M.Tech.: Computer Application to Industrial Drives
Department of Electrical and Electronics Engineering

Vision

The Electrical & Electronics Engineering department at NIE will be an internationally acclaimed centre of excellence imparting quality education for the benefit of academia, industry and society at large.

Mission

To be dedicated and coherent team putting in relentless harmonious effort for the dissemination of quality education in theory and applications of electrical engineering encompassing the state-of-the-art for the benefit of Academia, Industry and Society at large.

M.Tech(CAID)

Graduate Attributes

1. Scholarship of Knowledge :
   - Ability to absorb in-depth knowledge and acquire skills in the area of their discipline.

2. Critical Thinking
   - Analyse complex engineering problems by applying innovative thinking for solving practical problems.

3. Problem Solving
   - Ability to identify, formulate and analyse real world problems.

4. Research Skill
   - Ability to apply appropriate research methodologies and use modern tools for analysis and design of systems.

5. Usage of modern tools
• Learn and apply appropriate tools and techniques to solve complex Engineering problems.

6. Collaborative and Multidisciplinary work

• Ability to work individually and as a team member in multidisciplinary and multi cultural environment.

7. Project Management and Finance

• Ability to manage projects in multidisciplinary environment with sound knowledge of prevailing managerial and financial practices.

8. Communication

• Ability to communicate and interact effectively with the engineering community and the society at large as an individual or as a team leader.

9. Life-long Learning

• Ability to sustain interest in lifelong learning in a continuously changing environment.

10. Ethical Practices and Social Responsibility

• Ability to adapt and practice ethics in engineering in a socially and technologically changing scenario.

11. Independent and Reflective Learning

• Observe and examine critically the outcomes of one’s own actions and take corrective measures to facilitate learning by introspection.
**Program Educational Objectives**

**PEO1**: Our graduates will excel in industry / academia with proficiency in the field of power electronics and computer control of drives.

**PEO2**: Our graduates will exhibit creative and critical reasoning skills to comprehend, analyse, design and implement solutions for real world problems.

**PEO3**: Our graduates will exhibit social and managerial skills to succeed in their professional career.

**PEO4**: Our graduates will engage in lifelong learning and serve society ethically and responsibly as an individual or as a team member.

**Program Outcomes**

Students graduating from M.Tech (CAID) stream of E&EE department shall have the:

**PO1**: Ability to apply the knowledge to identify, model and solve electrical drive problems.

**PO2**: Ability to apply critical and innovative skills to design and develop hardware, software to solve real world problems.

**PO3**: Ability to employ state-of-the art tools and research methodologies in learning process.

**PO4**: Ability to practice ethics in engineering traits.

**PO5**: Ability for effective presentation and communication skills.

**PO6**: Ability to function productively across multidisciplinary teams.

**PO7**: Ability to manage projects in multidisciplinary environment with best in class managerial and financial practices.

**PO8**: Ability for lifelong learning and implement best engineering practices.

**PO9**: Ability to observe one’s own actions critically and to take corrective measures for reflective learning.
### DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

#### I SEMESTER—M.Tech (CAID)

<table>
<thead>
<tr>
<th>Sl. No.</th>
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## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
### II SEMESTER-M.Tech (CAID)

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### IV SEMESTER - M.Tech (CAID)

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Course Outcomes

On successful completion of the course, students will be able to:

1. Represent the internal structure, learn the principle of operation and base drive circuits of power electronic devices like power diodes, power BJT, power MOSFET, power IGBT, power SCR, etc.
2. Analyse voltage step down chopper, voltage step up chopper, two quadrant chopper, multiphase chopper, thyristor chopper and solve related problems.
3. Analyse single phase half bridge inverter, single phase full bridge inverter, PWM and SPWM techniques, three phase inverters and solve related problems.

UNIT 1: Power Semiconductor Devices-I: Introduction, Types of static switches, Ideal and Real switches, power diodes, power bipolar junction transistors and Power MOSFETs, Problems.


UNIT 4: Choppers-II: Multiphase choppers, Thyristor choppers, problems.

UNIT 5: Inverters-I: Introduction-functions and features of inverters, types of inverters, Half bridge inverter, the full bridge inverter configuration, problems.

UNIT 6: Inverters-II: Pulse Width Modulation (PWM), Shaping of output voltage wave form-Sinusoidal Pulse Width Modulation (SPWM), three phase inverters, problems.

SLE: Power darlington

SLE: Two transistor analogy of thyristors, Status of development of power switching devices

SLE: Switching control circuit for chopper converters

SLE: Inverter applications, input ripple current-use of an input filter, inverter operation with reverse power flow.
TEXT BOOK:


REFERENCE BOOKS:

Advanced Control Systems (4-2-0)

Sub Code    : MCD0502
Hrs/week    : 6 Hrs
SEE Hrs     : 3 Hrs

CIE    : 50% Marks
SEE    : 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Recognize the need for alternate models for representing control systems.
2. Develop solution of state equations of linear time-invariant and time varying systems.
3. Apply the concepts of controllability and observability to check whether a solution exists to optimal control problem.
4. Develop models of MIMO systems and discuss the technique of achieving non-interaction.
5. Design control systems by pole-placement technique.
6. Construct Liapunov functions and investigate stability of LTI systems.

UNIT 1: Introduction to state space analysis, State models of linear continuous-time systems, Canonical forms, Diagonalization, Different methods of computation of state transition matrix.  

9 Hours

SLE: Computation of State transition matrix by use of Cayley-Hamilton theorem

UNIT 2: Solution of state equations, State space representation of linear time-varying systems, Controllability and stabilizability, observability and detectability.  

