

Savitribai Phule Pune University

(Formerly University of Pune)

Syllabus for M.Phil./Ph.D. (PET) Entrance Exam : Electronics Science

Research Methodology

1. **Foundation of Research:** Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - understanding the language of research - Concept, Construct, definition, Variable. Research Process
2. **Problem Identification & Formulation:** definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem, Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & importance
3. **Research Design:** Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables.
4. **Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches.
5. **Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.
6. **Measurement:** Concept of measurement - what is measured? Problem in measurement in research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.
7. **Sampling:** Concept of Statistical population, Sample, Sampling Frame, Sampling Error, Sample size, Non Response. Characteristics of a good sample. Probability Sample - Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample - Practical considerations in sampling and sample size.
8. **Data Analysis:** data Preparation - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test including testing hypothesis of association.
9. **Interpretation of Data and Paper Writing:** Layout of a Research Paper, Journals in Electronics Science, Impact factor of journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. Use of Encyclopedias, Research Guides, Handbook etc., Academic databases for concerned discipline .
Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/mendeley, Software for paper formatting like LaTeX/MSOffice, software for detection of Plagiarism.
10. **Reporting and Thesis writing:** Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, Structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effective communication

11. **Application of results and ethics:** Environmental impacts - Ethical issues - ethical committees - Commercialization - Copy right - royalty - Intellectual property rights and patent law - Trade related aspects of intellectual property Rights - Reproduction of published material - Plagiarism - citation and acknowledgement - citation and acknowledgement - Reproducibility and accountability.
12. **Reasoning and Mentalability:** Analogy, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test, Representation through Venn-diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions, Statement & actions

Books Recommended

- 1) Research Methodology - C. R. Kothari
- 2) Research Methodology : An Introduction - Stuart Melville and Wayne
- 3) Practical Research Methods - Catherine Dawson
- 4) Select references from the Internet

REFERENCES

- 1) Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002. An introduction to Research Methodology, RBSA Publishers.
- 2) Kothati , C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
- 3) Sinha, S. C. and Dhiman, A. K., 2002. Research Methodology, Ess Ess Publications. 2 columes.
- 4) Trochim, W. M. K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p
- 5) Wadehra, B. L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

Additional reading

- 1) Anthony, M., Graziano, A. M. and Raulin, M. L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
- 2) Carlos, C. M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
- 3) Coley, S. M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
- 4) Day, R. A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
- 5) Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
- 6) Leedy, P. D. and Ormrod, J. E., 2004 Practical Research: Planning and Design, Prentice Hall.
- 7) Satarkar, S. V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

Subject Concerned Syllabus

Electronic Science (Ph.D.)

Unit—I

Electronic Transport in semiconductors, PN Junction, Diode equation and diode equivalent circuit,. Breakdown in diode. Zener diode, Tunnel diode, characteristics and equivalent circuits of BJT, JFET, MOSFET, Fabrication of Semiconductor devices and ICs.

Unit—II

SMPS, UPS, inverters, converters, Biasing of Bipolar junction transistors and JFET. Single stage amplifiers, Multistage amplifiers. Feedback in amplifiers, oscillators, function generators, multi vibrators, Operational Amplifiers (OPAMP)-characteristics and Applications, Computational Applications, Integrator, Differentiator, Wave-shaping circuits, F to V and V to F converters. Active filters, Schmitt trigger, Phase locked loop.

Unit—III

Logic families, flip-flops, Gates, Boolean algebra and minimization techniques, multiplexers and de multiplexers, Arithmetic circuits, Multivibrators and clock circuits, Counters-Ring, Ripple, Synchronous, Asynchronous, Up and down, shift registers, Memories, A/D and D/A converters.

Unit—IV

Architecture of microcontroller/microprocessor (Atmega, AVR, PIC, ARM), Embedded, Software development cycle, Memory and I/O interfacing, wired and wireless communication protocols, interrupts, embedded system design tools, Logic Analyzer, DAQ's, Operating system concepts and RTOS .

Unit—V

Maxwell's equations, Time varying fields, Wave equation and its solution, Rectangular waveguide, Poynting vector, Antenna parameters, Half-wave antenna, Transmission lines. Characteristic Impedance, Impedance matching, Smith chart

Unit—VI

Basic principles of amplitude, frequency and phase modulation, Demodulation, Intermediate frequency and principle of superheterodyne receiver, Spectral analysis and signal transmission through linear systems, Random signals and noise, Noise temperature and noise figure. Basic concepts of information theory, Digital modulation and Demodulation PM, PCM, ASK, FSK, PSK, Time-division Multiplexing, Frequency-Division Multiplexing, Data Communications-Circuits, line Codes, error detection and correction codes, GSM, GPRS and Modems.

