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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**

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
Second		**Hard Core**							
	HCT 2.1	Introduction to VLSI Design	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 2.2	Electrical & Electronic Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 2.3	Advanced Microcontrollers and Embedded systems	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Soft Core (Any One)							
	SCT 2.1	(a) 'C' Language and Python Programming (b) AI in Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Open Elective (Any One)							
	OET 2.1	(a) Introduction to Electronic Instrumentation (b) Instrumentation for Physical and Life Sciences-I	**40**	**10**	**50**	**2**	**0**	**0**	**2**
		Practical							
	HCP 2.1	VLSI Design Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 2.2	Electric & Electronic Instrumentation Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 2.3	Advanced Microcontrollers and Embedded Systems Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Soft Core (Any One)							
	SCP 2.1	(a) 'C' Language and Python Programming Lab (b) AI in Instrumentation LAB	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Mandatory skills							
		Computer Skills	**-**	**-**	**-**	**-**	**-**	**-**	**2**
		Total for Second Semester	**520**	**130**	**650**	**18**	**0**	**8**	**28**

II – SEMESTER

Course HCT 2.1: INTRODUCTION TO VLSI DESIGN

Teaching hours per week: 4 *Total Hours: 64*

Preamble:

This paper deals with the different integrated circuit fabrication technologies with their comparison. The electrical properties associated with different technologies are described. Also, VLSI circuit design process and its related aspects are discussed. To fabricate/implement various logic circuits and to learn their implementation on ASIC are described. The devices such as PLDs, the CPLD and FPGA the generic architectures are discussed., finally by using EDA tool and writing VHDL code for the digital logic circuits and their implementation on CPLD/FPGA devices is covered.

UNIT I: Introduction to VLSI Technology 16 Hrs

Metal-Oxide Semiconductor (MOS) and related VLSI Technology. Basic MOS Transistors. Enhancement and Depletion Mode Transistor actions. CMOS fabrication. BiCMOS technology. Electrical Properties of MOS and BiCMOS Circuits: ID-VD Characteristics of MOS Transistor in Saturated and Non-saturated regions. MOS transistor Threshold voltage. Body-effect. The n-MOS inverter. Pull up and pull-down ratio for n-MOS inverter. Alternative forms of pull-up. CMOS inverter. BiCMOS inverters. Latchup in CMOS circuits.

UNIT II: VLSI Circuits Design Process 16 Hrs

VLSI Design flow, Layers of abstraction, Stick Diagram, Design goals and layout diagrams. Sheet resistance and Standard unit of capacitance. Inverter delays, Propagation delays, Wiring capacitance. Inverter Design aspects – Specifications considering worst-case parameters. Inverter in the input stage and output stage. Internal inverter.

UNIT III: Semi Custom Integrated Circuit Design 16 Hrs

Complex Programmable Logic Devices (CPLD) –Generic CPLD architecture and Generic Logic block, Xilinx XC9500 CPLD family – Function – Block Architecture, Input/ Output – Block Architecture, Switch Matrix. Field Programmable Gate Arrays (FPGA) –General structure, Interconnect, Switch technology Xilinx XC4000 FPGA family –Configurable Logic Block, Input Block, Programmable Interconnect. Application Specific Integrated Circuits (ASICs) –Types, Introduction about Full Custom and Semi Custom ASICs, General Description with respect to their Structures of Gate arrays, Standard Cells.

UNIT IV: System Design Using VHDL 16 Hrs

Introduction to VHDL: VHDL Description of Combinational Networks, Modeling Flip-Flops using VHDL, VHDL Models for Multiplexer, Compilation & Simulation of VHDL Code, Modeling Sequential Machine, Variables, Signals & Constants, Arrays, VHDL operators, VHDL Functions, VHDL Procedures, Packages & Libraries. VHDL for combinational circuits: Adder, Subtractor, Multiplexer, De-multiplexer, Encoder, Decoder, Flip-Flops, Registers, & Counters.