9 Hours

SLE: Solution of state equations of linear time-varying systems

Unit 3: Kalman and Gilbert methods to test controllability and observability, Canonical decomposition, Pole-zero cancellation and system properties, PBH tests.  

8 Hours

SLE: Principle of duality

UNIT 4: Introduction to MIMO systems, Non-interaction in MIMO systems, Models for multivariable systems, Matrix fraction descriptions(MFD), Poles and zeros of MIMO systems, Basic MIMO control loop, Closed-loop stability.  

9 Hours

SLE: Stability in MFD form

UNIT 5: Pole placement by state feedback, Different methods of computing state feedback gain matrix, State observers-full order and minimum order.  

9 Hours
SLE: Effects of addition of observer on closed-loop system

UNIT 6: Liapunov Stability analysis of LTI systems, Model-reference control systems, Quadratic optimal control.  
SLE: Krasovskii’s method

TEXT BOOKS:

REFERENCE BOOKS:
DSP Architecture and Applications (4-0-2)

Sub Code : MCD0503  
CIE : 50% Marks
Hrs/week : 6 Hrs  
SEE : 50% Marks
SEE Hrs : 3 Hrs  
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain the architectural features of DSP processor.
2. Explain the peripherals and interrupt mechanisms.
3. Describe the capability of event managers of DSC.
4. Describe the DSP controller applications for special motors.
5. Explain mathematical modeling of motors by transformations.
6. Discuss different types of pulse width modulation techniques and applications.
7. Use CCS software and DSC for blinking LEDs, waveform generation and motor control.

UNIT 1: Introduction to DSC TMSLF2407, Brief introduction to peripherals. Introduction to the C2xx DSP core and code generation, components of C2xx DSC core, Mapping external devices to C2xx core and peripheral interface, system configuration register memory, memory addressing modes, assembly programming using C2xx DSC instruction set.  
9 Hours

SLE: Types of Physical memory, software tools with reference to DSC.

UNIT 2: General purpose I/O overview, multiplexing and general purpose I/O control register, using general purpose I/O ports. Introduction to interrupts, Interrupt Hierarchy, Interrupt control registers. ADC overview, operation of ADC.  
9 Hours

SLE: initializing & servicing interrupts of DSC.

UNIT 3: Overview of the event manager, event manager interrupts, general purpose timers, compare units, capture units and Quadrature encoded pulse circuitry.  
8 Hours

SLE: PWM generation using DSC.

UNIT 4: Connecting DSP to Buck-Boost converter, principle of Hybrid stepper motor, basic operation, stepper motor drive system, Implementation of stepper motor control system using DSC, Principles of BLDC motor, BLDC motor control system using DSC.  
9 Hours

SLE: DC-DC Buck boost converter structure
UNIT 5: Clarke’s Transformation, Park’s transformation, Transformation between reference frames, Field oriented control transformations.  

9 Hours

SLE: Implementing clarke’s and park’s transformation using DSC.

PMSM control system, Implementation of PMSM system using DSC.  

8 Hours

SLE: Principle of PMSM.

Text book

“DSP – based Electromechanical motion control”, Hamid T Toliyat and Steven G Campbell, CRC PRESS Newyork, Washington D.C

DSP Architecture and Applications – Lab

- C Program for implementation of linear convolution of two given sequences.
- C program to implement difference equation.
- DSP used to generate wave forms.
- Read switches and display using led's on DSP board.
- DC motor control using DSC
- Induction motor control using DSC
Advanced Microcontrollers (4-2-0)

Sub Code : MCD0507  CIE : 50% Marks
Hrs/week : 6 Hrs  SEE : 50% Marks
SEE Hrs : 3 Hrs  Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to :

1. Select a suitable and appropriate microcontroller/ARM for a given application.
2. Explain few microcontrollers architectures
3. Explain interfacing of any peripheral to an ARM or any processor.
4. Apply the knowledge to debug complex embedded systems.
5. Design, develop and deliver solutions to real world problems
6. Familiarize with the latest trends in the processors domain and use it to the present need

UNIT 1 : Familiarization of the features of advanced micro controllers and the development tools. CPU BUS architecture of 8 and 16 bit micro controllers, 8 bit instruction set. Special features study-BROWN OUT RESET circuit, Low Voltage Detect (LVD) circuit, Real Time clock (RTC), Watch dog timer (WDT).

SLE: 16 bit Instruction sets

9 Hours

UNIT 2 : Basic digital Input and output ports. Functions and subroutines. Interrupt subroutines.

SLE: Configuration of GPIOs

8 Hours

UNIT 3 : Timer functions, WatchDog Timer, Serial Communications port interface. ADC interface

SLE: DAC Interface

9 Hours


SLE: Thumb Instructions set

9 Hours

UNIT 5 : ARM architecture support for system development. AMBA. The ARMulator. The ARM debug architecture. ARM Processor cores ARM7 TDMI, ARM8, ARM9TDMI, ARM10TDMI.

