GULBARGA UNIVERSITY

SYLLABUS

For

M.Sc. ELECTRONICS AND INSTRUMENTATION

I, II, III, & IV Semesters

(Under CBCS & CGPA with effect from 2017-18 and onwards)

Department of Studies and Research in

INSTRUMENTATION TECHNOLOGY

Post Graduate Centre, Yerigera - 584 133, RAICHUR,

Karnataka, INDIA

Web: www.gulbargauniversity.kar.nic.in

Phone: 08532 204441

GULBARGA UNIVERSITY

Course Outline & Syllabus for Master of Science (M.Sc.) Electronics & Instrumentation under CBCS & CGPA

Second		**Hard Core**							
	HCT 2.1	Introduction to VLSI Design	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 2.2	Microcontrollers and Applications	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Soft Core (Any One)							
	SCT 2.1	Electrical and Electronic Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	SCT 2.2	Industrial Electronics	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Open Elective (Any One)							
	OET 2.1	Introduction to Electronic Instrumentation	**80**	**20**	**100**	**5**	**1**	**0**	**6**
	OET 2.2	Microprocessors & Interfacing	**80**	**20**	**100**	**5**	**1**	**0**	**6**
		Practical							
	HCP 2.1	VLSI Design Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 2.2	Microcontroller Programming and Interfacing Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Soft Core (Any One)							
	SCP 2.1	Electrical and Electronic Instrumentation Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	SCP 2.2	Industrial Control Electronics Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Total for Second Semester	**440**	**110**	**550**	**17**	**01**	**06**	**24**

L= Lecture, T= Tutorials, P= Practicals
4 Credits of Theory = 4 Hrs of Teaching per week
2 Credits of Practicals = 4 Hrs per week
Study Tour: An academic/ industrial study tour of duration 10-15 days can be conducted during the vacations of II or III Semesters.
***Project work can be carried out in the parent department or industries/R&D Organization/IISc./IITs/Any Universities. Project shall be conceptualized soon after the completion of the II semester. Student shall work for the project during the mid-term vacation in the II semester if the work is carried outside the department.**

Outcome of the course: After the completion of M.Sc. (Electronics & Instrumentation) the students will be able to design/develop/fabricate instrument for the measurement of various parameters such as process/biomedical/scientific/analytical etc., using microcontroller/ Microprocessor/PC/DSP etc.

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 ASIC's such as PLDs, the CPLD and FPGA the generic architectures are discussed. The basics needed to write VHDL code is also discussed, the modeling and simulation of combinational and sequential logic circuit by using EDA tool, finally by using EDA tool and writing VHDL code for the digital logic circuits and their implementation on CPLD/FPGA devices is covered in this chapter.

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.

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

Course HCT 2.2: 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 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: PIC Microcontroller Architecture, Programming and Interfacing 16 Hrs

PIC16C877 architecture, instruction set, addressing modes, memory organization, ports, interrupts, timers, CCP modules, ADC modules, serial communication modules.

Programming of PIC16C877 microcontroller. Interfacing of 7-segment display, multiplexed display, generation of PWM waveform.

UNIT IV: 8051/PIC16C877 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. Design and development of 8051 based electronic balance, temperature measurement and control system. Application of microcontroller PIC16C877 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. PICs in Practice - F P Volpe & S Volpe, Elector Electronics
4. Embedded Control Handbook - MICROCHIP (Vol. 1 & 2)

Course SCT 2.1: 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 basic principle and working. It also discuss the general Analog measuring instruments, Power and Energy meters, Bridges, Digital measuring instruments and waveform generators with their block diagram, principle, design features and applications.

UNIT I: General Analog Measuring Instruments 16 Hrs

Suspension Galvanometer, 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. AC Bridges: Wheatstone bridge, Kelvin bridge, 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)

Course SCT 2.2: INDUSTRIAL ELECTRONICS

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

Preamble:

This paper deals with the various control systems, components, industrial sensors, signal conditioning circuits and transmitters. Analog and digital control schemes are also covered in this paper.

UNIT I: Introduction Industrial control and Industrial sensors

Purpose of Automatic control, open-loop control, Closed-loop control: Elements of closed-loop control system, servo mechanism control system, process control systems. Position sensors: Potentiometers, optical encoders and LVDTs. Angular velocity sensors: Limit switches, optical, Hall effect. Proximity sensors, load sensors. Pressure sensors: Bourdon Tubes, bellows, semiconductors. Temperature sensors: Bimetallic, Thermocouples, RTDs, Thermistors. Flow sensors, liquid- level sensor and vision sensors.

Unit II: Signal Conditioners and Transmission 16 Hrs

Instrumentation Amplifier, Zero and Span circuit: Inverting summer, voltage to current converters: floating load, grounded load, Integrated circuit based current to voltage converters. Current to voltage converter, Voltage to frequency converters, frequency to voltage converters, Isolation circuits: general concepts, transformer coupled amplifiers, optical coupled amplifiers, Optical coupling for ON OFF applications. Cabling: Magnetic and electronic shielding, Grounding.

