.
Real world interfacing of 8051 with: LCD, keyboard, ADC and DAC.
Introduction to Advanced Microcontrollers: PIC, ARM and AVR- Introduction.

Embedded systems
An introduction to embedded systems, Classification of embedded systems.

LABORATORY/FIELD EXPERIENCES
1. Performing experiments on microcontroller universal kits
2. Programming Practices on 8051
3. Design of small embedded system projects

BOOKS RECOMMENDED
4. 8051 Microcontroller- I. Scott Mackenzie
6. Embedded Systems Design with 8051 Microcontrollers- Zdravko Karakehayov
7. The 8051 Microcontroller and Embedded systems-M.A.Mazidi, Pearson Education
CONTENTS

Air pollution measurement
Impact of man on the environment: An overview, Air pollution sources and effects, Meteorological aspects of air pollution dispersion. Air pollution methods and equipment, Air sampling techniques, gas analyzers, gas chromatography. Control of specific gaseous pollutants, measurement of automobile pollution; smoke level meter, orsat gas apparatus, CO/HC analyzer.

Water pollution measurement
Sources and classification of water pollutants; Biological oxygen demand (BOD), Chemical oxygen demand (COD), Dissolved oxygen (DO), waste water sampling and analysis, Waste water sampling techniques and analyzers, gravimetric, volumetric, calorimetric, potentiometer, flame photometry, atomic absorption spectroscopy, ion chromatography. Instruments used in wastewater treatment and control, solid waste management techniques.

Measurement of other pollutants
Measurement of radioactive pollutants, ganger counter, Noise level measurement techniques.

LABORATORY / FIELD EXPERIENCES
1. Experimental analysis of air pollution of a given sample
2. Study of air pollution control techniques used in a given industry
3. Sampling and analysis of pollution level of a given water sample
4. Case study of air pollution control in an industry
5. Case study of flue gas handling in a thermal power station
6. Case study of water pollution control.

BOOKS RECOMMENDED
1. Environmental Pollution Control Engineering; C.S. Rao; Wiley Eastern LTD, New Delhi.
2. Environmental Engineering, G.N. Pandy, G.C. Carney, TMH, New Delhi
## CONTENTS

### Analytical Methods of Measurements

Physical methods of chemical analysis, special methods of analysis, basic techniques, terminologies, units, Interaction of electromagnetic radiations with matter, emission, absorption and scattering techniques. Instrumentation related to X-Ray, Ultraviolet and Infrared techniques.

### Special Analysis

Various light sources, spectrometer, detectors and data processing, comparison of various spectral analytical techniques, refractometry, nuclear magnetic resonance spectrometry. Analytical techniques based on separation method: Basics of chromatography liquid, gas and HPLC Mass Spectrometry and related instrumentation.

### Electrometric Methods of Analysis


## LABORAOTRY / FIELD EXPERIENCES

1. Study of operation and maintenance of mass-spectrometry related instruments
2. Study of operation and maintenance of pH and selective potentiometry related instruments.
3. Study of operation and maintenance of voltmetry related instruments
4. Study of operation and maintenance of colometry related instruments
5. Study of operation and maintenance of conductometry
6. Case study of operation and maintenance of an analytical instrumentation laboratory.

## BOOKS RECOMMENDED

1. Instrumental Methods of Chemical analysis; Galen W. Ewing, McGraw-Hill, Koga Kusha Ltd.
4. Analytical Instrumentation HandBook: Galen W.Ewing, Marcel Decker Inc, USA.
MIC 6204  POWER PLANT INSTRUMENTATION

CONTENTS

Control of Power plants
Instrumentation scheme for monitoring and control of various parameters of power plants through control panels. Instrumentation scheme for operation and maintenance of generating units.

Load Despatch
Automatic load dispatch using computers. Software used for optimum generator allocation. Computer based data acquisition system for power plant operations, maintenance and protection. SCADA in power systems.

Instrumentation for Transmission
Instrumentation schemes used for HVDC & EHVAC transmission systems. Energy management: Electronic instrumentation schemes adopted for energy conservation and energy audit.

LABORATORY/ FIELD EXPERIENCES

1. Preparation of layout of instrumentation and control schemes in a power plant
2. Study of computerized load dispatch system
3. Study of instrumentation scheme for HVDC & EHVAC transmission systems.
4. Study of computer control scheme for data acquisition and supervisory control of a power plant.
5. Case study of an energy audit in a small/medium industry.

