GULBARGA UNIVERSITY

SYLLABUS

for

M.Sc. INSTRUMENTATION TECHNOLOGY

Choice Based Credit System (CBCS)
(Revised syllabus with effect from 2011-2012 and onwards)

Department of Studies and Research in
INSTRUMENTATION TECHNOLOGY
Post Graduate Centre, Yerigera - 584 133, **RAICHUR**,
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GULBARGA UNIVERSITY

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

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
First		**Hard Core**							
	HCT 1.1	Fundamentals of Instrumentation	80	20	100	4	0	0	4
	HCT 1.2	Analog and Digital Circuits	80	20	100	4	0	0	4
	HCT 1.3	Control Systems and Automation	80	20	100	4	0	0	4
		Soft Core (Any One)							
	SCT 1.1	Introduction to 8086 Microprocessor and 'C' Programming	80	20	100	4	0	0	4
	SCT 1.2	Digital Electronics	80	20	100	4	0	0	4
		Practical							
	HCP 1.1	Transducers and Signal Conditioners Lab	40	10	50	0	0	2	2
	HCP 1.2	Analog and Digital Circuits 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	8086 & and 'C' Programming and Interfacing Lab	40	10	50	0	0	2	2
	SCP 1.2	Digital Electronics Lab	40	10	50	0	0	2	2
		Total for First Semester	480	120	600				24
Second		**Hard Core**							
	HCT 2.1	Electrical and Electronic Instrumentation	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	Personal Computer for Measurement and Control	80	20	100	4	0	0	4
	SCT 2.2	Introduction to VLSI Design	80	20	100	4	0	0	4
		Open Elective (Any One)							
	OET 2.1	Introduction to Instrumentation	80	20	100	4	0	0	4
	OET 2.2	Microprocessors & Interfacing	80	20	100	4	0	0	4
		Practical							
	HCP 2.1	Electrical & Electronic Instrumentation 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	PC Based Instrumentation using 'C' and MATLAB	40	10	50	0	0	2	2
	SCP 2.2	VLSI Design Lab	40	10	50	0	0	2	2
		Open Elective (Any One)							
	OEP 2.1	Electronic Instruments Lab	40	10	50	0	0	2	2
	OEP 2.2	8086 Programming and Interfacing Lab	40	10	50	0	0	2	2
		Total for Second Semester	480	120	600				24

Semester	Code	Title of the Course	Semester Exam	IA	Total	L	T	P	Credits
Third		**Hard Core**							
	HCT 3.1	Single Chip Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 3.2	Process Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Soft Core (Any One)							
	SCT 3.1	Digital Signal Processors and Applications	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	SCT 3.2	PLC and its Applications	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Open Elective (Any One)							
	OET 3.1	Introduction to Microprocessors and Microcomputer	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	OET 3.2	MATLAB and its Applications	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Practical							
	HCP 3.1	Cygnal/ARM Microcontrollers Programming and Interfacing	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 3.2	Process Instrumentation Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Soft Core (Any One)							
	SCP 3.1	DSP Programming and Interfacing Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	SCP 3.2	PLC Programming Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Open Elective (Any One)							
	OEP 3.1	Interfacing with IBM PC	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	OEP 3.2	MATLAB Programming Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Total for Third Semester	**480**	**120**	**600**				**24**
Fourth		**Hard Core**							
	HCT 4.1	Industrial Components and Systems	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	HCT 4.2	Scientific/Analytical Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Soft Core (Any One)							
	SCT 4.1	Biomedical Instrumentation	**80**	**20**	**100**	**4**	**0**	**0**	**4**
	SCT 4.2	Instrumentation in Process Industries	**80**	**20**	**100**	**4**	**0**	**0**	**4**
		Practical							
	HCP 4.1	Advanced Controllers Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCP 4.2	Analytical Instrumentation Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
		Soft Core (Any One)							
	SCP 4.1	Biomedical Instrumentation Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	SCP 4.2	Process Industry Lab	**40**	**10**	**50**	**0**	**0**	**2**	**2**
	HCMP 4.3	**Major Project (72 for Project Evaluation +48 for Viva-voce + 30 for IA = 150 Marks)**	**120**	**30**	**150**	**0**	**0**	**6**	**6**
		Total for Fourth Semester	**480**	**120**	**600**				**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

I – SEMESTER

Course HCT 1.1: FUNDAMENTALS OF INSTRUMENTATION

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

UNIT I: Instruments and their Classification 16 Hrs

Functional elements of Instrumentation and measuring systems. Typical Applications of instrument systems. Types of instruments. Standards and calibrations. Introduction to errors and uncertainties in the measurement of performance parameters of instruments. Propagation of uncertainties in compound quantities. Static performance parameters, Impedance loading and matching. Specifications of an instrument. Selection of an instrument.

