M.Tech. Degree

IN

PROCESS CONTROL AND INSTRUMENTATION

SYLLABUS
FOR
CREDIT BASED CURRICULUM
(For students admitted in 2014-15)

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA
Program Educational Objectives

The major objectives of the M.Tech. (PCI) programme of the department are to equip the students with adequate knowledge and skills in the areas of Process Control and Instrumentation, and to prepare them for:

1. a successful career in Process Control, Instrumentation, Automation and interdisciplinary fields.
2. research and contribution to technological development in the fields of Process Control and Instrumentation
3. attaining professional competency to address the technological needs of society and industrial problems.
4. exhibiting project management skills and ability to work in collaborative environment.
5. life-long independent and reflective learning skills in their career.

Programme Outcomes:

A student who has undergone the M.Tech. programme would have acquired abilities

1. to apply knowledge of mathematics, science and engineering in practice,
2. to identify, critically analyze, formulate and solve engineering problems with comprehensive knowledge in the area of specialization,
3. to select modern engineering tools and techniques and use them with dexterity,
4. to design processes systems and provide solutions considering health, safety, manufacturability, societal and environmental factors,
5. to contribute solutions to engineering problems by research and innovation,
6. to devise and conduct experiments, interpret data and provide meaningful and unbiased conclusions,
7. to understand the impact of engineering solutions in a contemporary, global, economical, environmental and societal context for sustainable development,
8. to document professionally his/her work for effective dissemination of knowledge,
9. to function professionally with ethical responsibility as an individual as well as in multidisciplinary teams with positive attitude,
10. to effectively communicate with the engineering community and with the society at large and capable of presenting reports and design documentation by adhering to appropriate standards.
11. to understand the role of a leader, leadership principles and attitude conducive to effective professional practice.
12. to appreciate the importance of goal-setting and to recognize the need for life-long reflective learning.
Curriculum

The total minimum credits required for completing the M.Tech. Programme in Process Control and Instrumentation Engineering is 64.

**SEMESTER I**

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Department of Instrumentation and Control Engineering
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Department of Instrumentation and Control Engineering
Course Objectives: This course is primarily to introduce various measurement techniques to students from non-circuit branches.

Course Content:
General concepts and terminology of measurement systems, static and dynamic characteristics, errors, standards and calibration.

Introduction, principle, construction and design of various active and passive transducers. Introduction to semiconductor sensors and its applications; Design of signal conditioning circuits for various Resistive, Capacitive and Inductive transducers and piezoelectric transducer.

Introduction to transmitters, two wire and four wire transmitters, Smart and intelligent Transmitters. Design of transmitters.

Introduction to EMC, interference coupling mechanism, basics of circuit layout and grounding, concept of interfaces, filtering and shielding.

Introduction to safety, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures – NEMA types, fuses and circuit breakers. Protection methods: Purging, explosion proofing and intrinsic safety.

Course Outcome:
Upon completing this course the student would learn thoroughly about
1. basic measurement techniques
2. sensing and transducing various physical quantities
3. electromagnetic interference and data transfer
4. safety in handling industrial instruments.

TEXT BOOKS:

REFERENCES:
IC 601-B CHEMICAL PROCESS SYSTEMS

Course Objectives: This course is primarily to introduce various chemical processes and modeling to students from circuit branches.

Course Content:
Historical overview of Chemical Engineering: Concepts of unit operations and unit processes, and more recent developments, The Chemical Industry-scope, features & characteristics. Flow sheets, and symbols for various operations.

Material balances in simple systems involving physical changes and chemical reactions; systems involving recycle, purge, and bypass, combustion reactions, Forms of energy, optimum utilization of energy, Energy balance calculations in simple systems. Introduction to Computer aided calculations-steady state material and energy balances, combustion reactions.

Basic Fluid Concepts: Dimensions and Units, Velocity and Stress Fields, Viscosity and surface tension, Non Newtonian viscosity, Dimensional Analysis (Buckingham PI theorem), Types of flows, Methods of Analysis, Fluid Statics. pipe flow, Pumps, Agitation and Mixing, Compressors.