BOOKS FOR STUDY:

1. Basic VLSI Design, 3/e –D. A. Pucknell and K. Eshraghian, PHI, ND, 2006.
2. Digital systems design using VHDL – Charles H. Roth, Thomson Brooks/Cole, 2005.
3. Fundamentals of Digital Logic with VHDL Design – Stephen Brown and Zvonko Vranesic, TMH, ND, 2002.
4. Digital Electronics - Ronald Tocci.

BOOKS FOR REFERENCE:

1. Principles of CMOS VLSI Design. A System Perspective - N. Weste, K. Weste, K., Eshraghian-Addison-Wesley Publishing Co.
2. Digital Design -principles and practices - John F. Wakerly ,3rd Edition, Pearson Education

OUTCOME OF THE COURSE:

1. Students will be able to handle any type of CPLD/FPGA

2. Students will be able to understand limitations and capabilities of IC making.
3. Students will be able to develop their own libraries to develop specific application.
4. Students will be able to design and fabricate various digital systems using CPLD/FPGA devices

Course HCT 2.2: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

Teaching hours per week: 4 Total Hours: 64

Preamble:

This paper deals with study of different types of electrical and electronic instruments with their principle and working. It also discusses the design and application of, Power and Energy meters, DC/AC Bridges, Digital measuring instruments such as multimeter, frequency meter, phase meter, function generators and waveform generators.

UNIT I: General Analog Measuring Instruments 16 Hrs

Permanent-magnet moving coil (PMMC) Galvanometer: Torque and deflection, PMMC Mechanisms, DC Ammeters, DC Voltmeters, Ohmmeters: serial and shunt types, extension of range of meters, multi-meters. AC meters: Electrodynamometers, rectifier type, thermo instruments.

UNIT II: Power & Energy Meters, Instrument Transformers, and Bridges 16 Hrs

Electrodynamometers in power measurements, Watthour meter, Power-factor meter, Instrument Transformers: Potential transformers and current transformers. DC Bridges: Wheatstone bridge, Kelvin bridge. AC Bridges: Maxwell bridge, Hay bridge, Schering bridge, Wein bridge.

UNIT III: Analog Measuring Instruments 16 Hrs

Electronic voltmeters (Transistor, FET & Op-Amp Versions), AC Voltmeters: Rectifier type, RMS voltmeters, AC milli/micro voltmeters, Nano-ammeter, Analog frequency meter, Analog phase meter, Cathode Ray Oscilloscope: Single beam, dual trace, dual beam.

UNIT IV: Digital Measuring Instruments and Wave Form Generators 16 Hrs

Digital voltmeters, Digital multimeter, Digital frequency meter, Digital phase meter, Q-meter, Digital storage oscilloscope and sampling oscilloscopes, Sine/Square wave generators, Radio frequency signal generator, Standard signal generator, function generator, Spectrum analyzer, Vector impedance meter.

BOOKS FOR STUDY:

1. Electronic Instrumentation and Measurement Techniques — William David Cooper & Albert D Helfriek.
2. Electronic Instrumentation - H S Kalsi
3. A Course In Electrical and Electronic Measurements and Instrumentation - A. K. Sawhney

BOOKS FOR REFERENCE:

1. Measurement of Systems—Application and Design — Earnest O Doeblin
2. Op-Amp and Linear Integrated Circuit –R F Coughlin, F F Driscoll
3. Hand Book of Biomedical Instrumentation –R S Khandpur (TMH)

OUTCOME OF THE COURSE:

1. Students understand the principle and working of various Electrical and Electronics instruments and their applications
2. Students are also able to design and develop various Electrical and Electronic Instruments viz. Ammeter, Voltmeter, Ohmmeter, Multimeter, Frequency meter, phase meter etc.....