UNIT II: Sensors and Transducers 16 Hrs

Classifications of transducers, static and dynamic characteristics of transducer, selection of transducers. Types of transducers. Displacement transducers - Variable resistance, inductance and capacitance, linear variable differential transformer (LVDT), rotary variable differential transformer (RVDT), optical encoders, Synchronous and resolvers. Temperature transducer, temperature scales. Mechanical temperature sensors. Resistance type temperature sensors: Platinum resistance thermometer. Thermisters. Thermocouples. Solid state sensors. Quartz sensors.

UNIT III: Strain Gauges, Opto-Electronic, and Pressure Transducers 16 Hrs

Strain - Definition. Principle of working of strain gauges. Gauge factor. Types of strain gauges. Materials for strain gauges. Application of strain gauges. Photo-conductive cell. Photovoltaic cell (Solar cell). Photo diode. Photo transistor. Photo FET. Photo emission tube. Photo multiplier tube. Optical fiber sensors. Pressure transducers: Elastic transducers, Electrical pressure transducers, Piezoelectric pressure transducer. Vibrating element pressure sensors. Thin film pressure transducers.

UNIT IV: Signal Conditioners and Recorders 16 Hrs

Active filters – Low-pass, high-pass, band-pass, band-rejection, Second order Butterworth filter. Peak detector. Sample and hold circuit. Phase sensitive detector. Amplifiers: chopper stabilized DC amplifier, logarithmic and anti-logarithmic amplifier. Isolation amplifier. Lock-in amplifier. Recorders: strip chart recorder. Galvanometer and potentiometer type recorder. X-Y recorder (direct and null type), thermal type recorder. Inkjet & laser printers, LCD display, data loggers.

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—William David Cooper & Albert D Helfrick.
3. Transducers – K. P. Neubert.
4. Mechanical measurements – Beckwith, Marangoni,
5. Transducers – Norton.

Course HCT 1.2: ANALOG AND DIGITAL CIRCUITS

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

UNIT I: Power Supplies and Regulation 16 Hrs

Rectifiers - Half wave, full wave, bridge. Voltage multipliers. Filters - RC, LC, Π- sections. DC voltage regulation – Zener and Electronic regulation. LM723 regulator. Switch mode regulated power supplies (SMPS). AC voltage regulation: Step voltage regulation and servo voltage regulation. Invertors -Low tension DC to High tension AC or DC using electronic choppers.

UNIT II: Analysis of Operational Amplifiers 16 Hrs

Introduction to operational amplifiers (Op-Amps). Characteristics of an ideal and practical operational amplifier: 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. Instrumentation amplifier.

UNIT III: Digital Electronics 16 Hrs

Number system and codes, Logic gates and Boolean algebra, Combinational logic circuits, Flip-Flops, Digital arithmetic operations and circuits.

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. Register: Serial-In serial-out, serial in – parallel out, parallel in – serial out, parallel in-parallel out, shift register. TTL logic family, TTL gates.

BOOKS FOR STUDY:

1. Linear Integrated Circuits – Sanjay Sharma
2. Linear Integrated Circuits – D. Roy Choudhury & 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

BOOKS FOR REFERENCE:

1. Operational Amplifiers and Characteristic- Robert G Irvine
2. Op-Amp and Linear Integrated Circuits – Robert F Caughlin
3. Digital Principles and Applications- Albert Paul Malvino and Donald P. Leach

Course HCT 1.3: CONTROL SYSTEMS AND AUTOMATION

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

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

Types of control system: Open-loop and closed-loop, Feedback and its effects, Mathematical Modeling - Differential Equation Approach to the Electrical systems, Mechanical system, thermal 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 system. Design Specifications or Performance Indices of Second Order System. Static error coefficients. Concept of Stability, Necessary condition for Stability. Routh-Hurwitz stability Criterion. Relative stability Analysis.
Roots-Locus concepts. Rules for constructing Root-locus. Construction of root-loci. Root contours.

