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RAICHUR UNIVERSITY

SYLLABUS
For
M.Sc. ELECTRONICS AND INSTRUMENTATION

I, II, III & IV Semesters

(Under CBCS & CGPA with effect from 2023-24 and onwards)

Department of Studies and Research in
INSTRUMENTATION TECHNOLOGY
Raichur University, Krishna Tunga campus, Yeragera - 584 133, RAICHUR
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Course Outline & Syllabus for Master of Science (M.Sc.) Electronics & Instrumentation under CBCS & CGPA

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
First		**Hard Core**							
	HCT 1.1	Analog and Digital Electronics	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 1.2	Fundamentals of Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 1.3	Control Systems and MATLAB	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Soft Core (Any One)							
	SCT 1.1	(a) Microcontrollers and Applications (b) MATLAB & Applications	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Practical							
	HCP 1.1	Analog and Digital Electronics Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 1.2	Transducers and Signal Conditioners Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 1.3	Analysis of Control Systems using MATLAB	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Soft Core (Any One)							
	SCP 1.1	(a) Microcontrollers Lab (b) MATLAB Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Mandatory skills							
		Communication Skills	-	-	-	-	-	-	**2**
		Total for First Semester	**480**	**120**	**600**	**16**	**0**	**8**	**26**

I – SEMESTER

Course HCT 1.1: ANALOG AND DIGITAL ELECTRONICS

Teaching hours per week: 4 Total Hours: 64

Preamble:

A well-designed power supply is essential for any electronic circuit for proper functioning. Hence, this paper deals with the design and working of various power supplies and their individual sections. The paper also describes the basics of op-amps and their applications. The fundamentals of Digital electronics and various Digital devices and their operations are discussed. The units I and II are devoted for Analog electronics and units III and IV are devoted for Digital electronics.

UNIT I: Power Supplies and Regulation 16 Hrs

Block diagram of DC power supply. Rectifiers: Half - wave, Full – wave and Bridge. Filters: RC, LC, Π- sections. Voltage multipliers, DC voltage regulation: Zener, Discrete Component regulators and LM723 regulator. Three pin regulators. Switch Mode Power Supplies (SMPS). AC voltage regulation: Step voltage regulation and Servo voltage regulation. Invertors: Low tension DC to High tension AC or DC. Introduction to battery charger circuits – Battery Management systems and Applications. Noise signal in power supply and its elimination techniques.

UNIT II: Analysis of Operational Amplifiers 16 Hrs

Introduction to operational amplifiers (Op-Amps). Characteristics of ideal and practical operational amplifiers: Basic BJT differential amplifiers, Constant current source, Active load, Current mirror, Circuit details of typical operational amplifier circuits (μA741). Op- Amp-configurations, Mathematical operations, Solutions of second order differential equations, Wave form generation, Wein-bridge oscillator and multivibrators, Precision rectifiers and Instrumentation amplifier. Nano ampere – ultralow signal recovery techniques.

UNIT III: Digital Electronics 16 Hrs

Number systems and codes, Logic gates and Boolean algebra, Combinational logic circuits, Flip-Flops, Digital arithmetic operations – Half adder/subtractor, Full adder/subtractor, parallel adder/subtractor, BCD adder, Excess-3 adder/subtractor and circuits. Karnaugh Maps for simplification of logic circuits. Code converters, Encoders and Decoders. Multiplexers and Demultiplexers.

UNIT IV: Counters and Shift Registers 16 Hrs

Counters: Asynchronous (ripple) counter, counters with MOD numbers, IC Asynchronous counter, asynchronous down counters, propagation delay in ripple counters, synchronous (parallel) counters, synchronous down and up/down counters, Presettable counters, decoding a counter, decoding and latches, cascading BCD counters, Synchronous counter design. Registers: Serial-In serial-out, serial - in parallel out, parallel - in serial - out, parallel – in parallel out, shift registers. TTL logic family, TTL gates. Circuit design and analysis using simulators.

BOOKS FOR STUDY:

1. Linear Integrated Circuits – Sanjay Sharma
2. Linear Integrated Circuits - D Roy Choudhary & Shail Jain
3. Operational Amplifiers & linear Integrated circuits – Raviraj & Mohan Dudeja
4. Operational Amplifiers-Ramakant Gayakwad
5. Digital Systems –Principles & Applications –Ronaldo J Tocci & Meal S. Widmer
6. Digital Principles –Malvino & Leach
7. Fundamentals of Digital Circuits – A. Anandkumar

BOOKS FOR REFERENCE:

1. Operational Amplifiers and Characteristic- Robert G Irvine
2. Op-Amp and Linear Integrated Circuits – Robert F Caughlin

OUTCOME OF THE COURSE:

1. The Candidate understands the basic principles of analog and digital electronic devices, various circuits/systems and applications.

2. After studying this paper, the student can be able to design, analyse and fabricate various Analog and Digital Systems.

Course HCT 1.2: FUNDAMENTALS OF INSTRUMENTATION

Teaching hours per week: 4 Total Hours: 64

Preamble:

This paper deals with the fundamentals of instruments. Basics of instruments and their classification, characteristics are dealt. Transducers, signal conditioners and recorders with their features, working principle, advantages, limitations and applications are covered in this paper.