SLE: JTAG boundary scan test architecture

8 Hours

UNIT 6: Application interfaces: Generic IOs, Switch debounce, Tri-state, open collector outputs. Direct LED, LCD interfaces. Interfacing of RF Modules to embedded systems. VLSI Blue Tooth Base Band controller

9 Hours
SLE: Motor drive applications

TEXT BOOKS:
2. “The 8086/8088 family design, programming and interfacing” John Uffenbeack, PHI 1st Edition

REFERENCE MATERIALS and DATA SHEETS:
1. INTEL 8051- 8 bit Micro controller Datasheets
2. INTEL 8086- 16 bit processor Datasheets
CMOS VLSI DESIGN (4-2-0)

Sub Code : MCD0508            CIE : 50% Marks
Hrs/week : 6 Hrs               SEE : 50% Marks
SEE Hrs : 3 Hrs                Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Discuss Basic MOS transistor technology and its characteristics.
2. Analyse CMOS process Technology and CMOS digital electronics circuits comprising of logic components and their interconnects.
3. Discuss basic design rules, layout and diagrams.
4. Explain the Basics of Digital CMOS Design and Sequential MOS logic Circuits.
5. Describe Dynamic Logic Circuit techniques used in VLSI technology.

UNIT 1: MOS Transistor theory: n MOS / p MOS transistor, threshold voltage equation, body effect, MOS device design equation, sub threshold region, Channel length modulation. mobility variation, Tunneling, punch through, hot electron effect MOS models.

CMOS inverter, $\beta_n / \beta_p$ ratio, noise margin, static load MOS inverters, differential inverter, transmission gate, tri-state inverter, Bi CMOS inverter. (Text Book.1. Chap.2) 10 hours

SLE: Small signal AC Characteristics

UNIT 2: CMOS Process Technology: Lambda Based Design rules, scaling factor, semiconductor Technology overview, basic CMOS technology, p well / n well / twin well process. Current CMOS enhancement (oxide isolation, LDD. refractory gate). (Text Book.3. Chap.4, 5) 10 hours

SLE: Multilayer inter connect

UNIT 3: Circuit elements, resistor, capacitor, interconnects, sheet resistance & standard unit capacitance concepts delay unit time, inverter delays, driving capacitive loads. 6 hours

SLE: Propagate delays

UNIT 4: MOS mask layer, stick diagram, design rules and layout, symbolic diagram, mask feints, scaling of MOS circuits. (Text Book.3. Chap.4, 5)

Basics of Digital CMOS Design:
Combinational MOS Logic circuits-Introduction, CMOS logic circuits with a MOS load, CMOS logic circuits, complex logic circuits.  

12 hours

SLE: Transmission Gate


8 hours

SLE: CMOS D latch and triggered Flip Flop

UNIT 6: Dynamic Logic Circuits - Introduction, principles of pass transistor circuits, Voltage boot strapping synchronous dynamic circuit techniques, Dynamic. (Text Book.2 Chap.7, 8, 9)  

6 hours

SLE: CMOS circuit techniques.

TEXT BOOK:

Non-Linear Control Systems (4-2-0)

Sub Code   : MCD0509                    CIE     : 50% Marks
Hrs/week   : 6 Hrs                      SEE     : 50% Marks
SEE Hrs    : 3 Hrs                      Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Discuss the fundamental concepts and features unique to non-linear systems.
2. Investigate stability of non-linear systems by phase-plane methods.
3. Apply numerical methods to solve problems of non-linear systems.
5. Construct Liapunov functions and investigate stability of non-linear systems.
6. Discuss the phenomena like circle criterion, DIDF, Lure’s criterion, Popov’s method and disturbance issues in non-linear control systems.

UNIT 1: Introduction, frequency-amplitude dependence, multi-valued responses and jump resonances, sub-harmonic oscillations, frequency entrainment, limit cycles, asynchronous quenching.  
8 Hours

SLE: Inherent and intentional nonlinearities

UNIT 2: Phase-plane analysis of linear and non-linear control systems, singular points construction of phase trajectories- Isocline method, Delta method.  
9 Hours

SLE: Pell’s method

9 Hours

SLE: Adam’s method

UNIT 4 : The describing function method, derivation of describing functions, stability analysis by describing function method.  
9 Hours

SLE: Relative stability from Describing function

9 Hours

SLE: Variable-gradient method

UNIT 6 : Circle criterion, Dual input Describing function, Lure’s criterion and popov’s method, Disturbance issue in nonlinear control.  
8 Hours

SLE: Non smooth nonlinearities
TEXT BOOKS:

3. “Modern Control Engineering”, K.Ogata, 3rd edition, PHI.
Process Control and Instrumentation (4-2-0)

Sub Code : MCD0510
Hrs/week : 6 Hrs
SEE Hrs : 3 Hrs

CIE : 50% Marks
SEE : 50% Marks
Max marks : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Explain process control loop, digital process control and measurement time response.
2. Define the purpose and techniques of analog and digital signal conditioning.
3. Describe different types of sensors.
4. Apply digital control implementation strategies for process control.
5. Explain controllers principle and characteristics.
6. Apply the process control principles to distributed control application.

UNIT 1: Introduction to Process Control: Process control principles, servo mechanism, discrete state control system, process control block diagram, control system evaluation, analog and digital processing, sensor time response. 10 Hours

SLE: Analog data representation

UNIT 2: Analog and Digital Signal Conditioning: Principle of analog signal conditioning, Op-amp circuit in instrumentation, converters, data acquisition systems. 8 Hours

SLE: DAS software salient features.

UNIT 3: Sensors: Resistance-Temperature Detectors, Thermistor, Thermocouple, Capacitive and Inductive sensors, Variable –Reluctance sensors, Level sensors, Strain sensors. 8 Hours
SLE: Optical sensors fundamentals and applications

UNIT 4: Discrete State Process Control: Definition, characteristic of the system, relay controllers and ladder diagrams and PLC’s. 10 Hours

SLE: Ladder diagram notation and implementation for system control

UNIT 5: Controller Principles: Process characteristic, control system parameters, controller modes. 8 Hours

SLE: Principles of Analog controllers and application.