UNIT III: Frequency Response Analysis and Stability Criteria 16 Hrs

Introduction, Frequency response of First and second order system, correlation between time and frequency responses. Polar plots, Bode plots. Experimental determination of transfer functions from Bode plots. Introduction to mathematical preliminaries. Nyquist stability criterion. Nyquist plots, assessment of relative stability. Gain Margin (GM) and Phase Margin (PM). Constant M and N circles. Nicholas Chart.

UNIT IV: State Variable Analysis and Design 16 Hrs

Concept of state, state variables and state model. State models for Linear continuous and Time-varying system. Diagonalization. State transition matrix. Properties, Methods of computing state transition matrix, Solutions of state equations. Concepts of Controllability and observability. State variables for linear discrete time system.

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

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.

Course SCT 1.1: INTRODUCTION TO 8086 MICROPROCESSOR AND 'C' PROGRAMMING

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

UNIT I: Microprocessor with Advanced Architecture and 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 Assembly language programs for use with an assemblers, procedures and Macros, Assembly language program development tools, debugging assembly language programs.

UNIT II: 8086 System Connections, Timing and Interfacing 16 Hrs

8086 Hardware overview, 8086 Timing parameters. Interfacing: Memory (RAM and EPROM), Programmable Peripherals: 8255, 8254, 8279, 8259, and their interfacing with microprocessor. 8086 Interrupts and Interrupt response.

UNIT III: Interfacing of Data Converters and Serial Communication 16 Hrs

Interfacing of A/D & D/A Converters with microprocessor. Serial data communication, serial data transmission methods and standards (RS 232 Interface). Modem handshaking. bi-synchronous, Interfacing Intel 8251A -USART. Applications of microprocessor for stepper motor and temperature control.

UNIT IV: 'C' Language Programming 16 Hrs

An overview of 'C'. Constants, variables & data types. Operators and expressions. Program control statements –Decision making, branching and looping. Arrays: One, two, multidimensional arrays, Initialization. Functions, passing values to functions. Structures: Definition, Initialization, giving values to structures. Pointers: Understanding pointers, Declaring and Initialization, Pointers as addresses. Input and output disk files operations in 'C'. 'C' language programs.

BOOKS FOR STUDY:

1. Microprocessor Interfacing – Programming and Hardware – Douglas V. Hall.
2. Introduction to Microprocessor, 3/e – A. P. Mathur
3. Let us C – Yeshwanth Kanetkar

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

Course SCT 1.2: DIGITAL ELECTRONICS

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

UNIT I 16 Hrs

Digital computers and digital systems, binary numbers, number base conversion, octal and hexadecimal numbers, complements, binary codes, binary storage and registers, binary logic and integrated circuits. Definition of Boolean algebra, basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, digital logic gates, IC digital logic families, simplification of Boolean functions, two, three, and four variable maps, sum of products and product of sums simplifications, NAND and NOR implementation, non-degenerate forms, AND-OR-INVERT implementation, Don't-Care conditions, the tabulation method, determination and selection of prime-implicants.

UNIT II 16 Hrs

Combinational circuit, design procedure, adders, subtractors, code conversion, analysis procedure, multilevel NAND and NOR circuits, exclusive-or and equivalence functions, binary parallel adder, decimal adder, magnitude comparators, decoders, multiplexers, read-only memory, programmable logic array. Sequential circuit, flip-flops, analysis of clocked sequential circuits, flip-flop excitation tables, design procedure, design of counters, design with state equations.

UNIT III 16 Hrs

Registers, shift registers, ripple counters, synchronous counters, timing sequences, the memory unit, examples of random access memory, inter-register transfer, arithmetic, logic, and shift micro-operations, conditional control statements, fixed-point binary data, overflow, arithmetic shifts, decimal data, floating-point data, non-numeric data, instruction codes, design of simple counter.

UNIT IV 16 Hrs

Processor organization, arithmetic logic unit, design of arithmetic logic unit, status register, design of shifter, processor unit, design of accumulator, control organization, microprogram control, control of processor unit, microprogram sequencer.

