

Curriculum and Syllabus

of

Pre- Ph.D. Course

for

Doctor of Philosophy (Ph.D.)

in

Instrumentation Engineering

(Applicable for 2024-25 batch and onwards)



**Department of Instrumentation Engineering
School of Engineering and Technology,
H. N. B. Garhwal University,
Srinagar Garhwal, Uttarakhand- 246174**

Pre- Ph.D. Course (Instrumentation Engineering)

Pre-Ph.D. Course-work Scheme			
S. No.	Course Code	Course Name	Credits
1	SET/IE/R101	Research Methodology	4
2	SET/IE/R102	Research and Publication Ethics (RPE)	3
3	-	Elective – I	4
4	-	Elective – II	4
		Total	15

*List of Courses for Elective-I and Elective-II			
S. No.	Course Code	Course Name	Credits
1	SET/IE/RE103	High Vacuum Instrumentation	4
2	SET/IE/RE104	Analytical Instruments	4
3	SET/IE/RE105	Sensors and Transducers	4
4	SET/IE/RE106	Thin Film Deposition and Characterization Techniques	4
5	SET/IE/RE107	Process Instrumentation and Control	4
6	SET/IE/RE108	Embedded Systems for Instrumentation	4

*Student has to choose any two courses from the list of electives

SET/IE/R101: Research Methodology

UNIT-I

Research Methodology: Introduction, Meaning of Research, Objective of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Defining the Research Problem: Research Problem Definition, Selecting the Problem, Necessity of Defining the Problem, Techniques involved in Defining a Problem.

UNIT- II

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Dependent and Independent Variable, Extraneous Variable, Control, Confounded Relationship, Research Hypothesis, Experimental and Non-Experimental Hypothesis-Testing Research, Experimental and Control Groups, Treatments, Experiment and Experimental Unit(s).

Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey Versus Census Survey, Types of Sampling Designs, Non-probability Sampling, Probability Sampling, Complex Random Sampling Designs.

UNIT- III

Data Collection: Introduction, Experiments and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Data Preparation: Data Preparation Process, Questionnaire Checking, Editing, Coding, Classification, Tabulation, Graphical Representation, Data Cleaning, Data Adjusting, Some Problem in Preparation Process, Missing Values and Outliers, Types of Analysis, Statistics in Research.

Use of internet in research work: Use of internet networks in research activities in searching material, paper downloading, submission of papers, relevant websites for journals and related research work. Introduction to Patent laws etc., process of patenting a research finding, Copyright, Cyber laws.

References:

1. Research Methodology Methods and Techniques, Kothari, C. R., Wiley Eastern Ltd.
2. Microsoft Excel Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Press, ISBN: 0735619018.
3. Research Methodology: a step-by-step guide for beginners, Kumar, Pearson Education.
4. Practical Research Methods, Dawson, C., UBSPD Pvt. Ltd.
5. Research Methodology, Sharma, N. K., KSK Publishers, New Delhi.

SET/IE/R102: Research and Publication Ethics (RPE)

About the Course:

Overview: This course has 6 modules mainly focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, impact factor, etc.) and plagiarism tools will be introduced in this course.

THEORY

RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

RPE 02: SCIENTIFIC CONDUCT (5 hrs.)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: falsification, fabrication, and plagiarism
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

RPE 03: PUBLICATION ETHICS (7 hrs.)

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

PRACTICE

RPE 04: OPEN ACCESS PUBLISHING (4 hrs.)

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies.
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

RPE 05: PUBLICATION MISCONDUCT (4 hrs.)

A. Group Discussions (2 hrs.)

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. 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

RPE 06: DATABASES AND RESEARCH METRICS (7 hrs.)

A. Databases (4 hrs.)

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics (3 hrs.)

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP and Cite Score
2. Metrics: h-index, g-index, i10 index, altmetrics

Seminar in thrust area(s) of the research interest

Candidate has to prepare and present a seminar in the department related to a specific field of his/her research interest, elaborating its current status, different methodologies, and advancements.

References:

1. Bird, A. (2006). Philosophy of Science, Routledge
2. Macintyre, Alasdair (1967) A short history of ethics. London
3. Praveen Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 9789387480865
4. Beall, J. (2012) Predatory publishers are corrupting open access. Nature, 489 (7415), 179-179.

SET/IE/RE103: High Vacuum Instrumentation

Kinetic theory of gases in closed system;
Production and measurement of high vacuum;
Materials for vacuum environment;
Vacuum system design and fabrication;
Leak detection;
Applications of high vacuum in thin film technology.

