## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

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### (A71004) ANALYTICAL INSTRUMENTATION

**Course Objective :** To introduce spectroscopic methods, Chemical Instrumental Analysis, Electro-analytical methods to numerous applications ranging across healthcare, environmental and pharmaceutical industries.

**UNIT–I:**

**pH and Conductivity & Dissolved Component Analyser:** Conductivity meters – pH meters – Dissolved oxygen, hydrogen analyzers – Sodium analyzer – Silica analyzer and sampling systems.

**Gas Analysers:** Thermal conductivity types – CO monitor – NOX analyzer – H 2 S analyzer system and sampling – Industrial analyzer circuits, Theory and problems on Beer – Lamberts Law.



**UNIT – II:**

**Chromatography – I:** Gas chromatography – Liquid chromatography – their principles and applications.

**Chromatography – II:** oxygen analyzer – paramagnetic type – detectors and sampling systems.

**UNIT – III:**

**Spectrophotometers – I:** UV, VIS Spectrophotometers – Single beam and double beam instruments – Instrumentation associated with the above Spectrophotometers – Sources and detectors – Sources and detectors for IR Spectrophotometers.

**UNIT – IV:**

**Spectrophotometers – II:** FT IR Spectrometer – Flame emission and atomic absorption Spectrophotometer – Atomic emission Spectrophotometer - sources for Flame Photometers and online calorific value measurements.

**UNIT – V:**

**Principle of Nuclear Magnetic Resonance:** Instrumentation associated with NMR Spectrophotometer – Introduction to mass spectrophotometers , Principle and brief discussion on ELECTRON SPIN RESONANCE (ESR.)

**Special Analytical Instruments:** Nuclear radiation detectors – Ionization chamber – GM Counter – Proportional Counter – Solid state detectors ND PMT.



**TEXT BOOK:**

1. Handbook of Analytical Instruments – by Khandpur. TMH.

2. Analytical Instrumentation by Bela G. Liptak, CRC Press -1994.

**REFERENCES:**

1. Instrumental Methods of Analysis – by Willard H.H., Merrit L.L., Dean J.A.. and Seattle F.L., CBS Publishing and Distributors, 6/e, 1995.
2. Instrument Technology – by Jones B.E., Butterworth Scientific Publ., London, 1987.
3. Mechanical and Industrial Measurements – by Jain R.K., Khanna Publishing, New Delhi, 2/e, 1992.
4. Principles of Instrumental Analysis – by Skoog D.A. and West D.M., Holt Sounder Publication, Philadelphia, 1985.
5. Instrumental Analysis – by Mann C.K., Vickerks T.J. & Gullick W.H., Harper and Row Publishers, New York, 1974.

**Course Outcome :**



The student is expected to acquire the knowledge is instruments used in Pharma and chemical Industries.

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### (A70439) EMBEDDED SYSTEMS

**Objective:** To learn the method of designing a real time system.

**UNIT I :**

**8051 Family Architecture:** 8051 Microcontroller Architecture, Microcontroller 8051 Pins, 8051 Ports, Internal and External Memory, Counter and Timers, Serial Communication in 8051, Interrupts, Interrupts in 8051, External Interrupts.



**UNIT - II**

**Introduction to Real – Time Operating Systems :** Tasks and Task States, Tasks and Data, Semaphores, and Shared Data, Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.

**UNIT - III**

**Basic Design Using a Real-Time Operating System** : Principles, Semaphores and Queues, HardReal-Time Scheduling Considerations, Saving Memory and Power, An example RTOS like uC-OS (Open Source); Embedded Software Development Tools: Host and Target machines, Linker/ Locators for Embedded.

Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System.



**UNIT – IV**

**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, the Vector Table, Core Extensions, Architecture Revisions, ARM Processor Families.

**UNIT V:**

**Introduction to the ARM Instruction Set:** Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, Conditional Execution.

**Introduction to the Thumb Instruction Set:** Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions Single and Multiple- Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.

**TEXT BOOKS:**

1. Microcontrollers Architecture, Programming, Interfacing and System Design by Raj Kamal, 2e, Pearson.
2. ARM System Developer's Guide Design & Optimizing System Software by Sloss, Elsevier.

**REFERENCES :**

1. The 8051 Microcontroller & Embedded Systems using Assembly & C, by Kennet J Ayala and Dhananjay V. Gadre., Cengage Learning.
2. Embedded / Real Time Systems: Concepts, Design & Programming (Black Book) 2005 edition,by – KVKK Prasad.
3. Introduction to Embedded Systems – by Shibu K.V, MGH.

**Outcomes:**

Upon completion of this course, the student will be able to

- Understand the basics of an embedded system.
- Design, implement and test an embedded system.

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### (A70432) VLSI DESIGN

**Course Objectives:**

The objectives of the course are to:



- Give exposure to different steps involved in the fabrication of ICs using MOS transistor, CMOS/BICMOS transistors and passive components.
- Explain electrical properties of MOS and BiCMOS devices to analyze the behavior of inverters designed with various loads.
- Give exposure to the design rules to be followed to draw the layout of any logic circuit.
- Provide concept to design different types of logic gates using CMOS inverter and analyze their transfer characteristics.
- Provide design concepts to design building blocks of data path of any system using gates.
- Understand basic programmable logic devices and testing of CMOS circuits.

**UNIT –I:**

**Introduction:** Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS.

**Basic Electrical Properties:** Basic Electrical Properties of MOS and BiCMOS Circuits: $I_{ds}$-$V_{ds}$ relationships, MOS transistor threshold Voltage, $g_m$, $g_{ds}$, Figure of merit $\omega o$; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

**UNIT -II:**

**VLSI Circuit Design Processes:** VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.



**UNIT –III:**

**Gate Level Design:** Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

**UNIT -IV:**

**Data Path Subsystems:** Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters.

**Array Subsystems:** SRAM, DRAM, ROM, Serial Access Memories.

**UNIT -V:**

**Programmable Logic Devices:** PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach, Parameters influencing low power design.

**CMOS Testing:** CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques.

**TEXT BOOKS:**

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, PHI, 2005 Edition.
2. CMOS VLSI Design – A Circuits and Systems Perspective, Neil H. E Weste, David Harris, Ayan Banerjee, 3rd Ed, Pearson, 2009.
3. VLSI Design – M. Michael Vai, 2001, CRC Press.

**REFERENCE BOOKS:**

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. CMOS logic circuit Design - John .P. Uyemura, Springer, 2007.
3. Modern VLSI Design - Wayne Wolf, Pearson Education, 3rd Edition, 1997.
4. VLSI Design- K. Lal Kishore, V. S. V. Prabhakar, I.K International, 2009.
5. Introduction to VLSI – Mead & Convey, BS Publications, 2010.

**Course Outcomes:**

Upon successfully completing the course, the student should be able to:

- Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors.
- Choose an appropriate inverter depending on specifications required for a circuit.
- Draw the layout of any logic circuit which helps to understand and estimate parasitics of any logic circuit.
- Design different types of logic gates using CMOS inverter and analyze their transfer characteristics.

- Provide design concepts required to design building blocks of data path using gates.
- Design simple memories using MOS transistors and can understand Design of large memories.
- design simple logic circuit using PLA, PAL, FPGA and CPLD.
- Understand different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.

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### (A71005) PC BASED INSTRUMENTATION

**Course Objective:** To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation and programming.

**UNIT –I**

**Introduction to Computer Instrument Communication:** Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.



**UNIT –II**

**Programmable logic controller (PLC) basics:** Definition, overview of PLC systems, input/output modules, power supplies and isolators.

**Basic PLC programming:** Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

**UNIT – III**

**PLC intermediate and advanced functions:** Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

**UNIT –IV**

**Application of PLC:** Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating.

**UNIT – V**



**Related Topics:** Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves and smart actuators.

**TEXT BOOKS**

1. Programmable Logic Controllers – Principles and Applications, John. W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New

Jersey, 1998.

2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

## REFERENCES

1. PC Based Instrumentation and Control Third Edition by Mike Tooley; Elsevier.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation and Control. By Kevin James, Elsevier.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.
4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.
5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, Newyork, 1997.
6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

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### (A71117) TELEMETRY AND TELECONTROL

### (Elective-I)

**Objective:** To make students understand the application of telemetry techniques to Instrumentation.



**UNIT – I**

**Telemetry Principles:** Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency

**Symbols and Codes:** Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

**UNIT – II**

**Frequency& Time Division Multiplexed Systems:** FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.

TDM-PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

**UNIT – III**

**Satellite Telemetry:** General considerations, TT&C Service, Digital Transmission systems, TT&C Subsystems, Telemetry and Communications.

**Modern Telemetry:** Zigbee, Ethernet.



**UNIT – IV**

**Optical Telemetry:** Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System.

**UNIT – V**

**Telecontrol Methods:** Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance and regulation – Telecontrol using information theory –Example of a Telecontrol System.

**TEXT BOOKS**

1. Telemetry Principles – D. Patranabis, TMH.
2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991.

## REFERENCES

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.

2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.

3. Data Communication and Teleprocessing System – by Housley T., PH Intl.,Englewood Cliffs, New Jersey, 1987.

**Outcome:** Upon completion of this course students will appreciate t he application of different telemetry systems and control to any process.

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### (A70445) OPTO ELECTRONICS & LASER INSTRUMENTATION

(Elective-I)

**Course Objective:** To make the students under stand the application of Opto Electronics and Lasers in the quantifying.

**UNIT – I**

**Optical Fibers and Their Properties** Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers.

**UNIT – II**

**Laser Fundamentals** Introduction to lasers – Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductor lasers.



**UNIT – III**

**Opto-Electronic Components** Optical sources: LED, LD - Optical detectors: PIN, APD - Electro-optic, Magneto optic and Acousto-optic Modulators.

**UNIT – IV**

**Industrial Applications of Optical Fibers** Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers – Applications.

**UNIT–V**

**Laser instrumentation** Industrial applications of lasers – Lasers for measurement of distance, length, velocity, acceleration, current, voltage and atmospheric effect - Bio-medical applications - Holography: Principle, Methods, Holographic Interferometers and applications.

**TEXT BOOKS**

1. 'Optical Fiber Communication – Principles and Practice', J.M. Senior,, Prentice Hall of India, 1985.
2. 'Introduction to Opto Electronics', J. Wilson and J.F.B. Hawkes, Prentice Hall of India, 2001.



**REFERENCES**

1. Understanding Fiber Optics, 4th or 5th edition; Jeff Hecht; Prentice

Hall publishers.

2. 'Optical Fibre Communication and Sensors', M. Arumugam, Anuradha Agencies, 2002.
3. 'Optical Fibre Communication', G. Keiser, 'McGraw Hill, 1995.
4. Lasers: Theory and Applications – by Thyagarajan K. and Ghatak A.K., Plenum Press.
5. Monte Ross, 'Laser Applications', McGraw Hill, 1968.

**Course Outcome:**

Upon completion of this course the student shall be able to apply his instrumentation knowledge and understand how light and LASER can be used for measurements.

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### (A70357) ROBOTICS AND AUTOMATION

### (Elective-I)

**Objectives**

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.

**UNIT-I**

**Basic Concepts** Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

**UNIT- II**

**Power Sources and Sensors** Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

**UNIT- III**

**Manipulators, Actuators and Grippers** Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

**UNIT-IV**

**Kinematics and Path Planning** Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages.

**UNIT-V**

**Case Studies** Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

**TEXT BOOKS**



1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

## REFERENCES

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

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### (A70515) COMPUTER NETWORKS

### (Elective-II)

**Objectives:**

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To explore the various layers of OSI Model.
- To introduce UDP and TCP Models.

**UNIT-I**

Overview of the Internet: Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model, Internet history standards and administration; Comparison of the OSI and TCP/IP reference model.

**Physical Layer:** Guided transmission media, wireless transmission media.

**Data Link Layer** – design issues, CRC Codes, Elementary Data link Layer protocols, sliding window protocol

**UNIT-II**

**Multiple Access Protocols :** ALOHA, CSMA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer, data link layer switching & use of bridges, learning bridges, spanning tree bridges, repeaters , hubs, bridges , switches, routers and gateways.

**UNIT-III**

**Network Layer:** Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Hierarchical Routing, Congestion control algorithms, admission control.



**UNIT-IV**

**Internetworking:** Tunneling, Internetwork Routing, Packet fragmentation, IPv4, Ipv6 Protocol, IP addresses, CIDR, IMCP, ARP, RARP, DHCP.

**Transport Layer:** Services provided to the upper layers elements of transport protocol-addressing connection establishment, connection release, Connection Release, Crash Recovery.

**UNIT-V**

**The Internet Transport Protocols :** UDP-RPC, Real Time Transport Protocols, The Internet Transport Protocols- Introduction to TCP, The TCP

Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The future of TCP.

**Application Layer :** Introduction ,providing services, Applications layer paradigms, Client server model, Standard client-server application-HTTP, FTP, electronic mail, TELNET, DNS, SSH

**TEXT BOOKS:**

1. Data Communications and Networking – Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Computer Networks — Andrew S.Tanenbaum, 4th Edition, Pearson Education.

**REFERENCE BOOKS:**

1. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, Pearson Education.
2. Understanding communications and Networks, 3rd Edition, W.A.Shay, Cengage Learning.
3. Introduction to Computer Networks and Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
4. Computer Networks, L.L.Peterson and B.S.Davie, 4th edition, ELSEVIER.
5. Computer Networking: A Top-Down Approach Featuring the Internet, James F.Kurose,K.W.Ross,3rd Edition, Pearson Education.

**Outcomes:**



- Students should be understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and ad hoc networks.

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### (A70435) DIGITAL CONTROL SYSTEMS
### (Elective-II)

**Objective:**

This course gives fundamentals digital control systems, z-transforms, state space representation of the control systems, concepts of controllability and observabilty, estimation of stability in different domains, design of discrete time control systems, compensators, state feedback controllers, state observers through various transformations.

**UNIT – I:**

**Introduction:** Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.

**Z – Transforms:** Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms. Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.

**UNIT – II:**

**State Space Analysis:** State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations. Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function.

**UNIT –III:**

**Stability Analysis**: Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of closed loop systems in the Z-Plane.

Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.



**UNIT-IV:**

**Design of Discrete Time Control System :** Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.

**UNIT – V:**

**State Feedback Controllers & Observers:** Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula.

State Observers – Full order and Reduced order observers.

**Outcome:**

After going through this course the student gets a thorough knowledge on, basics of digital control systems, z-transforms, mapping between S-plane and Z-plane, state-space analysis, concept of controllability and observabilty, derivation of pulse-transfer function, stability analysis in S-domain and Z-domains, stability through jury-stability test, stability through bilinear transformation and R-H criteria, design of discrete-time control systems, design of lag, lead, lead-lag compensators, design of PID controllers and design of state feedback controllers and observers, with which he/she can able to apply the above conceptual things to real-world electrical and electronics problems and applications.



**TEXT BOOK:**

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition.

**REFERENCE BOOKS:**

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.Digital Control and State Variable Methods by M.Gopal, TMH .
2. Digital Control Systems , V. I. George, C. P. Kurian, Cengage Learning.
3. Digital Control Engineering Analysis and Design M. Sami Fadali Antonio Visioli, AP Academic Press.

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### (A71112) MEDICAL INSTRUMENTATION

### (Elective-II)

**Objectives:** To understand



- the genesis of biopotentials
- different types electrodes and bioamplifiers
- Electrical Safety

**UNIT-I**

**Origin of Biopotentials :** Cell Structure, Electrical activity – Resting State, Active State, Action Potential.

**Nernst Equation:** Derivations and its significance. Refractory Period, Characteristics of Stimulus.Strength-Duration relationship.Electrical equivalent circuit of Axon. Membrane time and space constants, Membrane conductance, Nerve conduction.

Propagation of impulses in unmyelinated and myelinated nerve fiber, Electrical properties of synaptic junctions - EPSP and IPSP, Electroneurogram (ENG), Electromyogram (EMG), Electrocardiogram (ECG), Electroretinogram (ERG), Electroencephalogram (EEG), Electrooculogram (EOG).

**UNIT-II**

**Bio Potential Electrodes :** The Electrode – Electrolyte Interface, Polarization, Polari able and Nonpolarizable Electrodes, Electrode Behavior and circuit Models, The Electrode – skin Interface and Motion Artifact, Body-surface Recording Electrodes, Internal Electrodes, Electrode Arrays, Microelectrodes and its equivalent circuit, Electrodes for Electric stimulation of Tissue.

**UNIT-III**

**Bio Amplifiers :** General considerations for signal Conditioners, Pre-Amplifiers, Differential amplifier, Instrumentation Amplifier, Carrier amplifier, Chopper amplifier, Isolation amplifier, Sources of Noise in Low – Level Measurements.

**UNIT-IV**



**Basic Recording Systems:** Writing Systems, Direct Writing Recorders, Thermal & Ink Systems the Ink Jet Recorder, Potentiometric Recorder, Digital Recorders, Thermal Array Recorder, Video Printers, Electrostatic Recorder, Medical oscilloscope, LCD Display.

## UNIT-V

**Electrical Safety :** Physiological effects of Electricity, Important Susceptibility parameters, Distribution of Electric Power, Macro shock hazards, Micro Shock hazards, Electrical - Safety codes and Standards, Basic Approaches to protection against shock, Protection : Power distribution, Protection : Equipment Design, Electrical Safety Analyzers, Testing the Electrical System. Test of Electric Appliances.

## TEXT BOOK:

1. John G. Webster. Medical Instrumentation.- Application and Design. John Wiley and Sons. Inc., New York. Third edition 2013.

## REFERENCE:

1. R.S. Khandpur. Hand Book of Biomedical Instrumentation, McGraw Hill, 2nd Edition, 2003.
2. L. A Geddes, Principles of Applied Biomedical Instrumentation, John Willy & Sons, 1989.
3. Joseph .J. Carr, John M. Brown, Introduction to Biomedical Equipment Technology, Pearson-2001.

## Outcomes:

- Know the basic levels of neuronal organization.
- Differentiate the electrodes used to acquire biopotentials and list the problems associated with acquisition.
- Recognize physiological parameters.

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### (A70497) EMBEDDED SYSTEMS LABORATORY

This lab is to provide skills needed to develop software for ARM based Embedded System. The aim is to teach the basics of device drivers, programming for Linux Kernel. The lab programs will be taught on ARM board with simple devices like GPIOs, LEDs, seven segment displays, keypads, Temperature sensors and $E^2$PROM devices. And, also to provide interface to real world through ADCs and DACs.

The goal is to focus on learning the kernel interface, while still programming real hardware.

**Required Skill-set:**

1. Keil IDE or Equivalent IDE
2. Embedded C
3. ARM architecture
4. LINUX OS
5. Circuit simulation software like Proteus, Multisim (MCU).

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### (A71084) ANALYTICAL INSTRUMENTATION LAB

1. Gas analyzers.
2. Gas and liquid chromatography.
3. Spectrometer: UV and VIS spectrometer.
4. Spectrometer: IR and FT IR Spectrometer.
5. Flame photometer.
6. Measurement of calorific value.
7. Mass spectrometer.
8. pH Meter.
9. Conductivity Meter.
10. Bomb Calorimeter.
11. GM Counter.
12. Measurement of Gas Pollutents- Co, No, So.
13. NMR Spectrometer.
14. Water Purity Measurement.
15. Turbidity Measurement.

**(To perform any Twelve experiments)**



**Equipment:**

Gas/ Liquid chromatographer, Gas Analyzer, UV & VIS spectrometer, IR spectrophotometer, Absorption spectrophotometer, Flame photometer, Bomb calorimeter.