UNIT 6: Digital Control: computers in process control, process control networks, characteristic of digital data.
SLE: Salient features of controller software. 8 Hours

TEXT BOOK:

REFERENCE BOOK:
FACTS Controllers (4-2-0)

Sub Code : MCD0511  
Hrs/week : 6 Hrs  
SEE Hrs : 3 Hrs  
Course outcome

On successful completion of the course, students will be able to:
1. Analyse uncompensated and compensated AC transmission lines.
2. Describe the principle of operation and configuration of FACTS controllers and SVC.
3. Explain the structure, functions and applications of TCSC and GCSC.
4. Explain the structure, functions and applications of STATCOM.
5. Explain the structure, functions and applications of SSSC.
6. Explain the structure, functions and applications of combined FACTS controllers viz., UPFC and IPFC.

UNIT 1: AC Transmission line and reactive power compensation: Basics of power transmission networks, Control of power flow in AC transmission line, Analysis of uncompensated AC line, Passive power compensation, Objectives of series compensation, Compensation by a series capacitor connected at the mid point of the line, Objectives of shunt compensation, Shunt compensation connected at the mid point of the line.  

UNIT 2: Introduction to Flexible AC Transmission systems: Advances in Power-Electronics switching devices, Principles and applications of Semiconductor switches, FACTS – terms and definitions, Applications of FACTS controllers.

UNIT 3: Thyristor and GTO Controlled Series Capacitor: Introduction, Basic concepts of controlled series compensation, Operation of TCSC, Analysis of TCSC, Applications of TCSC.
UNIT 4: Static Synchronous Compensator (STATCOM) : Principle of operation of STATCOM, Control characteristics of STATCOM, Simplified analysis of a three phase six pulse STATCOM, Applications of STATCOM.  
9 Hours

SLE: Comparison between STATCOM and SVC

UNIT 5: Static Synchronous Series Capacitor (SSSC) : Introduction, Operation of SSSC and the control of power flow, Comparison between variable series compensation and SSSC, Power flow control characteristics, Applications of SSSC.  
9 Hours

SLE: Control scheme for SSSC

UNIT 6: Unified Power Flow Controller (UPFC): Introduction, Operation of UPFC, UPFC connected at sending end, midpoint and receiving end of transmission line, Applications of UPFC, Interline power flow controller (IPFC).  
8 Hours

SLE: Control scheme for UPFC.

TEXT BOOKS:


REFERENCE BOOKS:

Automotive Electronics (4-2-0)

Sub Code    : MCD0512                   CIE    : 50% Marks
Hrs/week    : 6 Hrs                   SEE    : 50% Marks
SEE Hrs     : 3 Hrs                   Max marks : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Analyse electrical and electronic systems and overall architecture in automobiles.
2. Discuss electronic engineering technologies like Networking, Architecture of electronic systems & Control Units in vehicles.
3. Describe automotive sensors classification, requirements & trends.
4. Explain sensor measuring principles & its applications.
5. Discuss different types of sensors.
6. Explain the role of sensors and actuators for the design of Self-Managing Automotive Systems.

UNIT 1: Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, Electronic diesel control, Lighting technology, Electronic stability program, Adaptive cruise control. 8 hours

SLE: Study of occupant-protection systems

UNIT 2: Networking and bus systems: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, Coupling of networks, Examples of networked vehicles.

Architecture of electronic systems & Control Units: Overview, Vehicle system architecture. Control units: Operating conditions, Design, Data processing, Digital modules in the control unit. 8 hours

SLE: Advances in control unit software

UNIT 3: Automotive sensors: Basics and overview, Automotive applications, Sensor market, Features of vehicle sensors, Sensor classification, Error types and tolerance requirements, Reliability, Main requirements & trends, Physical effects for sensors, Selection of sensor technologies. 10 hours

SLE: Study of the design of Anti-lock braking system (ABS System)
UNIT 4: Sensor measuring principles: Sensors for the measurement of position, speed, rpm, acceleration, pressure, force, and torque, Flow meters, Gas sensors and concentration sensors, temperature sensors. 

SLE: Working of piezoelectric knock sensors


SLE: Principles of Connected car technology

UNIT 6: Actuators: Electromechanical & fluid mechanical actuators, Electrical machines

Hybrid drives: Drive concepts, Operating strategies for electric hybrid vehicles, Recuperative brake system, Electrical energy accumulators.

Symbols and circuit diagrams: Circuit symbols & circuit diagrams, Designations for electrical devices, Terminal designations.

SLE: Fuel Cell working and application.

Text Book:


REFERENCE BOOKS:

Applied Engineering Mathematics (4-0-0)

Sub Code : AEM0401
Hrs/Week : 04
SEE Hrs : 03
Total : 52 hrs

CIE : 50% Marks
SEE : 50% Marks
Max. : 100 Marks

Objective: Mathematics course content is designed to cater to the needs of several subjects at the PG level.

Course outcomes

1. Obtain the extremals of functions expressed in the form of integrals and solve standard variational problems.
2. Solve linear homogeneous partial differential equations with constant coefficients.
3. Obtain the numerical solution of a partial differential equation.
4. Optimize the function under some constraints by different methods.
5. Establish the homomorphism between vector spaces using Linear transform and obtain orthonormal basis for a vector space using inner product space.
6. Evaluate complex line integrals.