Review of conduction, resistance concept, extended surfaces, lumped capacitance; Introduction to Convection, natural and forced convection, correlations; Radiation; Heat exchangers-Fundamental principles and classification of heat exchangers, Evaporators


Course Outcome:
Upon completing this course, the student would understand
1. basic chemical process engineering.
2. fundamentals of fluid mechanics.
3. the working of heat exchangers.
4. the working of large scale industrial processes such as distillation columns and reactors.

TEXT BOOKS:
IC 603 MODERN CONTROL ENGINEERING

Course Objectives:
1. To introduce and teach advanced methods and techniques of linear system analysis and design from modern and digital control theory, and emphasize their interrelation.
2. To introduce mathematical modeling, analysis, and design of a larger class of systems in a unified framework.

Course Content:


Analysis of Linear State Equations – First order scalar differential equations, System modes and modal decomposition, State Transition Matrix, Time-varying matrix case.


Course Outcome:
1. The student is exposed to an appropriate modern paradigm for the study of larger scale multi-input-multi-output systems.
2. The student understands the importance of linear algebra and matrix theory in designing practical control systems.
3. The student is motivated to study more general systems and their stability using Lyapunov’s theory.
4. The student learns to implement modern control systems using a digital computer in the loop.

Text Books:

References:
Course Objective:
Expose students to the advanced control methods used in industries and research. This course prepares the student to take up such challenges in his profession.

Course Content:


Special Control Techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control, model based control systems.

Multivariable Control Analysis: Introduction to state-space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable PI controllers, Design of multivariable DMC and MPC.

Sample Data Controllers: Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers. Introduction to PLC and DCS.

Course Outcomes:
Upon completing the course, the student should have understood
1. controller tuning.
2. type of controller that can be used for specific problems in chemical industry.
3. design of controllers for interacting multivariable systems.
4. design of digital control systems.

Text Books:

References:
IC 605 PROCESS CONTROL & INSTRUMENTATION LAB

Course Objectives

1. To provide students with hands-on experience to apply their practical knowledge in designing, testing and simulation of any instrumentation and process control system.
2. To provide practical experience to the students in simulation softwares and real time interfacing cards and also to make them familiar with important process control applications.

List of Experiments

1. Modeling of flow process using two point Method
2. Real time Position control of a servo system.
4. Level Control using P, PI, PID Controllers
5. Ladder logic Programming using PLC
6. Thermocouple cold junction compensation
7. Design of temperature transmitter using RTD and XTR101
8. ADC and LCD interfacing with Microcontroller 8051
9. Stepper motor interfacing with MC8051
10. Real time Vibration control of a cantilever beam
11. On line system identification of a given system
12. Tank level control simulation in LABVIEW.
13. Temperature control of a water bath using LABVIEW DAQ card

Course Outcomes:

On completion of this lab students will be familiar with

1. Design of signal conditioning circuit for a given sensor
2. Design and tuning of PI, PID controllers for different processes
3. Modeling of a given system
4. Implementation of simple closed loop control system in real time
5. Use of Microcontroller for the design of standalone instrumentation systems.
## SEMESTER II

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Course Objectives:
This course is an adaptation of numerical methods pertaining to control engineering problems. The algorithms are set in a numerical algebraic framework and are designed and analyzed in a formal way.

Course Content:

Review of Linear Algebra - Vector spaces, Orthogonality, Matrices, Vector and Matrix Norms, Kronecker Product

Numerical Linear Algebra - Floating point numbers and errors in computations, Conditioning, Efficiency, Stability, and Accuracy, LU Factorization, Numerical solution of the Linear system $Ax = b$, QR factorization, Orthogonal projections, Least Squares problem, Singular Value Decomposition, Canonical forms obtained via orthogonal transformations.


Large scale Matrix computations, Some Selected Software.

Course Outcome:
Upon completing this course, the student would be competent enough to develop software exclusively for control theoretic problems.

TEXTBOOKS/REFERENCES/RESOURCES:

4. www.scilab.org/download/
Pre Requisites: The students should have already learnt the chemical engineering fundamentals.

Course Objectives:
1. The major objective is to understand how to invent chemical process flowsheets, how to generate and develop process alternatives, and how to evaluate and screen them quickly.
2. To simulate the steady-state behavior of process flowsheets using a suitable simulation software.

Course Content:
Flowsheeting

Sequential modular approach to flowsheeting
Solution, partitioning and tearing a flowsheet, convergence of tear streams with suitable example.