BOOK RECOMMENDED

3. Power system stability and control: Anderson and Fouad, Galgotia publications, New Delhi
4. Economic scheduling; S. Mukhopadhyay, Wiley Eastern
MIC 6205   INDUSTRIAL ELECTRONICS

CONTENTS

Power Semiconductor diodes and transistors
Characteristics of power diodes, power transistor, power MOSFETS, insulated Gate Bipolar Transistor (IGBT), Mos-controlled thyristor and their comparison.

Thyristors and their characteristics
Review of thyristors such as SCR, TRIAC, GTO, PUT, SUS, SCS, ASCR, RCT. Thyristor Controlled Circuits.

Three phase controlled rectifiers
Single phase half wave and full wave converters, Analysis of three phase rectifier, Effect of source impedance on the performance of converters, Dual Converters.

Choppers
Control strategies, step up choppers, A, B, C, D and E type of choppers, Voltage, Current and Load commutated choppers.

Inverters
Single phase series and parallel inverter, single-phase & three-phase bridge inverters, Pulse width modulated inverters, Reduction of harmonics in the inverter output voltages, Current source inverter.

Cycloconverters
Single phase, Mid-point and bridge type cycloconverters. Three phase half-wave cycloconverters, Output voltage equation, Load commutated cycloconverters.

Electric drives
Single-phase and three-phase dc drives, chopper drives, ac drives, Induction motor drives, Speed control of three-phase induction motors, Synchronous motor drives, Microprocessor controlled ac and dc drives.

FACTS Controllers
SVC, TCSC, STATCOM, SSSC, UPFC

LABORATORY / FIELD EXPERIENCES
1. Basic experiments on thyristor and their applications.
2. Solid state control of drives.
3. Fabrication, testing and trouble shooting of various industrial electronic circuits.
4. Design and testing of thyristor based controllers for electric drives.
5. Design and testing of microprocessor based drive controllers.
6. Study of applications of solid state control of industrial drives.
BOOKS RECOMMENDED

CONTENTS

Introduction
Optical Electronics, Optical process in semiconductors.

Photo Sensitive Devices
Light emitting diodes, Photo-diodes, Photoconductors, Junction photodiodes, PIN diodes, Avalanche photodiodes, Photo transistors, Optical sensors.

Lasers

Optical fibre
Introduction to fiber communication, Optical fiber materials, their properties, Optical fiber communication schemes, Comparison of optical fiber communication with the conventional communication.

LABORATORY / FIELD EXPERIENCES

1. Study and verification of characteristics of a light emitting diode.
2. Experiments on laser beam production and their control
3. Study and verification of Characteristics of a photo conductor device.
4. Study and verification of characteristics of an avalanche photo diode.
5. Study of an opto-electronic integrating circuit used in industries.

BOOKS RECOMMENDED

CONTENTS

Introduction
Uses of computer networks, Network hardware and software, Reference models, Example network, Example data communication services.

Physical Layer
Theoretical basis of data communication, Transmission media, Wireless transmission, Telephone system, Narrow band and Broadband ISDN and ATM, Communication satellites.

Data Link Layer
Design issues, error detection and correction, elementary data link protocols, sliding window protocols, protocol specification and verification, data link protocols.

Medium Access Sublayer
Channel allocation problem, Multiple access protocols, IEEE standard 802 for LANs and MANs, Design of LAN, Detection and management of collisions, Budge s, High Speed LANs, Satellite networks.

Network Layer
Design issues, Routing algorithms, Congestion control algorithms, Internetworking, Network layer in the internet and in ATM networks.

Transport Layer
Transport service, Elements of transport protocols, Internet transport protocols, ATM AAC layer protocols, performance issues.

Application Layer
Network security, Domain name system (DNS), Simple network management protocol, Electronic Mail, Usenet, World wide web, Multimedia.

LABORATORY / FIELD EXPERIENCES

1. Testing x 2.5 and TCP/IP protocols.
2. Setting up LAN connection
3. Installing a bridge between networks.
4. Setting up a link through Async/Sync modems

BOOKS RECOMMENDED

1. Computer Networks –A. Tanenbaum –PHI
2. Data communication, networks and Systems – Thomas C.Bartee, Howard W. Sams & Co
5. Design & Analysis of Computer Communication Networks – Ahuja.V.
CONTENTS

Artificial Neural Networks
Biological Neural Network-structure of human brain, Characteristics of ANN, Artificial neurons, Types of ANN-single layer and multilayer, Hopkinsons, counter propagation, back propagation, feedforward etc., Non Linear activation functions, Training of ANN and different training algorithms, bidirectional associative memories, various applications of ANN in the field of engineering in general and electrical engineering in particular, programming methods using ANN Techniques.