Course HCT 2.3: ADVANCED MICROCONTROLLERS AND EMBEDDED SYSTEMS

Teaching hours per week: 4 Total Hours: 64

Preamble:

Embedded systems are systems which contain both computer like hardware and software and designed for a particular task. Now days embedded systems play an important role in day-to-day life. Hence, this paper deals with the embedded systems architecture/description of various elements/ classification / programming. Finally design and applications of some typical embedded systems are covered in this paper.

UNIT I: Cygnal C8051F020 Microcontrollers 16 Hrs

Cygnal C8051F020 microcontroller architecture, memory organization, description of functional units of microcontroller: ports, interrupts, on chip ADCs, DACs, serial peripheral interface, timers, programmable counter array. Comparative study of C8051F020 with C8051F060 and C8051F350. Programming and Applications.

UNIT II: ARM7 Microcontrollers 16 Hrs

ARM7 microcontroller architecture, memory organization, description of functional units of microcontroller: ports, interrupts, on chip ADCs, DACs, serial peripheral interface, timers, programmable counter array. Comparative study of ARM7 with ARM9 and ARM11 Programming and Applications.

UNIT III: Introduction to Embedded Systems 16 Hrs

Embedded systems, elements of embedded system, classification of embedded systems, application areas of embedded systems, purpose of embedded systems, embedded hardware and firmware design and development, RTOS based embedded system design: Operating system components- Kernel, tasks, process, threads, process management, memory management, task scheduling and task synchronization. Vx works/Micro C IDE.

UNIT IV: Typical Embedded Systems 16 Hrs

Microcontroller based temperature, level, pressure, flow control system. Microcontroller based DC motor speed control system and position and speed control system.

BOOKS FOR STUDY:

1. Embedded Systems Architecture, Programming and Design- Raj Kamal
2. Cygnal C8051F020/F060/F350 Data Manuals
3. Silabs IDE Manual
4. ARM7 data manual
5. Introduction to Embedded Systems – Shibu K V

BOOKS FOR REFERENCE:

1. Embedded Systems Design – Steve Heath
2. Embedded Systems - John B. Peatman.

OUTCOME OF THE COURSE:

1. The students understand the architecture/Instruction set/ Interfacing and applications of advanced microcontrollers.
2. The students understand the Embedded systems design and applications.
3. The students will be able to design and fabricate embedded systems using advanced microcontrollers.

Course SCT 2.1(A): 'C' Language and Python Programming

Teaching hours per week: 4 Total Hours: 64

Preamble:

This course deals with introduction to C language and Python programming. The basic programming structures of both the programming languages are discussed in details in this course.

UNIT I: Introduction to C language

Introduction to C language, Variables and Data types - Identifiers in C,Variables and Data Types, Constants. Console IO operations - Printf and Scanf, Unformatted IO Functions. Operators and Expressions - Expressions and Arithmetic Operators, Relational and Logical Operators, Bitwise Operators. Control flow statements - If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue, Special Cases. Working with functions - Introduction and Writing Functions, Scope of Variables, Storage classes, Pass by Value and reference, Recursion. Working with arrays - Arrays Declaration and Initialization, Sample Programs using Arrays, Arrays as Function Parameters, 2-Dimensional Array.

UNIT II: Pointers, Strings, Structures & Unions, File handling in C

Pointers - Introduction to Pointers, Pointers as Function parameter, Pointer Arithmetic, Pointers and Arrays, Function Pointers, Dynamic Memory Allocation using malloc, calloc and comparison with malloc. String Handling - Introduction to Strings, Sample Program, More Sample Programs, Standard String Library Functions, Array of String. Structures and Unions - Declaring and Instantiating Structures, Structure as Parameter and Pointer to Structure, Enumerated Data Type, Union, Bit Fields. File Handling - What is a Stream, File Handling-Writing and Reading Characters, Writing and Reading Structure in Text Format, Writing and Reading in Binary Format. Pre – processor directives - Understanding Pre-Processor directives, Header Files and Project. Command line arguments and variables – Arguments, Command Line Argument, Variable Number of Arguments

UNIT III: Introduction to Python programming

Introduction to python programming, Installing Python in Windows/Linux/Mac OS, Using Python interpreter, execute a Script, Structuring with Indentation, Editor. Data types and Variables – Variables, Variables v/s identifiers, Naming convention of variables, Keyword. Data Structure – List, Tuples, Sets, Dictionaries. Input And Output - Input function, Input with raw_input (), Output with old string format, Python format function. Control Flow - If/Else Statements, For/while Statements, Range () function, Break and continue statements, Else clauses on Loops.