Flowsheeting by equation solving methods
Selection, decision and tearing of variables in a flowsheet with simple and complex examples

Flowsheet applications
P & I D development, typical stages of P & I D, Applications of P & I D in design stage - Construction stage - Commissioning stage - Operating stage - Revamping stage - Applications of P & I D in HAZOPS and Risk analysis.

Course Outcome:
At the conclusion of this course the successful student should be able to
1. Understand the input/output structure of a flowsheet for a given manufacturing unit.
2. Synthesize and design flowsheet sub-systems, to develop the recycle structure(s).
3. Simulate the steady-state behavior of process flowsheets at each level of process development.

TEXT BOOKS:

REFERENCES:
Department of Instrumentation and Control Engineering

IC 604 INDUSTRIAL INSTRUMENTATION

Course Objectives:
To enable the students to understand the fundamentals of various types of industrial measurements.

Course Content:
Review of Industrial Instrumentation

Measurement in thermal power plant
Selection, Installation and maintenance of Instruments used for the measurement of fuel flow, Air flow, Drum level, Steam pressure, Steam temperature and other parameters in thermal power plant – Analyzers - Dissolved Oxygen Analyzers- Flue gas Oxygen Analyzers-pH measurement- Coal/Oil Analyzer – Pollution Controlling Instruments

Measurement in Petrochemical Industry
Parameters to be measured in refinery and petrochemical industry-Temperature, Flow and Pressure measurements in Pyrolysis, catalytic cracking, reforming processes-Selection and maintenance of measuring instruments – Intrinsic safety.

Instrumentation for energy conservation & management and safety
Principle of energy audit, management & conservation and measurement techniques – Instrumentation for renewable energy systems – Energy management device (Peak load shedding) – Electrical and intrinsic safety - Explosion suppression and deluge systems – Flame arrestors, conservation vents and emergency vents – Flame, fire and smoke Detectors- Metal detectors.

Special Purpose Instrumentation

Course Outcomes:
1. To have an adequate knowledge on basic industrial instrumentation.
2. Ability to prepare design documentation and execute the instrumentation requirements in various process industries.

REFERENCE BOOKS:
Electives for Semester I

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Course Objectives:
1. To impart skills to students in the mathematical tools necessary for the specialization.
2. To teach an array of concepts widely used in the academia and the industry.

Course Content:


Introduction to Optimization, Linear Programming (Graphical method and Simplex method), Dynamic Programming (Multistage Decision Process, Principle of Optimality), Further Topics in Optimization, including Nonlinear Programming, Queuing Theory, Game Theory, Multi-Objective Optimization.

Introduction to Probability and Stochastic Processes - Basics of Probability Theory, Random Variables, Discrete and Continuous, moments and other functions of Random Variables, Limit Theorems and Inequalities

Course Outcome:
1. Formulate engineering problems as mathematical problems
2. Have a basic understanding of numerical methods
3. Learn unconstrained and constrained optimization methods and applications
4. Use mathematical software for the solution of engineering problems

Reference Books:
2. NPTEL Lectures in Mathematics.
Course Objectives:
1. To impart practical skills in measurement techniques to students from non-electrical background
2. To teach an array of concepts widely used in the academia and the industry.

Course Content:


Analog-Digital sampling, Introduction to A/D and D/A conversion, ADCs for signal conditioning, Hardware design techniques.

Characterization and classification of signals, Typical signal processing applications, Time domain representations of signals and systems, Discrete-time signals, Discrete-time systems, Characterization of LTI systems.

Transform domain representation of signals and systems, The discrete time Fourier transform, Discrete Fourier series, Discrete Fourier transform, Computation of DFT.

Basic structures for IIR systems, Basic structures for FIR systems.

Course Outcome:
Upon completing this course students from non-electrical background would learn
1. about practical signal conditioning circuits.
2. about analog-digital conversion and hardware design techniques.
3. the fundamentals of digital signal processing.
4. analysis and design of IIR and FIR filters for digital signal processing.

TEXT BOOKS:
1. S. Franco, Design with Operational Amplifiers & Analog Integrated Circuits, 3/e, TMH, 2002
Course Objectives:
To impart knowledge on sampled-data control systems, various discrete control algorithms, parameter estimation methods, and adaptive control algorithms.