BOOKS FOR STUDY:

1. Digital logic and computer design, PHI –Morris Mano M.
2. Digital Fundamental, 8/e, Pearson-Education, -Floyd and Jain
3. Introduction to logic and computer design, MGH –Alan B Marcovitz,
4. Digital systems: Principles and applications, 8/e, Pearson Education –Ronald J. Tocci,

BOOKS FOR REFERENCE:

1. Digital computer fundamentals, 6/e, TMH –Bartee J. C.,
2. Digital integrated electronics, MGH –Herbert Taub and Donald Schilling

II – SEMESTER

Course HCT 2.1: ELECTRICAL AND ELECTRONIC INSTRUMENTATION

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

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 multimeters, 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 HCT 2.2: MICROCONTROLLERS AND APPLICATIONS

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

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, and 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 - Kenneth 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 Microcontroller- John B. Peatman
5. Design with PIC Microcontrollers – John B. Peatman

BOOKS FOR REFERENCE:

1. MCS51 User Manual -Intel Corporation.
2. Embedded Microcontrollers Data Book- Intel Corporation.
3. Embedded Microcontrollers Application- Intel Corporation.
4. PICs in Practice - F P Volpe & S Volpe, Elector Electronics
5. Embedded Control Handbook - MICROCHIP (Vol. 1 & 2)

Course SCT 2.1: PERSONAL COMPUTER FOR MEASUREMENT AND CONTROL

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

UNIT I: Introduction to Personal Computer 16 Hrs

A basic microcomputer organization – Block diagram and functional units. Block diagram of mother board. Computer peripherals – CRT operation, CRT controller, Mass data storage systems – Floppy disk overview, floppy disk controller, hard disk data storage, optical disk data storage and printer mechanisms.

Unit Ii: PC I/O, Memory, Ports & Extension Slots 16 Hrs

I/O addressing and decoding techniques, memory address decoding. Interrupts in computer. Serial, parallel and USB ports. PC extension slots (ISA & EISA). Digital input/output register interfacing techniques, interfacing of memory and design of digital input/output and timer (DIOT) cards. Design of AD-DA (digital to analog converter, analog to digital converter) cards for IBM PC. Design of GPIB cards for PC.

UNIT III: Introduction to MATLAB 16 Hrs

Working in the command window, Arithmetic operations, Display Formats, Built-in Functions, Defining scalar variables. Handling of arrays, Mathematical operations with arrays, Script files functions, two directional plots. Programming in MATLAB. Application of MATLAB using Simulink and GUI based systems.

UNIT IV: PC for Measurement and Control 16 Hrs

Role of PC in instrumentation. Application of PC for temperature, pressure, liquid level measurement and control. PC based AC motor Speed control system. Design of PC based UV, Visible, and IR spectrophotometers.

BOOKS FOR STUDY:

1. IBM PC and Clones – B. Govindarajalu
2. IBM PC and Clones – Rajesh Hongal
3. Interfacing to IBM Personal Computer – Lewis C. Eggebrecht
4. MATLAB – An introduction with Applications – Amos Gilat

BOOKS FOR REFERENCE:

1. Microprocessor and Interfacing: Programming and Hardware – Douglas V. Hall
2. The IBM PC Connection – James F. Caffron
3. Computer based Industrial Control – Krishna Kant
4. Computer Controlled Systems – K. J. Astram & B. Wittenmark
5. MATLAB Programming – Kiran Singh, B. B. Chaudhuri

Course SCT 2.2: INTRODUCTION TO VLSI DESIGN

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

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, The ASIC Design process.

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, Demultiplexer, 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 OET 2.1: INTRODUCTION TO INSTRUMENTATION

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

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

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: Signal Conditioners 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 — William David Cooper & Albert 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: 4 *Total Hours: 64*

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. Member 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, 8-bit digital to Analog converter, switch, binary counter using LEDs, static and multiplexed display using SSDs, & Stepper Motor.

UNIT IV: Applications 16 Hrs

Role of microprocessor in Instrumentation. Application of microprocessor for Measurement of Weight, Frequency, Temperature measurement and control, Stepper Motor 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

III – SEMESTER

Course HCT 3.1: SINGLE CHIP INSTRUMENTATION

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

UNIT I: Introduction to C8051F020 Microcontroller 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.