Unit III: Analog Controllers 16 Hrs

Error Amplifier, On/Off Controllers, Proportional Controllers, Integral and Proportional Integral controllers, Derivative and three- mode (PID) controllers: Parallel three mode (PID) Controller, derivative overrun, Integral windup, bumpless auto/manual transfer. Cascaded and feed forward controller.

Unit IV: Digital Controllers and Power Interfaces 16 Hrs

Data Acquisition: Analog to digital conversion, digital to analog conversion, error. Single-loop digital control: digital control schemes, control algorithms, mode of operation. Programmable Logic controllers. Power Operational amplifiers, Switch mode servo amplifiers: principle of pulse width modulation, Switch mode filter, switching diode, pulse width modulation IC, transistor switch. Thyristor based power interfaces.

BOOKS FOR STUDY:

1. Industrial Control Electronics- J. Michael Jacob
2. Modern Control Technology: Components and Systems – Christopher Killian 3.
3. Instrumentation Measurement Analysis–Nakra & Chaudhry

BOOKS FOR REFERENCE:

1. Programmable Logic Controllers – John Webb
2. Computer based Industrial Control – Krishna Kant
3. Industrial/Process Instrumentation – Douglas M. Considine

Course OET 2.1: INTRODUCTION TO ELECTRONIC INSTRUMENTATION

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

Teaching hours per week: 5 *Total Hours: 64*

Preamble:

This paper is offered to other department students. This paper deals with fundamentals of instrumentation with the general functional elements of any measurement system and the brief study of all elements such as transducer, signal conditioner, data presentation elements. The principles and working of various instruments will be studied in the IV unit.

UNIT I: Introduction to Instrumentation 16 Hrs

Functional elements of measurement system. Classification of Instruments. Standards and calibration. Static characteristics of an instrument. Types of control system, open-loop and closed-loop system, feedback and its effects. Mathematical modeling of instruments. Transfer function. Stability criteria.

UNIT II: Transducer and Data Presentation Elements 16 Hrs

Transducers: Definition, types, characteristics, selection. Temperature, pressure, and displacement transducers, Strain gauges. Data presentation elements: Strip chart recorders, galvanometric, LCD, Printers (Laser, Inkjet), Data logger.

UNIT III: Operational Amplifiers 16 Hrs

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.

UNIT IV: Test and Measuring Instruments 16 Hrs

Principle and working of ammeter, voltmeter, ohmmeter, analog multimeter, analog frequency meter and analog phase meter. Analog versus digital instruments, digital voltmeter, digital multimeter, digital frequency and phase meters, CRO: block diagram and principle of working.

BOOKS FOR STUDY:

1. Instrumentation Measurement Analysis - Nakra and Choudary
2. Measurement of Systems—Application and Design — Earnest O Doeblin
3. Sensors & Transducers - Patranabis
4. Electronic Instrumentation - H S Kalsi
5. Control Systems Engineering – Nagrath. I. J. & Gopal. M.

BOOKS FOR REFERENCE:

1. Electronic Instrumentation and Measurement Techniques — W D Cooper & A D Helfriek
2. Automatic Control Systems- Benjamin C. Kuo
3. Modern Control System Engineering – K. Ogata

Course OET 2.2: MICROPROCESSOR AND INTERFACING

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

Teaching hours per week: 5 *Total Hours: 64*

Preamble:

This paper of offered to other department students. Microprocessors plays an important role in instrumentation. The paper deals with architecture, functional units, addressing modes, instruction set, programming, and interfacing of memory & peripheral devices to 8086 microprocessor. Finally the typical applications of µP in instrumentation are discussed.

UNIT I: Introduction to Microprocessor Architecture & Programming 16 Hrs

Introduction to 16-bit Microprocessors, Architecture of 8086, Functional elements and description. Comparative features of Intel family microprocessor (8086, 8088, 80286, 80386 and 80486). Instruction set of 8086, Addressing modes, writing programs for use with an assembler, procedures and Macros, Assembly language program development tools.

UNIT II: 8086 Hardware, Memory, Peripherals, and Interfacing 16 Hrs

8086 Hardware overview, 8086 Timing parameters, Memory Banks, Programmable Peripheral Interface 8255, Programmable Interval Timer 8254, Interfacing: Memory (RAM and EPROM), 8255, and 8254.

UNIT III: Analog and Digital Interfacing 16 Hrs

Data converters, interfacing 8-bit analog to digital converter & digital to analog converter, switch, binary counter display, static and multiplexed display using SSDs, & Stepper Motor.

UNIT IV: Applications 16 Hrs

Role of microprocessor in Instrumentation. Application of µP for stepper motor control, Humidity measurement, Temperature measurement & control, DC motor speed Control.

BOOKS FOR STUDY:

1. Microprocessor Interfacing – Programming and Hardware – Douglas V. Hall.
2. Introduction to Microprocessor – A. P. Mathur, 3/e
3. Microprocessor/Microcomputer for measurement and control – Austander, David M and Paul Sangnes.

BOOKS FOR REFERENCE:

1. Microcomputer Systems: The 8086/8088 Family Architecture, Programming and Design – Yu-Cheng Liu and Gienn A. Gibson.
2. Microprocessor and microcomputer-based system design – Mohamed Rafiquzzaman
3. The Intel Microprocessors – Barry B. Brey