UNIT I: Instruments and their Classification 16 Hrs

Functional elements of Instrumentation and measuring systems, Typical Applications of instrument systems. Classification of instruments. Standards and calibrations. Microprocessor/PC based Instruments. Introduction to errors and uncertainties in the measurement. Propagation of uncertainties in compound quantities. Static Characteristics of Instrument. Specifications and selection of an instrument.

Unit 2- Transducers/ Sensors 16 Hrs

Analog Transducers: Resistive, Inductive, Capacitive, Piezoelectric transducers, Strain Gauges, Displacement transducer, Opto – electrical transducers. Digital Transducers. Microsensors – Silicon Microsensors, Smart sensors.

Unit 3 – Signal Conditioners 16 Hrs

Amplifiers: chopper stabilized DC amplifier, Isolation amplifier and Lock-in amplifier. Active filters – Low-pass, high-pass, band-pass, band-rejection and Second order Butterworth filter. Peak detector. Sample and hold circuit. Phase sensitive detector. A/D and D/A converters. Ultra-low level signal amplification.

Unit 4 – Recorders 16 Hrs

Digital voltmeter, CRO, Galvanometric recorder, Servo type of potentiometric recorder, Magnetic tape recorder, Digital recorders of memory type, electronic display devices: LED, LCD. Digital display: Dot matrix and Segmental display. Applications: Temperature and Humidity measurement systems. Systems design using simulators.

BOOKS FOR STUDY:

1. Instrumentation measurement & analysis –Nakra /Choudhary
2. Instrumentation devices & systems –Rangan, Mani, Sharma
3. A Course in mechanical measurements & instrumentation – A. K. Sawhney
4. Sensors and transducers – B. Patranabis

BOOKS FOR REFERENCE:

1. Measurement of systems—Application and design—Earnest O. Doeblin
2. Electronic instrumentation and measurement technique—W. D. Cooper & A. D. Helfrick.
3. Mechanical measurements – Beckwith, Marangoni.

OUTCOME OF THE COURSE:

1. The Candidate understands the Functional elements of an Instrument and types of Instruments also their characteristics.
2. Students will be able to appreciate the importance of static characteristics in designing/ selecting any instrument.
3. The students will be able to design and construct an Instrument to measure the parameters like Temperature, Pressure etc.…

Course HCT 1.3: CONTROL SYSTEMS AND MATLAB

Teaching hours per week: 4 Total Hours: 64

Preamble:

One of the important features of any instrument is to control the parameter. Hence, in this paper, the study of various control systems and transfer function approach or classical control theory for control system in time domain and frequency domain are dealt. Analysis of stability of a system by using RH criterion/ root locus in time domain and by using Bode plot/ Nyquist plot in frequency domain are covered. Study of MATLAB & Programming and application of MATLAB systems are dealt in detail in the last unit.

UNIT I: Introduction to Control Systems and Mathematical Modeling 16 Hrs

Control System: Open-loop and Closed-loop, Feedback and its effects, Mathematical Modeling - Differential Equation Approach to the Electrical systems, Mechanical system. Definition of Transfer function, Transfer function Approach to Physical System (Armature Controlled and field-controlled DC servo motor), Block Diagram Algebra. Signal flow-graphs.

UNIT II: Time Response Analysis, Stability Criterion and Root Locus Techniques 16 Hrs

Standard Test Signals, Time Response of first and second order systems. Design Specifications or Performance Indices of second order system. Static error coefficients. Concept of Stability. Routh-Hurwitz stability Criterion. Relative stability Analysis. Roots-Locus: Rules for construction, Root contours.

UNIT III: Frequency Response Analysis and Stability Criteria 16 Hrs

Introduction, Frequency response of first and second order systems, Correlation between time and frequency responses. Polar plots, Bode plots. Experimental determination of transfer functions from Bode plots. Nyquist stability criterion, Nyquist plots, Gain Margin (GM) and Phase Margin (PM). Concept of state variables and state models.

UNIT IV: MATLAB for Control systems 16 Hrs

MATLAB: Schematic diagram of MATLAB, MATLAB Toolboxes, MATLAB Windows, Common system commands and mathematical operations, Handling of Matrices, Writing the MATLAB programs for the analysis of control systems using Tool Boxes.

BOOKS FOR STUDY:

1. Control Systems Engineering – Nagrath. I. J. & Gopal M.
2. Automatic Control Systems- Benjamin C. Kuo
3. Modern Control System Engineering – K. Ogata
4. MATLAB for control systems – Dukkipat Rao

BOOKS FOR REFERENCE:

1. Feedback Control System Analysis & Design – D Azz, J. J. and Houpis C.H.
2. Control System Design – Savant C. J.
3. Basic Automatic Control Theory – Murphy G. J.