UNIT II: Embedded 'C' Programming 16 Hrs

Instruction set, addressing modes of C8051F020, embedded 'C' programming using Keil/Silab IDE. Embedded 'C' programming for ADC module, DAC module, timers, programmable counter array, capture/compare modules, interrupts, serial ports, and JTAG. Interfacing of LCD and Stepper Motor.

UNIT III: Introduction to ARM Microcontroller 16 Hrs

Architectural Overview, ARM7TDMI-S Processor, Memory organization, Pin Connect Block, GPIO, Functional Units: A/D Converter, PWM, Timers, Vector Interrupt Controller, and Serial Ports.

UNIT IV: Design and Development of Single Chip Instruments 16 Hrs

Design and development of C8051F020 based Lock-in amplifier, Air quality monitoring system. C8051F020 based DC motor position control system, DC motor speed control system, and temperature control system, waveform generation. C8051F060 based level control system.

BOOKS FOR STUDY:

1. Cygnal C8051F020/F060/F350 Data Manuals
2. Silabs IDE Manual
3. ARM7 (LPC2129) User Manual

BOOKS FOR REFERENCE:

1. Embedded Systems - John B. Peatman

Course HCT 3.2: PROCESS INSTRUMETNATION

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

UNIT I: Temperature and Pressure Measurement Systems 16 Hrs

Temperature measurement, International practical temperature scale, Non–electrical temperature measurement systems, Electrical temperature measurement systems and Radiation type temperature measurement systems. Moderate Pressure measurement systems, High pressure measurement systems, Low pressure or vacuum measurement systems, calibration and testing.

UNIT II: Flow and Force Measurement Systems 16 Hrs

Primary or quantitative meters, secondary or Rate Meters, Special Methods – Ultrasonic flow meters, Electromagnetic flow meters, Anemometers, Laser Doppler Anemometers. Force: Balance, Hydraulic Load cells, Pneumatic Load cells, Elastic Force (Proving Ring) and Electric Force measurement systems.

UNIT III: Torque, Humidity, and Moisture Measurement Systems 16 Hrs

Torque: Rotating and stationary torque measurement systems, proximity type torque measurement systems. Humidity: Definitions of absolute, specific and relative humidity and Dew point. Psychrometers, Hair hygrometer, Electrolysis type hygrometer, Dew point measurement. Moisture: Definition, Resistivity, Conductivity and Capacitance type, NMR and IR methods for moisture measurement

UNIT IV: Level and Density Measurement Systems 16 Hrs

Float type, Displacer type, Hydrostatic type level measurement systems, Electrical methods - Resistance and capacitance type level measurement systems, Radiation methods – Ultrasonic and Radioactive type level measurement systems. Liquid density, units and definitions - Displacement and float type Densitometers. Hydrometers – Hydrostatic, ultrasonic sludge, sonic, ball type, Capacitance – Oscillating corilosis and Radiation Densitometers.

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BOOKS FOR STUDY:

1. Industrial Instrumentation and Control – S. K. Singh
2. Instrumentation Measurement Analysis–Nakra & Chaudhry
3. Instrumentation Devices and systems –Rangan, Mani & Sharma
4. Instrumentation and Control Systems – S. Bhaskar
5. Process Instrumentation – Patranabis
6. Industrial Instrumentation – T.R. Padmanabhan

BOOKS FOR REFERENCE:

1. Industrial/Process Instrumentation – Douglas M. Considine
2. Instrument Engineer's Handbook: Process Measurement and Analysis - B. G. Liptak
3. Instrument Engineer's Handbook: Process Control – B. G. Liptak

Course SCT 3.1: DIGITAL SIGNAL PROCESSOR AND APPLICATIONS

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

UNIT I: Introduction to Digital Signal Processing 16 Hrs

Signals, Systems & signal processing, Discrete time signals, Systems, Types, Advantages of DSP, Fourier series and Fourier transform – Definition, theorem & properties. Z- Transform – Definition, Theorem & Properties. Inverse Z- transform- solutions of differential equations and Transfer function.

UNIT II: Digital Filter Design 16 Hrs

Analog filters v/s Digital filters. Design of IIR Filters from Analog filters, IIR filter deign by approximation of derivatives, by impulse invariance, by bilinear transformation. Design of Butterworth & Chebyshew filters. Design of FIR filters using windows.