Unit-I: Calculus of Variation

Variation of a function and a functional. Extremal of a functional, variation problems, Euler’s equation, Standard variational problems including geodesics, minimal surface of revolution,

(SLE: hanging chain problem), Brachistochrone problems, Isoperimetric problems. Functionals of second order derivatives

- 9Hrs

Unit-II: Partial Differential Equations - I

Solution of linear homogeneous PDE with constant and variable coefficients.(SLE : Cauchy’s type partial differential equation)

- 9 Hrs

Unit-III: Partial Differential Equations - II


- 8 Hrs

Unit-IV: Linear Programming


- 9Hrs
**Unit-V:**  
**Linear Algebra**


Linear transformations, Kernel, Range. Matrix of linear transformation, Inverse linear transformation (SLE: Applications).  

- 9 Hrs

**Unit-VI:**  
**Complex Integration**

Basic concepts of analytical functions, Complex line integral, Cauchy’s theorem, Cauchy’s integral formula. Laurent series expansion (SLE: Problems on Laurent series expansion), poles and residues, Cauchy’s residues theorem.  

- 8 Hrs

**Books for Reference:**

Power Electronics Applications to Drives (4-2-0)

Sub Code : MCD0504
Hrs/week : 6 Hrs
SEE Hrs : 3 Hrs

CIE : 50% Marks
SEE : 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Explain the functions and applications of linear regulators and switched mode power supplies.
2. Describe the functioning of SMPS converter circuit topologies.
3. Use choppers and converters for DC drive control.
4. Explain the working of voltage source inverters, current source inverters, cycloconverters and load commutated inverter.
5. Use inverters for the control of AC motors.
6. Explain the concept of vector control for controlling AC motors.

UNIT 1: Power Supply Systems: Introduction, linear regulators, functional circuit blocks of an “OFF-LINE” switcher, the front end rectifier, minimization of input line current harmonics. 8 Hours

SLE: construction of high frequency transformers.

UNIT 2: SMPS converter circuit topologies: the “Buck” or “Forward converter”, the “Boost converter” and the “Buck-Boost converters” – the flyback mode, half bridge and full bridge inverter topologies for SMPS. The Cuk Converter, Resonant Converters. 9 Hours

SLE: Controllers for SMPS, uninterruptible power supply systems (UPS)

UNIT 3: Adjustable Speed DC Motor Drives: Introduction, Speed Control of a separately Excited DC Motor. Chopper Controlled DC Motor Drives, DC Motor Using Phase Controlled Thyristor Converters, Phase Controlled Dual Converter, Control of Series Motors. 9 Hours

SLE: DC Motor Basics, equations for Torque and Induced EMF, saturation curve, method of exciting the field of a DC Motor.

UNIT 4: Adjustable Speed AC Motor Drives I: Voltage source inverters, current source and current regulated types of inverters, the phase controlled cycloconverter, load commutated inverter. 9 Hours

SLE: 3 phase cycloconverters.

UNIT 5: Adjustable speed AC motor drives II: Adjustable speed drives using the cage type induction motor, adjustable speed drives using the wound rotor induction motor.
SLE: adjustable speed drives using synchronous motor.

UNIT 6: Vector Control of AC motor drives: Equations for the electromagnetic torque in an IM using space vectors, vector control strategy for an IM. Field oriented frame of reference, acquisition of the rotor flux linkage vector, example of a complete vector scheme for an IM, vector control of SM drives.

SLE: Space vectors, voltage equations for an IM using space vectors.

TEXT BOOK:


REFERENCE BOOKS:

Microcomputer Control of Electric Drives (4-0-2)

Sub Code : MCD0505
Hrs/week : 6 Hrs
SEE Hrs    : 3 Hrs

CIE : 50% Marks
SEE : 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Concept of development of microcomputer control of drives.
2. Explain the architectural features of micro computers and digital implementation of drives control.
3. Discuss different types of compensators, digital firing schemes for power electronic devices.
4. Discuss micro controllers and micro computers for the control of AC/DC drives.
5. Explain the variable speed drive systems
6. Implement micro computers for the control of conventional and special machines.
7. Simulate/Use power electronic devices for control of drives.

UNIT 1 : Merits and demerits of Microcomputer Control of Electric Drives, Simplified sequence control diagram, Control system design stages, Computer loading factor, simplified structure of software and task timing diagram , Digital implementation of PI Compensator , Lag-Lead Compensator, Static Slip recovery scheme.

10 Hours

SLE: Classical methods for variable speed operation of drives.

UNIT 2 : The Microcomputers adopted for control of electrical drives, relative features and architecture, Review of power converters useful for DC and AC drives, Current speed sensing, Zero crossing detector, Position sensing circuits required for microprocessor based control.

8 Hours

SLE: Factors affecting the bit size of the micro controllers.

UNIT 3: Different types of Digital firing schemes for converters, Chopper and Inverter circuits, DC drive control, Induction motor drive control, Variable frequency synchronous motor drives.

8 Hours

SLE: Factors affecting selection of converters, duty cycle, solid state electric braking

UNIT 4: Microcomputer control of converter-fed DC motor drives ( Digital Leonard control system), Automatic current regulating loop , automatic speed regulating loop and over all algorithm, Basic principle of vector control of Induction motors, phasor diagram and digital block diagram, microcomputer control of vector control of Induction motor.

10 Hours

SLE: Conventional Static Leonard control systems
UNIT 5: Optimal efficiency drive of Induction motor with VIF control, Microcomputer control of current source fed synchronous motor drive, digital firing circuit, optical encoder, four quadrant operation of synchronous motor drive. 8 Hours

SLE: Comparison of Voltage Source Inverter and Current Source Inverters.