Textbooks/ References

1. Roth, A., Vacuum Technology, Elsevier Science, 1996.
2. Lafferty, J. M., Foundations of Vacuum Science and Technology, John Wiley and Sons, 1998.
3. Chopra, K. L., Thin Film Phenomena, Rober G. Krieger Publishing, NY, 1979.

SET/IE/RE104: Analytical Instruments

Principles, instrumentation, design and application of
UV, visible and IR spectroscopy;
Mass spectrometry;
X-ray methods of analysis including powder diffraction;
Electron microscopy and microprobe;
Scanning tunneling and atomic force microscopy;
Chromatography;
Thermal analysis including DTA, DSC and TGA.

Textbooks/ References

1. Willard, H. W., Merritt, L. L., Dean, J. A., and Settle, F. A., Instrument Methods of Analysis Sixth Edn, East West Publishers, 1992.
2. Strong, D. A., Holler, F. J., and Nieman, T. A., Principles of Instrumental Analysis (Fifth Edn,) Saunders, 1998.
3. Wiston, C., X Ray Methods, John Wiley and Sons, 1991.

SET/IE/RE105: Sensors and Transducers

Sensor fundamentals, classification of sensors, general sensor characteristics;
Strain sensors, pressure and force sensors;
Vacuum sensors, radiation sensors;
Sensors for biomedical applications;
Accelerometer, flow sensors;
Actuators, dc motor, stepper motor;
Piezoelectric sensors and actuators;
Signal conditioning amplifiers, filters, ADC and DAC.

Textbooks/ References

1. Norton, H. N., Handbook of Transducers, Prentice Hall, 1989.
2. Gardner, J. W., Microsensors: Principles and Applications, John Wiley, 1994.
3. Ristic, L. R. (ed.), Sensor Technology and Devices, Artech House Publishers, 1994.

SET/IE/RE106: Thin Film Deposition and Characterization Techniques

Deposition techniques: Electroplating, CVD, sol-gel, electron, ion beam, flash and laser evaporation, MBE
DC and RF diode, triode and magnetron sputtering;
Deposition systems and accessories: design and fabrication details of electron beam guns, ion sources;
Film thickness measurement and monitoring techniques;
Film characterization techniques: X-rays and electron beam techniques for structure and composition;
Instrumentation for measuring electrical, optical and electromechanical properties of films.

Textbooks/ References

1. Chopra, K. L., Thin Film Phenomena, Rober G. Krieger Publishing, NY, 1979.
2. Maissel, L., and Glong, R., Hand Book of Thin Film Technology, McGraw Hill, London, 1970.
3. Àpar Vassen, J. L., and Kem, W., Thin Film Process, Academic Press, NY, 1978.

SET/IE/RE107: Process Instrumentation and Control

Measurement of process and system variables;
Thermal, mechanical and optical sensors;
Analog and digital signal conditioning;
Principles of automatic control, discrete state process control;
Control hardware, actuators, relays, switches and valves;
Analog and digital controllers;
Control loop characteristics and analysis, Process tuning;
PLCs in process control, distributed control systems.

Textbooks/ References

1. Johnson, C. D., Process Control Instrumentation Technology, Prentice Hall of India, 1996
2. Doebelin, E. O., Measurement Systems – Application and Design, McGraw Hill, 1975.
3. Ogata, K., Modern Control Engineering, Prentice Hall of India, 1994.
4. Petruzella, Frank D., Programmable Logic Controllers (3rd ed.), McGraw Hill Higher Education, 2005.

SET/IE/RE108: Embedded Systems for Instrumentation

Overview of embedded systems and processors, state of the art processors, DSP processors;
Introduction to DSP processors, Fields of application, Arm Cortex-M based Microcontrollers;
AVR microcontrollers and embedded systems;
AVR Architecture and Programming;
Brach, Call and time delay loop;
AVR I/O port programming;
Arithmetic, Logical Instructions and Programs;
AVR advanced Programming;
AVR programming in C;
AVR Timer, Interrupt and Serial port Programming;
LCD, Keyboard, Relay and Stepper motor Interfacing;
Input capture and Wave generation;
Use of PWM, SPI and I2C for Interfacing with examples.

Textbooks/ References

1. Mazidi, M.A., Naimi, S., AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson, 2017.
2. Steven F. Barrett, Daniel J. Pack, Atmel AVR Microcontroller Primer, Morgan & Claypool Publisher, 2012.
3. Richard H. Barnett, Sarah Cox, Larry O'Cull, Embedded C Programming and the Atmel AVR, Cengage India, 2006.
4. Steven W. S., The Scientist and Engineer's Guide to Digital Signal Processing, California Technical Publishing, 1999.