UNIT III: Architecture and Programming of TMS320C50 Digital Signal Processor 16 Hrs

Architectural overview: Functional Block Diagram, Internal Hardware. Memory Organization: Data memory, Program memory, Interrupts, Serial ports. Addressing modes. Instruction set of TMS320C50 and Programming.

UNIT IV: Interfacing and Applications 16 Hrs

Interfacing of Codec (A/D and D/A Converters) with TMS320C50 DSP. FIR Digital Filter: Low-pass, High-pass, Band-pass and Band reject. Interfacing of DDS with DSP and generation of Sine/Cosine and other waveforms. DSP based lock-in Amplifier.

BOOKS FOR STUDY:

1. Digital Signal Processing , Principles, algorithm & applications – John G Proakis, Demitris G. Manolakis, PHI
2. Introduction to Digital Signal Processing –Johnny R. Johnson
3. Digital Signal Processing – S. Salivahan, A. Vallaraj, C. Gnanapriya
4. Digital Filters Analysis, Design and Application – Andreas Antonio
5. DSP TMS320C5X Architecture, Programming - B. Venkataramani and M. Bhaskar

BOOKS FOR REFERENCE:

1. Digital Signal Processing – Sanjit K.Mitra
2. Digital Signal Processing and Application – Pamos E. Papamichalis.
3. TMS3205X User's Guide – Texas Instruments

Course SCT 3.2: PLC AND ITS APPLICATIONS

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

UNIT I: Introduction to PLC 16 Hrs

Introduction, History, Fundamental Description, Input and Output Systems, Central Processing Unit, Memory Unit, Programming Unit, Peripheral Devices, Difference between Computer and PLC, Justification for use of PLCs, Features of Allen-Bradley PLC.

UNIT II: PLC Programming 16 Hrs

Types of PLC programming languages, Ladder Diagram Fundamentals: Drawing symbols, Arithmetic and logical instructions, Timing and counting instructions, Input and output instructions, operational procedure, programming examples.

UNIT III: PLC Interfacing 16 Hrs

Analog PLC operation: Analog modules& systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions. Developing ladder diagram programs, Interfacing: Switches (Start/Stop push button), Electro-mechanical relays (EMR), Solid state relays (SSR). Generate accurate delays and timing sequences.

UNIT IV: Applications 16 Hrs

Applications of PLC: Turn on/off a Lamp and motor, measure frequency, produce PWM wave, control the DC motor speed. PLC based temperature control, consistency control, level control, effluent discharge control.

BOOKS FOR STUDY:

1. Instrument Engineers Handbook: Process Control – Bela G. Liptak, Butterworth Heinemann
2. Programmable Controllers – George L. Batton, MGH
3. Computer based Industrial Control – Krishna Kanth, PHI,

BOOKS FOR REFERENCE:

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI
2. Programmable Logic Controllers- Programming Method and Applications – JR.Hackworth &F.D Hackworth Jr. –Pearson, 2004

Course OET 3.1: INTRODUCTION TO MICROPROCESSORS AND MICROCOMPUTER

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

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

UNIT I: Introduction to 16-bit Microprocessor 16 Hrs

Architecture of 8086 Microprocessor, Addressing modes, Instruction set, Assembly language programs using Assemblers, Procedures and Macros, Assembly language program development tools, Debugging assembly language programs, Comparative study with 8088, 80286, and 80486 Microprocessors.

UNIT II: Interfacing 16 Hrs

Memory and I/O organization, Memory Banks, Interfacing of Memory (RAM and EPROM), Programmable Peripherals 8255, 8254: Block diagram, programming, and Interfacing with 8086 μP. 8086 Interrupts and their responses. Interfacing of Binary Counter Display and Seven Segment Display with 8086 through 8255.

UNIT III: Personal Computer 16 Hrs

Hardware details of PC, Architecture of IBM PC, Memory and I/O map of PC. I/O Addressing and Decoding, Techniques, Memory Address Decoding. PC extension slots (ISA and EISA). BIOS and DOS Interrupts of PC, Printer port, Serial ports.