UNIT 6: Microcomputer of control of sensor less brush less motor drive control, vector control of synchronous motor drives. Microcomputer control of switched reluctance motors. 8 Hours

SLE: Indirect vector control of Drives

TEXT BOOKS:

REFERENCE BOOKS:

Microcomputer Control of Electric Drives – Lab
- P-sim simulation of rectifiers
- P-sim simulation of inverters
- Induction motor drive control using Triac
- Stepper motor control using PLC
- Induction motor control using PLC
Embedded Systems (4-0-2)

Sub Code : MCD0506  
CIE : 50% Marks  
Hrs/week : 6 Hrs  
SEE : 50% Marks  
SEE Hrs : 3 Hrs  
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Describe the functional blocks of a typical embedded system.
2. Describe the fundamental issues involved in hardware, software co-designs, embedded hardware and firmware, design and development approaches.
3. Familiarize the fundamentals of real time operating systems.
4. Utilize the IDE to debug firmware/software and solve simple problems on embedded systems.
5. Independently write simple firmware programs and demonstrate its functions.
6. Familiarize with the latest trends in ES domain and use it to the present need.

9 Hours

SLE: Other system components

8 Hours

SLE: Combinatorial and sequential logic

UNIT 3: Embedded Firmware Design and Development: Super loop and OS based approaches. Mixing Assembly and C. Basic Key words and operators. Macros and Directives. ISR, Dynamic Memory allocations.  
9 Hours

SLE: Recursive and reentrant functions

9 Hours

SLE: EDLC Approaches, EDLC Models

8 Hours
SLE: Device Drivers, How to Choose an RTOS


9 Hours

SLE: Types of Files Generated on Cross-compilation

TEXT BOOKS:


Embedded Systems LAB

1. Familiarisation of the KEIL micro vision and its control panels
2. Working of GPIOs, Timers, PWM functions,
3. Working of relays, key matrix and buzzer
4. Working of LCD and 7 segment LEDs
5. Working of ADC and DAC
6. DC motor interface
7. Stepper motor interface
8. Traffic lights interface
9. Elevator interface
High -Frequency Switching Power Supplies (4-0-0)

Sub Code  : MCD0403
Hrs/week  : 4 Hrs
SEE Hrs   : 3 Hrs

CIE              : 50% Marks
SEE              : 50% Marks
Max marks        : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Analyse different types of power converters used in SMPS.
2. Describe base drive circuits and protection circuits of power transistors and power MOSFET.
3. Design a high frequency power transformer and discuss power rectifier’s characteristics.
4. Design power inductor, magnetic amplifier reactor, filter capacitor and explain the working of synchronous rectifiers, PWM systems
5. Describe self bias techniques, protection circuits.
6. Analyse stability in SMPS, interference and safety standards.

UNIT 1: The Switching Power Supply : An overview, Push-Pull converter, Circuit variations of the Push-Pull converter, The full-Bridge circuit, ripple converter, Ringing choke converter, Sheppard-Taylor converter, Current- mode regulator converter.  8 Hours

SLE: Circuit analysis and design procedure of Ward converter

UNIT 2: Bipolar power transistor used as a switch, Inductive load switching relationships, Transistor antisaturation circuits, Base drive circuit techniques for bipolar transistors, Bipolar Transistor Secondary breakdown considerations, switching transistor protective networks, power MOSFET used as a switch, Gate drive consideration of the MOSFET, Design consideration of driving MOSFETs, Power MOSFET switch protection circuits  9 Hours

SLE: GTO switch , GATE drive requirements of the GTO.

UNIT 3: Core material and Geometry selection, Design of a power transformer, practical consideration, transformer choke design, Output rectification and Filtering schemes, power rectifier characteristics in switching power supplies design  9 Hours

SLE: Rectifier diode capability for the flyback, forward, and push-pull converters.

UNIT 4: Synchronous rectifiers, output power inductor design, Design of magnetic amplifier saturable reactor, control circuits for magnetic amplifiers, design of output filter capacitor, isolation techniques of switching regulator systems, PWM systems.  9 Hours

SLE: UC1838 Magnetic amplifier controller

UNIT 5: Optical coupler, Self-Bias technique used in primary side reference power supplies,
Opto-couplers circuit design, soft start in switching power supply design, current limit circuits, Overvoltage protection circuits.  

SLE: AC line loss detectors  

UNIT 6: Switching power supply stability, Stability analysis and synthesis using K factor, RFI sources in switching power supplies, AC input line filter for RFI Suppression, Power supply construction requirements for safety, power supply transformer construction for safety.  

SLE: Loop stability measurements, noise specifications  

TEXT BOOK:  

“HIGH-FREQUENCY SWITCHING POWER SUPPLIES: THEORY AND DESIGN” by GEORGE CHRYSSIS second edition, McGRAW-HILL.
Adaptive Control (4-0-0)

Sub Code : MCD0404  
Hrs/week : 4 Hrs  
SEE Hrs : 3 Hrs  
CIE : 50% Marks  
SEE : 50% Marks  
Max marks : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Define adaptive control problem and describe parameter estimation techniques for adaptive controllers.
2. Explain the concept of deterministic self tuning regulators.
3. Discuss the model reference adaptive systems.
4. Explain stochastic adaptive control strategies for non linear applications.
5. Explain the methods of relay feedback and oscillations for auto tuning.
6. Use design techniques and non linear transformations for gain scheduling.

UNIT 1 : Adaptive Control : Introduction, linear feedback, effects of process variations, adaptive schemes, the adaptive control problem, applications.

SLE: Simulation of Recursive Estimation.  

SLE: Deterministic self tuning regulator with disturbances of known characteristics.  