Fuzzy Logic

LABORATORY / FIELD EXPERIENCES

1. Simulation of ANN for digit recognition
2. Application of fuzzy logic for language translation
3. Programming exercises in ANN, FL & GA using MATLAB and its tool boxes.

BOOKS RECOMMENDED

1. Neural Networks & Fuzzy systems: Kosko.B., Prentice Hall of India
5. Introduction to Artificial Intelligence and Expert Systems, D.W. Patterson, Prentice Hall of India
CONTENTS

Introduction
Classification of signals, concept of frequency in continuous-time and discrete-time signals, sampling theorem, Discrete-time signals and systems. Analysis of Discrete-Time Linear-time-invariant systems-convolution sum. Solution of linear constant coefficient difference equations, correlation of discrete-time signals

Z Transform
Review of direct and inverse z-transforms, solution of linear differential equations, Analysis of linear time-invariant system in the z-domain

Discrete Fourier Transform
Review of Fourier Series and Fourier transform of continuous time and discrete-time signals, DFT and its properties, Fast Fourier Transforms, various algorithms.

Structures for the Realization of Discrete-time System
Structures for FIR systems-Direct from I and II, cascade and parallel form, structures for IIR systems.

Design of Digital Filters

DSP Chips and their Application
TMS C3X series: Architectural overview, CPU, Memory types of Addressing, Applications.

LABORATORY / FIELD EXPERIENCES
2. Implementation of various filters
3. Use of DSP chips

BOOKS RECOMMENDED
1. Discrete-time signal processing, : A.V. Oppenheim and RW Schieffer, PHI.
2. Theory and applications of Digital Signal Processing, Rabiner and Gold, PHI
MIC 7101 VIRTUAL INSTRUMENTATION

CONTENTS

Introduction to Virtual Instrumentation: Historical perspective, advantages, block diagram and architecture of a virtual instrument, conventional vs virtual instrumentation.

Learning LabVIEW: Introduction to LabVIEW, Front panel, Block diagram, Menus, Palettes, VI and Sub VI, Editing and Debugging VI, Structures, Arrays, Clusters, Charts and Graphs, Data acquisition, Instrument Control, Signal Generation and Signal Processing Examples

Active Interaction Devices: Gloves, Data glove, Power glove, Dexterous hard master, Mice and joysticks, Wands, Force balls, Biological input sensors, Voice recognition, Data suit

Displays: Sequential Scan Converter for VR displays, Interlace/Non-interlace modes, Parallel-in/Serial-out mode; Serial-in/Parallel-out mode. Multi-display Systems, Helmet-mounted displays, monochrome CRTs with shutters.

Application of Virtual Instrumentation in various fields: Aviation, Automotive, High voltage, Defence, Chemical, Industrial, Marine, Medical, Mining, Nuclear Energy, Virtual landscapes.

LABORATORY / FIELD EXPERIENCES

1. Geographical programming using LabVIEW
2. Applications of LabVIEW

BOOKS RECOMMENDED

1. Learning with LabVIEW 7 Express – R.H. Bishop, Pearson Education, Delhi.
2. LabVIEW Basic 1 Course Manual, National Instruments
3. www.natinst.com
4. www.ni.com
MIC 7102  DIGITAL COMMUNICATION

CONTENTS

Data Communication
General communication system, ASK, FSK, PSK, DPSK, Modulation and demodulation techniques, Baseband signal receiver, Probability of error, Optimum filter, Matched filter correlator examples.

Pulse Modulation
Sampling, Nyquist theorem, Calculation of percentage distortion due to undersampling, Spectrum of sampled signal, sampling with narrow pulses, Pulse amplitude modulation, pulse width modulation, pulse position modulation, digital modulation principles, Pulse code modulation, intersymbol interference, eye patterns, equalization, companding, Bandwidth and noise of PCM systems, Delta modulation, Adaptive DM, Comparison between various techniques.

Information and Theory
Information, Entropy, Mutual information, Redundancy and channel capacity, Shannon – Hartley theorem, Bandwidth S/N Trade off

Coding Theory
Shannon’s Theorem, Coding of $\eta$, Shannon-fano coding, Huffman coding, Hamming coding, bit error detection and correction, Error detection using parity bits, Block codes, CRC, convolution codes, Line and interface coding, NRZ codes, Manchester codes, Miller code.