UNIT IV: MATLAB and Application of PC 16 Hrs

Working in the Command Window, Arithmetic Operations, Display Formats, Built-in Functions, Defining scalar variables. Handling of arrays, Mathematical operations with arrays, Script files, functions, two directional plots. Programming in MATLAB. Application of MATLAB using Simulink and GUI based systems. Application of PC for Temperature Measurement using MATLAB.

BOOKS FOR STUDY:

1. Microprocessor and Interfacing: Programming and Hardware – Douglas V. Hall
2. IBM PC and Clones – B. Govindarajalu
3. Interfacing to IBM Personal Computer – Lewis C. Eggebrecht
4. MATLAB – An introduction with Applications – Amos Gilat

BOOKS FOR REFERENCE:

1. IBM PC and Clones – Rajesh Hongal
2. The IBM PC Connection – James F. Caffron
3. MATLAB Programming – Kiran Singh, B. B. Chaudhuri

Course OET 3.2: MATLAB AND ITS APPLICATIONS

Open Elective Paper-II offered to other Department Students)

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

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. Mathworks User Guide

BOOKS FOR REFERENCE:

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

IV – SEMESTER

Course HCT 4.1: INDUSTRIAL COMPONENTS AND SYSTEMS

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

UNIT I: Industrial Components 16 Hrs

Elements of Process Instrumentation: Switches (Toggle, Push button, DIP, Rotary, Thumbwheel and membrane), Relays (Electromechanical and solid state relays). I/P & P/I converters, Transmitters – Electronic and intelligent, Fiber Optic & Pneumatic Transmitters. Actuators**:** Hydraulic, Pneumatic & Electric type. Valves & their Classification P&ID symbols.

UNIT II: Advanced Industrial Control Systems 16 Hrs

Basic control actions - Proportional (P), Proportional + Integral (PI), Proportional + Derivative (PD), Proportional + Integral + Derivative (PID) Hydraulic, Pneumatic and Electronic Controllers. Single loop controllers. Digital PID Controllers, Cascade and Feed Forward Control Systems, Direct Digital Control Systems, Supervisory Control Systems, Distributed Control Systems (DCS).

UNIT III: Fuzzy Logic Controllers/Intelligent Controllers 16 Hrs

Fuzzy set theory, concepts and properties, fuzzy logic, block diagram of fuzzy logic controller, membership functions, fuzzification, design and rule base editor, defuzzification techniques, Typical applications: DC motor speed control.

UNIT IV: Programmable Logic Controllers 16 Hrs

PLC block diagram, PLC Hardware, PLC I/O Modules (Digital I/O & Analog I/O Modules), PLC Operations, Programming the PLC, Ladder diagram programming, Bit Instructions, Timers, Counters, Sequences, Advanced instructions. Applications of PLC. ON/OFF Control, Batch Mixing process control.

BOOKS FOR STUDY:

1. Modern Control Technology – Christopher T. Killian
2. Industrial Control Electronics – Michael Jacob
3. Process/Industrial Instrumentation – D. M. Considine
4. Industrial Instrumentation and Control – S. K. Singh
5. Fuzzy sets, fuzzy logic theory & Applications-G J Klir /B Yuan
6. Fuzzy logic with Engineering Application- Timothy J Ross

BOOKS FOR REFERENCE:

1. Computer based Industrial Control – Krishna Kant
2. Control System Engineering - Nagrath & Gopal
3. Programmable Logic Controllers – John Webb
4. Programmable Logic Controllers: Programming Methods & Applications – John R. Hackworth

Course HCT 4.2: SCIENTIFIC/ANALYTICAL INSTRUMENTATION

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

UNIT I: Colorimeters and Spectrophotometers 16 Hrs

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

UNIT II: Conductivity, pH Meters and Polarographs 16 Hrs

Conductivity Bridge- Principle & working of a conductivity bridge with block diagram. Salient features of individual blocks. Applications of conductivity bridge. pH meters- Principle & working with block diagram. Salient features of individual blocks. Types of pH meters: µC based pH meter, microcontroller based pH meter, Applications of pH meters in chemical and industrial fields. Polarograph-principle & 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.

UNIT III: Resonance and Mass Spectrometers 16 Hrs

Nuclear Magnetic Resonance Spectrometers- Principle and working with suitable schematic/block diagrams. Experimental arrangement. Salient features of individual blocks. Applications of NMR spectrometer. Electron Spin Resonance- Principle and working with suitable schematic/block diagrams. Experimental arrangement. Salient features of individual blocks. Applications of ESR spectrometer. PAS: Principle and working with block diagram, experimental arrangement, Salient features of individual blocks. Application of PAS.