SLE: Relations between MRAS and STR and Nonlinear systems.

SLE: Averaging in stochastic systems and Robust adaptive controllers.

Auto-tuning: Introduction, PID control, Auto-tuning techniques, Transient response methods.  
SLE: Auto-tuning methods based on relay feedback and relay oscillations.

9 Hours

SLE: Applications of gain scheduling.

MEMS and Microsystems (4-0-0)

Sub Code : MCD0405  
Hrs/week : 4 Hrs  
SEE Hrs : 3 Hrs  

CIE : 50% Marks  
SEE : 50% Marks  
Max marks : 100  

Course Outcomes

On successful completion of the course, students will be able to:

1. Discuss the overview of MEMS and Microsystems.
2. Explain the working principles of Microsystems.
3. Explain Microsystems design and fabrication.
4. Formulate the underlying scaling laws and general guidelines for miniaturization and design MEMS and Microsystems.
5. Analyse the materials for MEMS and Microsystems.
6. Evaluate the principles and processes involved in Microsystem Fabrication and Micro Manufacturing.

UNIT 1: Overview of MEMS & Microsystems: MEMS and Microsystems, Typical MEMS and Microsystem products, Evolution of Microfabrication, Microsystems and Microelectronics, the Multidisciplinary Nature of Microsystem Design and Manufacture, Microsystems and Miniaturization, markets for Microsystems.  

SLE: Applications of Microsystems in automotive and other industries  


SLE: Study of Microfluidics  

UNIT 3: Microsystem design and fabrication: introduction, Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of semiconductors, the Diffusion Process, Plasma Physics, Electrochemistry.  

SLE: Quantum physics  

UNIT 4: Scaling law in miniaturization: introduction to scaling, scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling in electromagnetic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer.  

SLE: Advanced Scaling methods
UNIT 5: Materials for MEMS and Microsystems: introduction, Substrate and wafers, Active substrate Materials, Silicon as substrate materials, silicon compounds, silicon Piezoresistors, Gallium arsenide, Quarts, Piezoelectric crystals, packaging materials. 9 hours
SLE: Polymers materials for MEMS and Microsystems

UNIT 6: Overview of Microsystem Fabrication Processes and micromanufacturing: introduction, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical vapour deposition-sputtering, Deposition by Epitaxy, Etching.

SLE: Advanced Microsystems Fabrication Processes 9 hours

Text Book:
1. ‘MEMS and Microsystems’, Tai Ran Hsu: TMH 2002
Programmable Logic Controllers (4-0-0)

Sub Code : MCD0406
Hrs/week : 4 Hrs
SEE Hrs : 3 Hrs

CIE : 50% Marks
SEE : 50% Marks
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Describe architecture and hardware of PLC.
2. Explain the interface for a variety of input and output devices for PLC.
3. Identify the programming constructs using ladder diagram, Instruction list, Sequential function charts (SFC), Structured text.
4. Analyse the ladder diagram for Timers, counters, sequencers for some closed end academic programming exercises.
5. Apply PLC for solving control problems involving classical PID control strategies.
6. Demonstrate PLC application for process control and distributed control problems.

UNIT 1 : Programming logic controller hardware and internal architecture, PLC systems Basic configuration and development, programming of PLC Hand-held programming, desktop and PC configurated system, I/O devices, mechanical switches, proximity switches, photoelectric sensors and switches, temperature sensors, position sensors, pressure sensors, smart sensors.

SLE: Interface of encoder device to PLC

UNIT 2 : Output devices, Relay, directional control valves, control of single and double acting cylinder control, DC motor, stepper motor, conveyors control, I/O processing-signal conditioning, remote connections, networks, processing inputs, programming features.

SLE: Serial and Parallel communication standards

UNIT 3 : Ladder programming, ladder diagrams, logic functions, latching multiple outputs, entering programs, function blocks, programming with examples, instruction list(IL), sequential function charts(SFC), structured text example with programs.

SLE: Implementation of different programming languages to practical systems.

UNIT 4 : Ladder program development examples with jump and call subroutines, timers, programming timers, off-delay timers, pulse timers, counters, forms of counter, up and down counting, timer with counters, programming with examples.

SLE: Sequencers
UNIT 5: Data handling, Registers and bits, data movement, moving number to timer, data comparison, sequential switching on arithmetic and BCD, PLC for closed loop control, PID control with PLC, examples with programs.  

SLE: Alarm program

UNIT 6: Designing systems, program development, safe systems, commissioning, fault finding, system documentation and examples with programs, development of temperature control, valve sequencing, conveyor belt control.

SLE: Bottle packing using PLC systems

TEXT BOOKS:

2. “Programmable logic controllers principle and application” ,John W Webb, Ronald Reis, Pearson publication.
Artificial Neural Networks and its Applications (4-0-0)

Sub Code : MCD0407  
Hrs/week : 4 Hrs  
SEE Hrs : 3 Hrs  

CIE : 50% Marks  
SEE : 50% Marks  
Max marks : 100

Course Outcomes

On successful completion of the course, students will be able to:

1. Define the properties of artificial neuron models.
2. Discuss multi layer feed forward neural networks.
3. Discuss training & learning in feed forward networks.
4. Explain symmetrical, asymmetrical and self organizing networks.
5. Analyse hybrid neural network models.
6. Apply the knowledge to solve real world problems.