Unit—VII

Optical sources-LED, Spontaneous emission, Stimulated emission, Semiconductor Diode LASER, Photodetectors-*p-n* photodiode, PIN photodiode, Phototransistors, Optocouplers, Solar cells, Display devices. Optical Fibres-Light propagation in fibre, Types of fibre, Characteristic parameters, Modes, Fibre splicing and connectors, Fibre optic communication system-coupling to and from the fibre, Modulation, Multiplexing and coding, Repeaters, Bandwidth and Rise time budgets.

Unit—VIII

Transduces-Resistance, Inductance Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Thermogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed and sound temperature, pressure, flow, humidity, thickness, pH, position.

UNIT-IX

Instruments – Digital Storage Oscilloscopes, signal generators, function generators, spectrum analyser, Power meters, dB meters, LUX meter, energy meters, GPS navigation system

Unit—X

Advanced Electronic Systems: DSP/Image Processing systems, Set top box, smart phone, digital camera, MP/MP4, SMART TV, CCTV, Solar PV system controllers, and converters

Subject Concerned Syllabus Electronic Science (M.Phil)

Unit—I

Electronic Transport in semiconductor, PN Junction, Diode equation, Breakdown in diodes. Zener diodes, Tunnel diode, characteristics and equivalent circuits of BJT, JFET, MOSFET

Unit—II

Rectifiers, Voltage regulator ICs and regulated power supply, Biasing of Bipolar junction transistors and JFET. Single stage amplifiers, Multistage amplifiers. Feedback in amplifiers, oscillators, function generators, multi vibrators, Operational Amplifiers (OPAMP)-characteristics and Applications, Computational Applications, Integrator, Differentiator, Wave-shaping circuits, F to V and V to F converters. Active filters, Schmitt trigger, Phase locked loop.

Unit—III

Logic families, flip-flops, Gates, Boolean algebra and minimization techniques, multiplexers and demultiplexers, Arithmetic circuits, Multivibrators and clock circuits, Counters-Ring, Ripple, Synchronous, Asynchronous, Up and down, shift registers, Memories, A/D and D/A converters.

Unit—IV

Architecture of 8051 and 8086, Addressing modes, Software development, Memory and I/O interfacing, interrupts, embedded system design tools editors, compilers, assemblers, debuggers, simulator & emulators, IDE.

Unit—V

Various data types in C, Storage classes in C, Decision-making and forming loops in program, Handling character strings. Arrays, Structure and union in C, User defined function, Pointers in C, Pointer to structures, pointer to functions. Dynamic data structure, file handling.

Unit—VI

Maxwell's equations, Time varying fields, Wave equation and its solution, Rectangular waveguide, Propagation of waves, Rectangular waveguide. Poynting vector, Antenna parameters, Half-wave antenna vector, Transmission lines, Characteristic Impedance, Smith chart.

Unit—VII

Basic principles of amplitude, frequency and phase modulation, Demodulation, Intermediate frequency and principle of superheterodyne receiver, Basic concepts of information theory, Digital modulation and Demodulation PM, PCM, ASK, FSK, PSK, Time-division Multiplexing, Frequency-Division Multiplexing, Data Communications-Circuits, Codecs and Modems

Unit—VIII

Optical sources-LED, Spontaneous emission, Stimulated emission, Semiconductor Diode LASER, Photodetectors-*p-n* photodiode, PIN photodiode, Phototransistors, Optocouplers, Display devices. Optical Fibres-Light propagation in fibre, Types of fibre, Characteristic parameters, Modes, Fibre optic communication system-coupling to and from the fibre, Modulation, Multiplexing and coding, Repeaters, Bandwidth and Rise time budgets.

Unit—IX

Transducers-Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of displacement, velocity, acceleration, force, torque, strain, speed and sound temperature, pressure, flow, humidity, thickness, pH, position.

Unit—X

Open-loop and close-loop control system, Error amplifier, on-off controller, Proportional (P), Proportional-Integral (PI). Proportional-Derivative (PD), PID controllers