UNIT IV: Electron Microscopes, Thermal Analysis and Chromatographs 16 Hrs

Transmission Electron Microscope- Principle and working with a block diagram. Salient features of individual blocks. Scanning Electron Microscope- Principle and working with a block diagram. Description of individual blocks. Applications of Electron Microscopes. Thermo gravimetric and Differential Thermal Analysis-Principle and working with a Schematic diagram. Description of individual blocks. Applications. Chromatographs- Gas and Liquid Chromatographs- Principle and working with a block diagrams. Applications.

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.

Course SCT 4.1: BIOMEDICAL INSTRUMENTATION

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

UNIT I: Biomedical Electrodes and Recorders 16 Hrs

Components of Biomedical system, Bio-electrical signal, Bio-potential electrodes. Transducers for Biomedical applications, Bio-potential amplifiers, Bio-potential recorders.

UNIT II: Cardiovascular and Respiratory System 16 Hrs

Physiology of Cardiovascular system, Anatomy of heart, Electrocardiography, Pace makers, Cardiac defibrillators, Blood pressure measurement, Artificial Heart. Physiology of Respiratory system, Measurement of Respiratory system, Mechanism of breath, Pulmonary function analyzers, Respiratory gas analyzers, Heart-lung machine.

UNIT III: Nervous System and Biotelemetry 16 Hrs

Physiology of Nervous system, Neuronal communication, Organization of brain, Electroencephalography. Telemetry –Elements of Biotelemetry system, Radio telemetry system, Implantable telemetry system, Telephonic telemetry, Uses of Biotelemetry.

UNIT IV: Modern Imaging Systems 16 Hrs

X-ray, computer aided tomography and applications, NMR imaging techniques and Applications. Medical Ultra sound, Pulse echo transmitter and receiver, A-scan, Echo-Opthamoscope, Echo-Cardiogram and B-scan, Biological effects of Ultra sound. Heomodialysis machine. Applications of Ar, He-Ne, Ruby lasers in biomedical field.

BOOKS FOR STUDY:

1. Hand book of Biomedical Instrumentation -R S Khandpur
2. Biomedical Instrumentation and Measurements- Leslie, Cromwell, Fred Wailbell, Erich, Pfeiffer
3. Biomedical Instrumentation – Arumugam
4. Biomedical Equipment and Technology – Joseph Brown

BOOKS FOR REFERENCE:

1. Biomedical Instrumentation and Measurements, Allied- Harry E Thomas.
2. Hand book of Biomedical Engineering –Jacob Kline
3. Transducers for Biomedical Measurements –Richard S C Cobold
4. Biomedical Electronics- Joseph Dubovy
5. Biomedical Instruments, Theory and Design-Welkowitz and Dentsch
6. Biological Engineering –Mech Schwan
7. Biomedical Engineering system- Climes and Muliem

Course SCT 4.2: INSTRUMENTATION IN PROCESS INDUSTRIES

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

UNIT I: Instrumentation in Thermal Industries 16 Hrs

Description of the process, measurement hardware, valves, controllers and displays, computer applications and typical control systems as applied to the thermal power stations.

UNIT II: Instrumentation in Iron and Steel Industries 16 Hrs

Description of the process, measurement hardware, valves, controllers and displays, computer Applications and typical control systems as applied to the iron and steel industries.

UNIT III: Instrumentation in Petrochemical Industries 16 Hrs

Control of distillation towers, refrigeration units, system boilers, furnaces, crystallizers, heat exchanges, pumps, compressors and evaporators in petrochemical industries.

UNIT IV: Instrumentation in Paper and Pulp Industries 16 Hrs

Description of the process, measurement hardware, valves, controllers and displays, computer applications and typical control systems as applied to the paper and pulp industries.

BOOKS FOR STUDY:

1. Instrumentation in Process Industries -B. G. Liptak
2. Industrial Instrumentation and Control –S. K. Singh
3. Computer based Industrial Control – Krishna Kant

BOOKS FOR REFERENCE:

1. Industrial Control Electronics - J. Michael Jacob
2. Industrial Manuals