Course Content:

Introduction to Pulse Transfer function- Open loop and closed loop response of SDS- Design and implementation of different digital control algorithm: Dead beat, Dahlin, Smith predictor and Internal Model Control algorithm with examples.


Course Outcome:
After completing this course, the student is exposed to
1. the fundamentals of various discrete-time systems.
2. employing a digital computer in the process loop.
3. curve fitting from the data and estimation techniques.
4. adaptive control paradigm.

TEXT BOOK:
2. P. Deshponde and Ash, *Computer Controlled System*, ISA Press, USA
Course Objectives: To understand different instrumentation techniques for measurement of environmental parameters

Course Content:

Particles emitted in radioactive decay - nuclear radiation detectors - injection chamber - Geiger-Muller counter - proportional counter - scintillation counter - Semiconductor detectors.


Noise pollution: basics of sound pollution, its effect to environment, measurement of sound, tolerable levels of sound. Measurement of sound level. Measurement techniques for soil pollution.

Course Outcome: After completing the course, the students should be able to understand spectral methods, methods for water quality, air quality, sound and soil pollution.

TEXT BOOKS:

REFERENCES:
Course Objectives:
1. This course is designed to expose students to ANN, fuzzy methods of analyzing problems which involve incomplete or vague criteria rather than complete data sets. The course investigates requirements analysis, logical design, and technical design of components for fuzzy systems development.
2. The subject is primarily concerned with the definitions and concepts associated with a fuzzy set, Fuzzy reasoning, Fuzzy design and Fuzzy logic applications. The course also introduces Neuro-Fuzzy systems, Fuzzy Genetic Algorithms.

Course Content:
Overview of Artificial Neural Network (ANN) & Fuzzy Logic

Neural Networks for Modeling and Control
Modeling of nonlinear systems using ANN- NARX,NNSS,NARMAX - Generation of training data - optimal architecture - Model validation- Control of nonlinear system using ANN- Direct and Indirect neuro control schemes- Adaptive neuro controller - Familiarization of Neural Network Control Tool Box.

ANN Structures and Online Training Algorithms
Recurrent neural network (RNN) - Adaptive resonance theory (ART) based network- Radial basis function network- Online learning algorithms: BP through time - RTRL algorithms - Least Mean square algorithm - Reinforcement learning.

Fuzzy Logic for Modeling and Control

Hybrid Control Schemes

Course Outcome: Upon the completion of the course, the students will be able to
1. Understand the overview of ANN and Fuzzy logic theory.
2. Solve and design various ANN models.
3. Apply and analyze the concept to existing systems.
4. Design of hybrid systems for engineering applications.

TEXT BOOKS
Course Objectives:
To learn the concepts and techniques used in sensor data fusion.

Course Content:

Taxonomy of algorithms for multisensor data fusion. Data association. Identity declaration.


High performance data structures: Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures. Designing optimal sensor systems with in dependability bounds. Implementing data fusion system.

Course Outcome:
Upon completion of this course the students will be able to
1. Understand the concept of sensor fusion.
2. Apply algorithms for multisensor data fusion.
3. Interpret high performance data structures.

TEXT BOOKS:

REFERENCES:
HM 711 TECHNICAL COMMUNICATIONS

Objectives:
The objective of the course is
1. To develop the professional and communicational skills of learners in a technical environment.
2. To enable students acquire functional and technical writing skills.
3. To enable students acquire presentation skills to technical and non-technical audience.

Course Description:
This course intends to focus on the discourse structures of technical communication where students will become familiar with and aware of the major components and practices within the field. This course concentrates on advanced writing and other communication skills, Principles and procedure of technical writing; attention to analyzing audience and purpose, organizing information, designing graphic aids, and writing such specialized forms as abstracts, instructions, resumes, technical reports, proposals and manuals.

Learning Outcome:
Learners will be able to:
- Communicate to multiple professional audiences clearly and effectively through both written and verbal modes
- Identify weaknesses in their own writing and apply appropriate revision processes to strengthen communication
- Analyze rhetorical aspects of audience, purpose, and context to communicate technical information effectively in written, oral, and visual media.
- Recognize structures or genres typically used in science and engineering, understand the processes that produce them, and the organizational and stylistic conventions characteristic of them, and apply this knowledge to their own writing tasks.