Modern Equipment
Modern Technology, Modem classification, Modem Modulation Methods, Modem Interface specifications, Modem Transmission characteristics, Modem features, compatibility, selection criteria.

Applications of Digital Communication
E-mail, voice managing, teletext, View Data, Digital satellite communication, Mobile Modulation System.

LABORATORY / FIELD EXPERIENCES
1. Implementation of ASK.
2. Practice on A/D cards.
3. Implementation of PCM
4. Familiarization and Application of modems.
BOOKS RECOMMENDED

2. Analogue and Digital Communication Techniques, Grahame Smilie, & Arnold, A Member of the Hoddes Headline Corporation, London
CONTENTS

Introduction of Technology Management

Technology Forecasting: Techniques of Forecasting, Technology Forecasting – Relevance Strategic alliance and Practicality, Technology transfer.

Management of Research, Development and Innovation: Technology mapping, Comparison of types of R & D projects and development approaches – radical platform and incremental projects, innovation process.


Managing Scientist and Technologists: Identification, Recruitment, Retention, Team work and Result orientation.


Investment in Technology: Venture Capital & Technology Development.

LABORATORY / FIELD EXPERIENCES

- Technology forecasting and Technology mapping
- Technology Strategy Development
- Exercise on Just-in-Time
- Cases on Venture Capital

BOOKS RECOMMENDED

1. Technology and Management, Cassell Educational Ltd. London
5. Innovation and Entrepreneurship in Organizations, Richard M. Burton & Borge, Obel Elsevier
7. New Product management, C Marle Crawford, IR WIN, USA
Introduction
Energy scenario-in context of Indian and global, conventional and non-conventional sources of energy, Renewable versus non-renewable sources of energy, Generation of electrical energy using non-conventional sources- Solar, Wind, Magnetohydro, Tidal, Geo-thermal, Ocean etc.

Energy Conservation
Various methods of energy conservation, Energy management techniques, case studies

Energy Efficient Technology
Technology for efficient utilization of electrical energy, Energy efficient devices, Instrumentation schemes for measuring and controlling electrical energy for implementation of energy efficient systems.

Energy Audit
Methods for doing preliminary, secondary and final energy audit, impact of power factor on electrical power systems, Improvement of power factor.

LABORATORY / FIELD EXPERENCES
Various Case Studies, Mini projects on energy audit.

BOOKS RECOMMENDED
Relevant journals and Reports
CONTENTS

Sensors and Transducers for biological applications
Types, properties, characteristics and selection of transducers for biological instrumentation.

Measurement of electrical parameters
Leads and electrodes, electrocardiography, electrical activity of the heart, equivalent cardiac generator. Einthoven lead system, standardization of recording and display of ECT (Electrocardiogram), EEG (Electroencephalogram), EMG (Electromyogram), EOG (Electroocculogram), ERG (Electroretinogram), EGG (Electrogastogram).

Measurement of non-electrical parameters
Bloodflow, droprecorder, electromagnetic flow meter, measurement of systolic and distolic pressures, blood pressure instruments, intraocular pressure, lung air pressure, audiometers. Measurement of body temperature, thermography. Cardiac tachometer, respiration rate phonocardiogram, heart sounds electrical stethoscope pulmonary function analysers. CO₂ - O₂ - Concentration in exhaled air, blood and lungs, pH value of blood, impedance plethysmography blood gas analysers, blood cell counters.

Medical Imaging Systems
Medical display systems, medical thermography X-Ray, diathermy equipment. Ultrasonics in biomedical application for diagnostic and therapeutic, CAT, MRI, Laser applications in biomedical field.

Patient safety
Electrical Safety of Medical Equipments, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Test Instruments for checking Safety parameters of biomedical equipments.

LABORATORY / FIELD EXPERIENCES

1. Study of sensors and transducers used in Bio-medical applications
2. Study of Bio Medical instruments used in Heart-care system
3. Study of operation and maintenance of ECG instrument
4. Study of operation and maintenance of instruments used for thermography
5. Study of operation and maintenance of instruments used for blood analysis
6. Case study of operation and maintenance of an ultrasonic machine

BOOKS RECOMMENDED

1. Biomedical Instrumentation and Measurements; L.C. Cronwell F.J. Weibell. E.A. Pfeiffer, PHI.