UNIT IV: Functions, File & Error handling, Module and class in python

Functions - Defining Function, Default Argument, Keyword Argument, Arbitrary Arguments List. File Handling - Reading from the file, Writing to the file, Methods of file objects. Error And Expectation - Syntax Errors, Exceptions, Handling Exceptions (try, except). Module - Creating Modules, Import a module, Import the names, Executing modules as scripts. Class Concept - Class Syntax, Class Objects, Instance Objects, Method Objects, Class and Instance Variables. Advanced Modules - Regular Expressions, datetime - date and time libraries, Dealing with Excel, GUI, Web Scrapping

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BOOKS FOR STUDY:

1. Programming in C by E Bal Guruswamy.
2. C programming Absolute Beginner's Guide by Greg Perry
3. Core Python programming by Dr. R Nageshwara rao
4. Programming in python by R S Salaria

OUTCOME OF THE COURSE:

By the end of the course students will be able to

1. Understand the basic structure of programming language.
2. Write, compile and debug the 'C' and Python programs.

Course SCT 2.1(B): Artificial Intelligence

Teaching hours per week: 4 Total Hours: 64

Preamble:

This course serves as an introduction to the rapidly evolving field of Artificial Intelligence (AI). Which encompasses various techniques and technologies that enable machines to mimic certain aspects of human intelligence, including learning, reasoning, problem-solving, perception, and language understanding. This course provides a comprehensive overview of fundamental AI concepts, Artificial Neural Networks, Machine Learning and implement intelligent systems.

UNIT I: Introduction to Artificial Intelligence and Machine Learning 16 Hrs

Artificial Intelligence: Definition and History of AI, Types of AI – Narrow AI and General AI, Applications of AI in various field. Machine learning: Basic concepts of Machine Learning, Supervised, Unsupervised and Reinforcement learning, Key algorithms and their applications (Linear Regression, Decision Trees, k – Nearest Neighbors.

UNIT II: MATLAB ANN Tools 16 Hrs

Introduction to Neural Network architectures, Data preparation, Network Creation and Configuration, Training Algorithms, Transfer learning, Performance Evaluation, Visualization tools, Hyperparameter Tuning, GPU Acceleration, Integration with MATLAB toolboxes, Code generation, Deployment options.

UNIT III: MATLAB Machine Learning Tools 16 Hrs

Introduction to Machine Learning, Supervised and Unsupervised Learning Algorithms, Preprocessing and Feature Engineering, Cross Validation and Model Evaluation, Hyperparameter tuning, Ensemble learning, Deep learning integration, Time series analysis, Model deployment, Interactive Apps, GPU acceleration, Classification, Regression and clustering, Interpretability and Explainability

UNIT IV: MATLAB based ANN and ML applications 16 Hrs

Image and Pattern recognition, Speech recognition, Facial recognition, Plant diseases detection.

BOOKS FOR STUDY:

1. MATLAB Deep Learning with Machine Learning Neural Networks and Artificial Intelligence by Kim.
2. Intro to Neural Net with MATLAB 6.0 by Sivanandam S N, McGraw Hill
3. Neural Networks and Learning Machines by Simon Hykin
4. MATLAB for Machine Learning by Ciaburro Giuseppe

OUTCOME OF THE COURSE:

By the end of the course students will be able to

1. Understand the foundation of AI and Machine learning.
2. Apply problem solving strategies.
3. Apply AI and Machine Learning in real world problem solving.