OUTCOME OF THE COURSE:

1. Able to do mathematical Modelling of Physical Systems.
2. Students will have the knowledge and skills to define control system, feedback control system and the importance of performance, characteristics/stability criteria in control system designing both in Time/Frequency domain.
3. Students will appreciate the importance of MATLAB Toolboxes in analysing control system Applications

Course SCT 1.1(a): MICROCONTROLLERS AND APPLICATIONS

Teaching hours per week: 4 Total Hours: 64

Preamble:

Microcontroller plays an important role in Instrumentation. Incorporation of microcontroller makes the system intelligent. Hence, this paper deals with the Architecture/ Instruction set/ Programming/ Interfacing of 8051 and PIC microcontrollers. Typical applications of 8051 and PIC microcontrollers are also dealt in the last unit.

UNIT I: 8051 Microcontroller Architecture 16 Hrs

Block diagram of 8051 microcontroller, Description of functional units of microcontroller, addressing modes, Classification of instructions set and programming, Comparative study of 8051 with 8031, 8751 and 89C51.

UNIT II: Interfacing of Peripherals 16 Hrs

Interfacing of memory (RAM & EPROM), Programmable peripherals 8155, 8755 and their interfacing, Interfacing of A/D & D/A converters. Interfacing of seven segment display, Multiplexed display, LCD module, Stepper motor with 8051 microcontroller.

UNIT III: Atmel Microcontroller Architecture, Programming and Interfacing 16 Hrs

Atmel architecture, instruction set, addressing modes, memory organization, ports, timers and counters, Interrupt controller, PWM, UART, USART, SPI, I2C, ADC, DAC, Watchdog timer, EEPROM, Comparator, USB, CAN, LCD controller, Ethernet controller, Programming of ATMEL microcontroller. Interfacing of LCD display, Ultrasonic sensor and generation of PWM waveform.

UNIT IV: Applications of Microcontroller for Measurement and Control 16 Hrs

Role of microcontroller in instrumentation, Application of microcontroller 8051 for measurement of frequency and time period of TTL signal. Measurement of thickness of an object through LVDT. Design and development of 8051 based electronic balance, temperature measurement and control system. Application of Atmel microcontroller for DC motor speed control.

BOOKS FOR STUDY:

1. The 8051 Microcontroller: Architecture, Programming and Applications –K. J. Ayala
2. The 8051 Microcontroller and Embedded Systems - Muhammad Ali Mazidi & J G Mazidi
3. Programming & customizing 8051 microcontroller -Myke Predko
4. Design with PIC Microcontrollers – John B. Peatman
5. Experiments with Microcontrollers – Dr. P. Bhaskar & Dr. K. Malakondaiah

BOOKS FOR REFERENCE:

1. MCS51 User Manual -Intel Corporation.
2. Embedded Microcontrollers Data Book- Intel Corporation.
3. PIC Microcontroller PIC87X Data mauel
4. Embedded Control Handbook - MICROCHIP (Vol. 1 & 2)

OUTCOME OF THE COURSE:

1. The students will understand the architecture, Instruction set, programming skills and Interfacing of different devices with microcontrollers
2. The students will be able to design and fabricate microcontroller-based systems for various applications
3. Students will understand the role of Microcontroller in Instrumentation.

Course SCT 1.1 (b): MATLAB AND APPLICATIONS

Teaching hours per week: 4 Total Hours: 64

Preamble:

This paper deals with the MATLAB and its structure, programming concepts, designing of Graphical user interface (GUI), creating models using SIMULINK, and also the typical applications of MATLAB in instrumentation in detail.

UNIT I: Introduction to MATLAB 16 Hrs

MATLAB: Schematic Diagram of MATLAB, MATLAB Toolboxes, MATLAB Windows, Common System Commands and Mathematical operations, Handling of Matrices, Handling of graphics, File Dialog Boxes.

UNIT II: MATLAB Programming 16 Hrs

Matrices and Arrays: Entering Matrices, Sum, Transpose and Diagonal, Subscripts, colon operator, Magic Function. Expressions: variables, numbers, operators, functions. Command window I\P &O\P: Format Function, Suppressing O\P, Entering Long Statements, Command Line Editing. Graphics: Plotting Techniques, Graph Components, Editing Plots, Basic Plotting Functions. Simulink.

UNIT III: Graphical User Interface 16 Hrs

Graphical User Interface, M-File Dialog boxes, Predefined Dialog Boxes, GUI Creations Fundamentals, GUI Development Environment, GUI Components, GUI Object Hierarchy, Capturing Mouse Actions.

UNIT IV: Application of MATLAB 16 Hrs

Application of MATLAB for simulation of various models, Designing of PID and Fuzzy Logic Controllers. Application of MATLAB for controlling rotational speed and angular position of DC motor.

BOOKS FOR STUDY:

1. MATLAB Programming- Y. Kirani Singh & B.B Chaudhury
2. Introduction to MATLAB- Gulati
3. Getting Started with MATLAB 7- Rudra Pratap
4.

BOOKS FOR REFERENCE:

1. An Introduction to fuzzy logic control- Driankov, H Hellendroon & M. Reifrank

OUTCOME OF THE COURSE:

1. Students will be Able to understand the ease of analysis of various systems by using MATLAB
2. Students will acquire knowledge to design various MATLAB simulation models