Curriculum and Syllabus

of

Pre- Ph. D. Course

for

Doctor of Philosophy (Ph. D.)

in

Electronics and Communication Engineering

(Applicable for 2024-25 batch and onwards)

Department of Electronics and Communication Engineering
School of Engineering and Technology,
H. N. B. Garhwal University (A Central University),
Srinagar Garhwal, Uttarakhand - 246174

Pre- Ph. D. Course (Electronics and Communication Engineering)

Pre- Ph. D. Course-work Scheme			
S. No.	**Course Code**	**Course Name**	**Credits**
1	SET/ECE/R101	Research Methodology	4
2	SET/ECE/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/ECE/RE103	Semiconductor Device Modeling	4
2	SET/ECE/RE104	Physics of Nanoscale Transistors	4
3	SET/ECE/RE105	CMOS VLSI Design	4
4	SET/ECE/RE106	Low Power VLSI Design	4
5	SET/ECE/RE107	CMOS Analog VLSI Circuits	4
6	SET/ECE/RE108	Digital Design using Verilog HDL	4

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

SET/ECE/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/ECE/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/ECE/RE103: Semiconductor Device Modeling

Introduction to semiconductor device models and their applications; Semi-classical Bulk Transport: qualitative model, EM field and transport equations; Drift-Diffusion Transport Model: – Equations, Boundary Conditions, Mobility and Generation / Recombination; Characteristic times and lengths; Energy band diagrams; Different types of device models; MOSFET Model: Structure and Characteristics, Qualitative Model, Equations, Boundary Conditions and Approximations, Surface Potential based and Threshold based solution, Model Testing, Improvement and Parameter Extraction;

References:

1. T. A. Fjeldly, T. Ytterdal and M. Shur, “Introduction to Device Modeling and Circuit Simulation”, John Wiley, 1998.
2. Y. Taur and T. H. Ning, “Fundamentals of Modern VLSI Devices”, Cambridge University Press, 2016.
3. Robert F. Pierret, “Advanced Semiconductor Fundamentals”, Pearson, 2002

SET/ECE/RE104: Physics of Nanoscale Transistors

Overview of MOS field effect transistor; Device model of double gate MOSFETs and FINFETs; Ballistic silicon transistor; Quasi-ballistic transistor; Subthreshold conduction, threshold voltage and its dependence, short channel MOSFETs: effective mobility, 2D electrostatics, scaling, channel profile and S/D engineering, leakage mechanisms in MOSFET; Strained silicon; SOI MOSFET; Nanowire transistor; Molecular scale transistor; Heterostructure FETs; Basic concepts of Schrödinger Equation; Self-Consistent Electrostatics; Band-structure of new channel materials (III-V material), 2D Nanomaterials for Flexible Electronics (graphene); Quantum effects in FINFET; Tunneling FET; Nanosheet Transistors; Complementary FET;

References:

1. Y. Taur and T. H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 2016.
2. Robert F. Pierret, "Advanced Semiconductor Fundamentals", Pearson, 2002
3. S. Dutta, "Quantum Transport: Atom to Transistor", Cambridge University Press, 2005.
4. M. Lundstrom and J. Guo, "Nanoscale Transistors: Device Physics, Modeling, and Simulation", Springer, 2005.
5. Relevant research articles.

SET/ECE/RE105: CMOS VLSI Design

Introduction to MOS transistor theory; Circuit characterization and simulation; estimation of delay and power; method of logical effort; interconnect design and analysis; combinational circuit design; sequential circuit design; Design methodology & tools, testing & verification; datapath subsystems; array subsystems; power and clock distribution; introduction to packaging.

References:

1. N. H. E. Weste and D. M. Harris, "CMOS VLSI Design : A Circuits and Systems Perspective", Pearson, 2015.
2. J. M. Rabey, A. Chandrakasan and B. Nicolic, "Digital Integrated Circuits A Design Perspective", Pearson, 2015.

SET/ECE/RE106: Low Power VLSI Design

Modeling and sources of power consumption in VLSI Circuits; Power estimation at circuit, transistor, and gate levels; Low power VLSI design techniques: Supply Voltage Scaling Approaches, Switched Capacitance Minimization Approaches, Leakage-power minimization approaches; Optimization of power dissipation at architecture and algorithmic levels; CAD/ software for low power synthesis; Low power memory design; Adiabatic switching circuits;

References:

1. A. Bellamour, and M. I. Elmasri, "Low Power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.
2. Anantha P. Chandrakasan and Robert W. Brodersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.
3. Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Design", Wiley-Interscience, 2000.

SET/ECE/RE107: CMOS Analog VLSI Circuits

Devices: Review of Device Characteristics, DC and Small Signal MOS I/V Characteristics; Small signal models of MOS; CMOS Processing and Layout; Analog Circuits: CS and CG Amplifiers, Source followers, Cascodes, Current Mirrors, Differential Pairs, Voltage and Current References; Frequency Response; Noise; Feedback; Nonlinearity and Mismatches; Short-channel effects and device modeling for analog design; Larger Circuits and Sub-systems: Basic operational amplifier design, Stability and Compensation, Fully differential op-amps, Common Mode Feedback, Internally compensated 2-stage CMOS operational amplifier design; Design examples for single-stage CMOS amplifiers and a complete CMOS operational amplifier.

References:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Education, 2002.
2. Grey, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley, 2009.
3. Relevant research papers and patents.

SET/ECE/RE108: Digital Design using Verilog HDL

Combinational and sequential logic design; FSM design; Digital Design Flow, High Level Design, Verilog Descriptions of Digital Systems and Simulation; Synthesis; Design using Programmable Logic Devices; SM Charts; Field Programmable Gate Arrays (FPGAs); Test Generation and Design for Testability; Rapid Prototyping using FPGAs.

References:

1. C. Roth and L. John, "Digital System Design Using Verilog", Cengage Learning, 2016.