Course Content
Communication:
Concepts, goals and levels of communication - General and technical communication - Significance of technical communication - Barriers to effective communication - Psychology of communication.
Oral Communication:
Tools and skills of communication - Presentation skills and Use of PowerPoint Slides, Public Speaking - Extempore / Prepared Speech - Requirements of oral communication - Body language and Nonverbal Cues - Difference between Group Discussion and Debate - Interview techniques.
Written Communication:
Effective Writing - Focus on Writing; Coherence and Cohesion - Report Writing - CV and Resume Writing - Drafting Proposals, Research papers - preparation of technical / software manuals - Reader Perspective - Comprehending and Summarizing a text - Non verbal cues in Writing.
Developing Listening Skills:
Listening as an active skill - Kinds of Listening- Listening for general content; Listening for specific information - Intensive Listening - Developing effective listening skills; Barriers to
effective listening skills - Listening Comprehension - Retention of facts, data & figures - Role of speaker in listening, Difference between note taking and note making.

Technology and Communication:
Telephone etiquette - Effective email messages - Editing skills - Use of charts and graphs using computer software - Elements of style in technical writing - Role of media in technology and communication - Library and Reference skills.

References:
### Electives for Semester II

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<tr>
<th>CODE</th>
<th>COURSE OF STUDY</th>
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<tr>
<td>IC 662</td>
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<td>System Identification and Adaptive control</td>
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<td>Micro Electro Mechanical Systems</td>
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<td>Optimal Control</td>
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<td>Safety in Engineering Industry</td>
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<td>Real-Time and Embedded Systems</td>
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<tr>
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<td>Image Processing</td>
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<td>Human Resource Management</td>
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Course Objective: This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

Course Content:

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.

Interface and backplane bus standards for instrumentation systems. Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.

Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.

Course Outcomes: Upon completion of the course, the student will be able to

1. Understand the popular process automation technologies.
2. Design and development of different PLC programming for simple process applications.
3. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system.
4. Know the latest communication technologies like HART and Field bus protocol.

Text Books:

**Reference Books:**
Course Objectives:
The objective of this course is to expose students to Communication systems emerged in the field. As the industry is progressing towards adopting these methods to build large scale Automation systems, this course prepares the student to take up such challenges in his Industrial Environment.

Course Content:

Fieldbus: Use of fieldbuses in industrial plants, functions, international standards, performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation.


PROFIBUS-PA: Basics, architecture, model, network design and system configuration. Designing PROFIBUS-PA and Foundation Fieldbus segments: general considerations, network design.

Course Outcome:
Upon completing the course, the student should have understood the concepts required for building industrial systems.

TEXT BOOKS/REFERENCES:

Course Objectives:
Expose students to the system identification and adaptive control methods used in industries and research.

Course Content:

Nonparametric model estimation: Correlation and spectral analysis for non-parametric model identification, obtaining estimates of the plant impulse, step and frequency responses from identification data.

Prediction-Error Model Structures: Parametric estimation using one-step ahead prediction error model structures and estimation techniques for ARX, ARMAX, Box-Jenkins, FIR, Output Error models. Residual analysis for determining adequacy of the estimated models.

Adaptive Control: Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback, pattern recognition, correlation technique.


Course Outcomes:
Upon completing the course, the student should have understood
1. Identification Methods
2. Estimation of Nonparametric models
3. Prediction-Error Model Structures
4. Adaptive control schemes.

TEXT BOOKS:
Course Objectives:
This course is designed to provide an introduction to microsystem technology and fabrication technologies followed by basic sensing and actuation principles of microsensors and actuators.

Course Content:
Introduction, emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.

Bulk micro machining: Introduction, etch-stop techniques, dry etching, buried oxide process, silicon fusion bonding, and anodic bonding.
Surface micro machining: Introduction, sacrificial layer technology, material systems in sacrificial layer technology, plasma etching, combined IC technology and anisotropic wet etching.


MEMS devices, electronic interfaces, design, simulation and layout of MEMS devices using CAD tools.

Course Outcome:
Upon undergoing this course, the student will be able to
1. Acquire knowledge in materials and methods to process sensors, actuators, and microsystems.
2. Analyze and describe of the functional behavior of MEMS devices.

TEXT BOOKS:

REFERENCES:
Course Objectives:
To impart knowledge on
1. Dynamic Programming
2. Calculus of variation
3. Pontryagin's Minimum Principle
4. Optimization techniques

Course Content:
Problem formulation - Mathematical model - Physical constraints - Performance measure
Optimal control problem. Form of optimal control. Performance measures for optimal control
problem. Selection a performance measure.