Course OET 2.1(a): INTRODUCTION TO ELECTRONIC INSTRUMENTATION

(Open Elective Paper-I offered to other Department Students)

Teaching hours per week: 2 Total Hours: 32

Preamble:

This paper is offered to other department students. This paper deals with fundamentals of instrumentation with the general functional elements and brief study of transducer, signal conditioner, data presentation elements.

Unit -I Introduction to Instrumentation 16Hrs

Functional elements of measurement system. Classification of Instruments. Standards and calibration. Static characteristics of an instrument. Transducers: Definition, types, characteristics, selection. Temperature, pressure, and displacement transducers, Strain gauges.

Unit – II Signal Conditioners and Recorders 16Hrs

Signal conditioning: Amplifiers, Introduction to Operational Amplifiers. Characteristics of an Ideal and Practical operational amplifier. Op-Amp configurations, mathematical operations, Solutions of second order differential equations, Wave form generation, Instrumentation amplifier, filters. Data presentation elements: Galvanometric recorders, CRO, Magnetic tape recorders and LED/LCD display.

BOOKS FOR STUDY:

1. Instrumentation Measurement Analysis - Nakra and Choudary
2. Measurement of Systems—Application and Design — Earnest O Doeblin
3. Sensors & Transducers – Patranabis

BOOKS FOR REFERENCE:

1. Electronic Instrumentation and Measurement Techniques — W D Cooper & A D Helfriek

OUTCOME OF THE COURSE:

1. The students understand the basic elements of Instrumentation system
2. Students will have good grasp of transducers/ Signal Conditioners/ Data Presentation Elements.

Course OET 2.1(b): INSTRUMENTATION FOR PHYSICAL AND LIFE SCIENCES - I

(Open Elective Paper-II offered to other Department Students)

Teaching hours per week: 2 Total Hours: 32

Preamble:

This paper is offered to other department students. The analytical instruments play an important role in analyzing the sample both qualitatively as well as quantitatively. This paper deals with principles, instrumentation and working of various analytical instruments viz., Colorimeter, Spectrometers, Conductivity meter, pH meter and Polarograph and their applications.

UNIT I: Colorimeters and Spectrophotometers 16 Hrs

Colorimeters- Principle and working with a Block diagram. Salient features of individual blocks. Specifications of a colorimeter. Applications of colorimeters to Analytical and Biomedical purposes. Spectrophotometers-Principle and working with block diagram. Salient features of individual blocks. Specification and operation of Spectrophotometer. Types of spectrophotometers –UV-Visible, and Infrared Raman Spectrometer and atomic absorption spectrophotometer, and Atomic absorption spectrometer. Applications of Spectrophotometers for chemical analysis.

UNIT II: Conductivity, pH Meters and Polarographs 16 Hrs

Conductivity Bridge- Principle and working of a conductivity bridge with a block diagram. Salient features of individual blocks. Applications of conductivity bridges. pH meters- Principle and working with a block diagram. Salient features of individual blocks. Types of pH meters: μC based pH meter, Applications of pH meters in chemical and industrial fields. Polarograph- principle and working with a block diagram. Salient features of individual blocks. Characteristics of dropping mercury electrode. Polarogram: Computer based pulse Polarograph, Applications of polarograph in chemical and industrial fields.

BOOKS FOR STUDY:

1. Hand Book of Analytical Instruments- R. S. Khandpur
2. Instrumental methods of Analysis- Chatwal and Anand
3. Principles of Instrumental Analysis- Skoog
4. Instrumental methods of Chemical Analysis- B. K. Sharma

BOOKS FOR REFERENCE:

1. Instrumental methods of Analysis- Willard, Merrit and Dean.
2. Molecular Spectroscopy- Singh and Dikshit
3. Instrumental Analysis- Mann, Wickers and Gulick.

OUTCOME OF THE COURSE:

1. The students understand the principle and working of various analytical instruments.
2. Students will appreciate the significance of analytical instruments in physical/ Life Sciences