SLE: General features of perceptrons  
10 Hours

UNIT 2 : Multilayer Networks: Exact and approximate representation using Feedforward networks, Fixed multilayer Feedforward network training by backpropogation, structural training of multilayer feedforward networks, unsupervised and reinforcement learning, the probabilistic neural network.  
SLE: Applications of multi layer networks for the systems.  
9 Hours

UNIT 3: Complexity of Learning Using Feed Forward Networks: Learnability in ANN, generalisability of learning, Space complexity of Feed forward networks.  
SLE: Types of learning techniques in ANN  
7 Hours

UNIT 4: Symmetric and Asymmetric Recurrent Network: Symmetric Hopfield networks and associative Memory, Symmetric Networks with Analog units, Seeking the global Minimum, A learning Algorithm for the Boltzmann Machine  
SLE: Asymmetric Recurrent Networks.  
9 Hours

UNIT 5: Competitive Learning and Self-Organizing Networks: Unsupervised Competitive Learning, Adaptive resonant Networks, Self-organizing Feature Maps, Hybrid Learning.  
SLE: Comparison of supervised and unsupervised learning.  
9 Hours
UNIT 6: Applications of Neural Networks: Neural Network Approaches to Solving Hard problems.

SLE: Character recognition using ANN

TEXT BOOK:

REFERENCE BOOKS:
REAL TIME OPERATING SYSTEMS (4-0-0)

Sub Code : MCD0408  
CIE : 50% Marks
Hrs/week : 4 Hrs  
SEE : 50% Marks
SEE Hrs : 3 Hrs  
Max marks : 100

Course Outcomes
On successful completion of the course, students will be able to:

1. Explain embedded system and its resources.
2. Discuss priority policies, I/O resources and memory systems.
3. Describe different muti-resource services.
4. Analyse different debugging components.
5. Discuss different performance tuning concepts.
6. Explain reliability issues of Embedded systems.

9 Hours

SLE: Thread Safe Reentrant Functions.

UNIT 2: Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies.
Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory.  
8 Hours

SLE: Flash file systems

UNIT 3: Multi-resource Services: Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion.
Soft Real-Time Services: QoS, Alternatives to rate monotonic policy, Mixed hard and soft realtime services.  
9 Hours

SLE: Missed Deadlines.

UNIT 4: Embedded System Components: Firmware components, RTOS system software mechanisms, Software application components.
10 Hours
SLE: Application-level debugging.

UNIT 5: Performance Tuning: Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency. 8 Hours

SLE: Fundamental optimizations.

UNIT 6: High availability and Reliability Design: Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Hierarchical applications for Fail-safe design. 8 Hours

SLE: Design tradeoffs.

TEXT BOOK:
Design of Control Systems (4-0-0)

Sub Code : MCD0409  
Hrs/week : 4 Hrs  
SEE Hrs : 3 Hrs

Course Outcomes
On successful completion of the course, students will be able to:

1. Review of time domain and frequency domain response specifications.
2. Recall the modeling of system controllers and configurations.
3. Apply the system concepts and performance requirements for the design of compensators.
4. Apply root locus and Bode diagram techniques for the design of controllers and interpret the performance of the systems.
5. Discuss Ziegler-Nichols methods of tuning controllers.
6. Discuss Robust control systems and apply the methods for Robust controller design.

UNIT 1: Review of time response analysis, Performance indices, Approximation of high-order systems by lower-order systems, Time domain and frequency domain specifications.  
8 Hours

SLE: Sketching of Root-locus and Bode plots for different systems and interpretation of stability.

UNIT 2: Approaches to system design, Cascade compensation networks, Introduction to compensators, Design of Lead, Lag and Lag-lead compensators using Root-locus diagram.  
9 Hours

SLE: compensators design sanity check with computer aided control system design packages.

UNIT 3: Design of Lead- Lag and Lag-lead compensators using Bode diagrams, System design on the Bode diagram using Analytical and Computer methods.  
9 Hours

SLE: Design for dead beat response, Realization of compensators.

UNIT 4: Design of P, PI and PID controllers using the Root-locus diagrams, PI and PID synthesis by pole placement  
9 Hours

SLE: computer simulation for PID Controllers and state variable feedback controllers.

UNIT 5: Ziegler-Nichols and Cohen-Coon turning of PID controllers by using the reaction curves, Active realization of PID controllers.  
8 Hours

SLE: Modifications of PID control schemes.

UNIT 6: Introduction to Robust control systems, Analysis of robustness, Design of robust control systems.  
9 Hours
SLE: Design of robust PID controlled systems

TEXT BOOKS:

REFERENCE BOOKS:
SEMINAR (2 credits)

Sub Code : MCD0201                      CIE : 50 Marks

Course Outcomes

On successful completion of the course, students will be able to:

1: Identify the topic of relevance within the discipline.
2: Describe the technical aspects of the topic and demonstrate the feasibility of the scheme.
3: Present and Document the study

INDUSTRIAL TRAINING (4 credits)

Sub Code : MCD0402                      CIE : 50 Marks

Course Outcomes

On successful completion of the course, students will be able to:

1: Connect the theory with hands on experience
2: Exposure to industrial atmosphere and work culture
3: Present and Document the training experience

PRELIMINARY PROJECT WORK (8 Credits)

Sub Code : MCD0801                      CIE : 50 Marks

Course Outcomes

On successful completion of the course, students will be able to:

1: Identify and Analyse the real world problems
2: Carry out literature survey
3: Define the problem and plan for the execution
FINAL PROJECT WORK (28 credits)

Sub Code : MCD2801
CIE : 50 Marks

Course Outcomes

On successful completion of the course, students will be able to:

1: Apply the knowledge acquired in the program to solve the problems
2: Harness the modern tools
3: Model, simulate and interpret results
4: Build hardware prototypes and validate