Dynamic Programming - Optimal control law - Principle of optimality. An optimal control
system. A recurrence relation of dynamic programming - computational procedure.
Characteristics of dynamic programming solution. Hamilton - Jacobi - Bellman equation.
Continuous linear regulator problems.

Calculus of variations - Fundamental concepts. Functionals. Piecewise - smooth extremals
Constrained extrema.

Variational approach to optimal control problems - Necessary conditions for optimal control
- Linear regulator problems. Linear tracking problems. Pontryagin’s minimum principle and state
inequality constraints.

Minimum time problems - Minimum control - effort problems. Singular intervals in optimal
control problems. Numerical determination of optimal trajectories - Two point boundary - valve
problems. Methods of steepest decent, variation of extremals. Quasilinearization. Gradient
projection algorithm.

Course Outcomes: Expose the students to the fundamentals of dynamic programming, calculus
of variation and various optimization techniques.

TEXTBOOK:
   1970.

REFERENCES:
   India, New Delhi, 1991.
IC 673 REAL TIME AND EMBEDDED SYSTEMS

Course Objectives:
1. To provide an understanding of hardware and software design and integration for embedded devices.
2. To provide knowledge of Real-time operating systems that can be used to enhance their skills in developing real-time embedded systems.

Course Content:
Introduction to embedded systems: Evolution, Classification, Challenges, Characteristics and requirements with examples.


Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task Communication- shared memory, message passing-, Inter process Communication – Synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority Inheritance.

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

Case Studies: Discussion of specific examples of complete embedded systems- Digital Camera, Washing Machine, Automotive Application.

Course Outcomes:
On completion of this course students will be able to:
1. Identify the specific processor and design for embedded application development
2. To demonstrate their competence and ability to develop a real-time embedded systems.

TEXT BOOK AND REFERENCES:
IC 675 IMAGE PROCESSING

Course Objectives:

Course Content:

Imaging Systems: Camera Imaging Model- Affine transformation, Warping, Perspective transformation and camera imaging model; Stereo vision-Epipolar geometry, Correspondence, Triangulation; Thermal Camera-Thermal science concepts of conductive, convective and radiation heat transfer, thermal capacitance, Thermal image interpretation; Lighting System- spectral power distribution (SPD) of light sources, Colorimetry: trichromatic vision, RGB colour specification system, CIE XYZ colour specification system, CIE standard illuminant; Medical Image Acquisition-X ray, fluoroscopy and angiography, CT angiography, MR Imaging.

Image Improvements & Analysis: Colour Spaces-RGB,LAB,CMY,YCC,HSV Colour Spaces, Colour Space Transformations; Image Enhancements -Histogram Modification, Contrast manipulation, Colour image enhancement, Multispectral image enhancement; Segmentation-Amplitude segmentation methods, Clustering segmentation methods, Region based segmentation methods; Morphological Operations-Binary image dilation and erosion, Binary image close and open operations, Grayscale image morphological operations;


Intelligent Vision System: Tracking-Kalmanfilter, Condensation; Motion Estimation-Detection and tracking of point features, Optical flow; Model based object recognition-Shape Analysis: Distance, perimeter, area measurements, Spatial Moments, Shape orientation descriptors. ModelMatching:Template Matching, Matched filtering; Classifications Model -Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent, Support Vector Machines, K-Nearest-Neighbor Classification, Non-parametric Classification, Unsupervised Learning, Clustering, Vector Quantization, K-means

Case Studies: Vision based Quality Analysis,Shape Detection, Surveillance,Medical imaging, Thermal Imaging, Robotic Vision.

Course Outcomes:

References:
2. Biophotonics, NPTEL Course by Dr. Manoj Varma, IISC Bangalore “http://nptel.ac.in/courses/117108037/11”
Course Objectives:
This course intends to give an eye opener for the students about Human Resource Management and its functions to develop the efficiency and effectiveness of the Human Resources in an industrial organization.

Course Content:


Course Outcomes: This course immensely benefits the stake holders to demystify about how the companies create a competent Human Resource Functions to solve bystander, shotgun and capricious personalities pertinent to potential employees.

TEXT BOOKS: