ADIKAVI SRI MAHARSHI VALMIKI UNIVERSITY, RAICHUR

DEPARTMENT OF POST GRADUATE STUDIES AND RESEARCH IN INSTRUMENTATION TECHNOLOGY

Ph.D. Course Work Syllabus
(With effect from 2025-26 and onwards)

Course Duration: Six months

Paper No.	Paper Title	Marks			End Exam. Time	Lecture Hrs.	Credit Value
		End Exam	I.A*	Total			
	Compulsory Papers						
HCT1.1	Research Publication and Ethics	35	15	50	2Hrs	2Hrs/Week	2
HCT1.2	Research Methodology	70	30	100	3Hrs	4Hrs/Week	4
HCT1.3	Recent Trends in Instrumentation	70	30	100	3Hrs	4Hrs/Week	4
	Elective Papers						
SCT1.1	Scientific/Analytical Instrumentation	70	30	100	3Hrs	4Hrs/Week	4
SCT1.2	Biomedical Instrumentation	70	30	100	3Hrs	4Hrs/Week	4
SCT1.3	Instrumentation in Process Industries	70	30	100	3Hrs	4Hrs/Week	4
SCT1.4	Agricultural Instrumentation	70	30	100	3Hrs	4Hrs/Week	4

Total Number of Credits = 14

HCT1.1 : RESEARCH PUBLICATION AND ETHICS

Contact hours per week: 2 *Total Hours: 30*

Unit-I: PHILOSOPHY AND ETHICS (3 hrs): Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgements and reactions

SCIENTIFIC CONDUCT (5 hrs): Ethics with respect to science and research; Intellectual honesty and research : Integrity; Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP): Redundant publications: duplicate and overlapping publications, salami slicing; Selective reporting and misrepresentation of data

Unit-II: PLIBLICATION ETHICS (7 hrs)

Publication ethics: definition, introduction and importance; Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types; Violation of publication ethics, authorship and contributorship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.

Unit-III: OPEN ACCESS PUBLISHING (4 hrs): Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU; Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

PUBLICATION MISCONDUCT (4 hrs):

A. **Group Discussions (2 hrs.) -** Subject specific ethical issues, FFP, authorship; Conflicts of interest; Complaints and appeals: examples and fraud from India and abroad.
B. **Software tools (2 hrs.) -** Use of plagiarism software like Turnitin, Urkund and other open source Software tools

Unit-IV: DATABASES AND RESEARCH METRICS (7hrs)

A. **Databases (4 hrs):** Indexing databases; Citation databases: Web of Science, Scopus, etc
B. **Research Metrics (3 hrs):** Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g index, i10 index, altmetrics

Reference Books:

1) C. R. Kothari, Research Methodology: Methods and Techniques, New Age International Pulishers, New Delhi, 2004
2) Deepak Chawla and Neena Sodhi, Research Methodology, Concepts and cases, 2nd ed., Vikas Publishing House Pvt Ltd., New Delhi, 2015
3) Vinayak Bairagi and Mousami V Munot, Research Methodology: A practical and Scientific Approach, CRC Press, New York, 2019
4) Comstock Gary, Research Ethics, Cambridge University Press, 2013
5) David Bridges, Philosophy in Educational research, Epistemology, Ethics, politics and quality, Springer International Publishing, AG, 2017
6) Peter Pruzan, Research Methodology; The Aims, Practices and Ethics of Science, Springer International Publishing, Switzerland, 2016.
7) C. George Thomas, Research Methodology and Scientific writing, II Edition, Springer, 2021.

HCT 1.2: RESEARCH METHODOLOGY

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

UNIT I: Introduction **16 Hrs**

Introduction. Objectives & motivation of research. Defining research problems. Types & significance of research. Research methods vs. methodology. Research and scientific method. Research process. Criteria of good research. Importance of research & development (R&D) activity in the field of instrumentation.

UNIT II: Report Writing **16 Hrs**

Methodology involved in selecting the research topic. Literature review using library & web resources. Collection of literature from primary, secondary, and tertiary sources. Important research journals in the area of instrumentation and their emphasis. Technical report writing. Research paper writing & publishing.

UNIT III: Statistical Methods and Data Analysis **16 Hrs**

Basic statistical concepts: types of measured quantities. Central tendency of data. Best estimate of true value of data. Measures of dispersion. Standard deviation of the mean. Graphical representation and curve fitting of data: Equations of approximating curves. Determination of parameters in linear relationship. Least square equations of second degree and higher.

UNTI IV: MATLAB **16 Hrs**

Introduction to MATLAB, Structure of MATLAB, File types, MATLAB windows, MATLAB Programming: M-file program, SIMULINK, and GUI programming. Role of MATLAB in Instrumentation.

BOOKS FOR STUDY:

1. C. R. Kothari – Research Methodology: Methods and Techniques
2. Jonathan, Anderson, Bairy M. Durkson, Millicent, Pulle – Thesis and Assignment Writings
3. B C Nakra & K K Choudhry – Instrumentation, Measurement and Analysis
4. MATLAB Programming- Y. Kirani Singh & B.B Chaudhury

BOOKS FOR REFERENCE:

1. R L Dominowaski – Research Methods, PH, NJ, 1980.
2. B A V Sharma, D Rajendra Prasad & P Satyanarayana – Research Methods in Social Sciences
3. Rangan, Mani, Sharma – Instrumentation Devices and Systems
4. Ernest O. Doebelin – Measurement Systems, Application and Design, (MGH)
5. Robert A. Day – How to write and publish a scientific paper, Institute of Scientific Information Press (1979), Philadelphe
6. Amos Gilat – MATLAB: An introduction with Applications
7. Rudra Pratap - Getting Started with MATLAB 7

HCT1.3: RECENT TRENDS IN INSTRUMENTATION

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

UNIT I: Intelligent Instrumentation 16 Hrs

Intelligent vs Dumb instruments. Block diagram of Intelligent Instruments. Design and development of Intelligent Instruments. Advantages, Examples and Applications of Intelligent Instruments.

UNIT II: System on chip 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. Programming and Applications.

UNIT III: IoT Based Instrumentation 16 Hrs

Definition of IoT. Introduction to cloud computing, Overview of IoT supported hardware platform such as Raspberry PI, ARM Processor, Arduino board. ESP32, IoT architecture. IoT applications.

UNIT IV: Advanced Controllers 16 Hrs

Digital PID Controllers, Cascade and Feed Forward Control Systems, Direct Digital Control Systems, Supervisory Control Systems, Distributed Control Systems (DCS).Fuzzy set theory, Fuzzy logic controllers, PLC block diagram, PLC Hardware, , Programming the PLC.

BOOKS FOR STUDY:

1. Artificial Intelligence and Intelligent Systems, N.P Padhy, Oxford University Press, 2005.
2. ARM7 (LPC2129) User Manual
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
4. Industrial Control Electronics – Michael Jacob
5. Modern Control Technology – Christopher T. Killian

BOOKS FOR REFERENCE:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Tata McGraw Hill, 2006
2. The Internet of Things: From RFID to the Next-Generation Pervasive Networked, Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
3. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
4. Computer based Industrial Control – Krishna Kant
5. Programmable Logic Controllers – John Webb

SCT1.1: SCIENTIFIC/ANALYTICAL INSTRUMENTATION

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

UNIT I: Intelligent Analytical Instruments 16 Hrs

Emission Spectroscopy: Flame Photometers, Flourimeters, Phosphorometers, Scanning Tunnelling Microscope (STM), Atomic Force Microscope (AFM): Principle and working with block and schematic diagrams, salient features of individual blocks, and applications.

UNIT II: Radio Chemical Instruments 16 Hrs

Radiation detectors, Gamma ray spectrometer, X-ray spectrometers, Mossbauer spectrometer: Principle and working with block and schematic diagrams, salient features of individual blocks, and applications.

UNIT III: Spectrometers 16 Hrs

Photoacoustic spectrometers - Resonating, non-resonating types. Photothermal spectrometers. DSC: Principle and working with block and schematic diagrams, salient features of individual blocks, applications.

UNIT IV: Environment Monitoring and Analysis 16 Hrs

Electrochemical analysers, ion selective electrodes, ion analysers, Environment pollution monitoring instruments, Air pollution monitoring instruments: Carbon dioxide, hydrocarbons, sulphur dioxide, nitrogen oxide, oxides. Water pollution monitoring instruments: TDS, dissolved oxygen, turbidity, pH, conductivity, chloride, fluoride.

BOOKS FOR STUDY:

1. Skoog, Holler, Nieman - Principles of Instrumental Analysis, 5th ed.
2. R S Khandpur – Handbook of Analytical Instruments.
3. Chatwal and Anand - Instrumental Methods of Analysis.

BOOKS FOR REFERENCE:

1. Willard, Merritt, Dean, Settle - Instrumental Methods of Analysis, 7th ed

SCT1.2: BIOMEDICAL INSTRUMENTATION

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

UNIT I: Introduction **16 Hrs**

Development of biomedical instrumentation. Physiological system of the body. Transducers for biomedical applications.

UNIT II: Patient Care Monitoring **16 Hrs**

Patient care and monitoring. The elements of intensive care monitoring. Instruments for patient monitoring system. Intensive care unit (ICU). Intensive coronary care unit (ICCU). Emergency room. - Computerised Patient monitoring system.

UNIT III: Laser Application in Medicine **16 Hrs**

Advantages of laser surgery - Laser based Doppler blood flow meter- Endoscope -Cardio scope –Laparoscope.

UNIT IV: Computer applications in Medicine **16 Hrs**

Computer aided ECG analysis- Computerized Catheterisation Laboratory. Computer controlled ultrasonic imaging –Applications. Computer aided tomography, MRI and applications.

BOOKS FOR STUDY:

1. Leslie Cromwell -Biomedical instrumentation and measurements -Prentice Hall.
2. L.A. Geddes and L.E. Baker -Principles of Applied biomedical instrumentation-John Wiley & Sons

BOOKS FOR REFERENCE:

1. B. Jacobson and J.G. Webster -Medicine and Clinical Engineering -Prentice Hall of. India
2. Macka Sturat Biomedical telemetering- John Wiley.
3. R.S. Khandpur -Handbook of biomedical engineering -Tata McGraw Hill.

SCT1.3: INSTRUMENTATION IN PROCESS INDUSTRIES

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

UNIT I: Instrumentation in Thermal Industries 16 Hrs

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

UNIT II: Instrumentation in Cement Industries 16 Hrs

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

UNIT III: Instrumentation in Iron and Steel Industries 16 Hrs

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

UNIT IV: Instrumentation in Petrochemical Industries 16 Hrs

Description of the process/plant, control of distillation tower, refrigeration units, system boilers, furnaces, crystallizers, heat exchangers, pumps, compressors and evaporators as applied to the petrochemical industry.

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

SCT1.4: AGRICULTURAL INSTRUMENTATION

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

UNIT I: Introduction **16 Hrs**

Necessity of instrumentation and control for agriculture, sensor requirement, remote sensing, biosensors in agriculture.

UNIT II: Soil Properties & Sensing **16 Hrs**

Properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis. Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples.

UNIT III: Greenhouse Parameters & Instrumentation **16 Hrs**

Greenhouse effect, Concept & construction of green houses, merits & demerits, ventilation, cooling & heating, wind speed, temperature & humidity, soil moisture, light intensity, rain gauge, carbon dioxide enrichment measurement & control.

UNIT IV: Computer Application in Agriculture **16 Hrs**

Role of instrumentation in agriculture. Application of smart instruments like Robots & Drones in agriculture, pesticide spray control, image processing and analysis for quality control.

BOOKS FOR STUDY:

1. Industrial instrumentation, “Patranabis”, TMH.
2. Principle of Farm Machinery, R.A Kepner, Roy Bainer;: CBS Publication
3. Process control and instrumentation technology, “C.D. Johnson”, PHI

BOOKS FOR REFERENCE:

4. Instrumentation handbook-process control, “B. G. Liptak”, Chilton.
5. Wills B.A., “Mineral Processing Technology”, 4th ed., Pergamon Press
6. Agricultural Engineering; RadheyLal: Saroj Publication
7. Environmental Engineering, Peary. II. S. and Others