ELCPHD 101: Research Methodology and Research Publication Ethics (RPE) and Computer Application. Marks: 50

SECTION-A

Basic concepts of Research Methodology **20 Marks**

a) Definition of Research Methodology-Distinction between Method and Methodology-Different kinds of Research
b) Finding Library Resources: Computer Literacy; Use of e-books; e-Journal & JSTOR
c) Style of Referencing-sources, quoting sources, abbreviation
d) Bibliography: MLA and APA Formats
e) Punctuation, Proof Reading and Dia-critical marking
f) Writing a Term Paper
g) Reviewing Articles and Books
h) Writing a good Research Proposal

SECTION B
Research and Publication Ethics **20 Marks**

(a) PHILOSOPHY AND ETHICS (3hrs.)

1. Introduction to philosophy: Definition, nature and scope, concept, branches
2. Ethics: Definition, moral philosophy, nature of moral judgments and reactions, different branches of ethics, research ethics.
3. Responsibilities of researchers to fellow researchers, respondents, the public and the academic community.

(b) **SCIENTIFIC CONDUCT**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)
4. Redundant publications: Duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data
6. Privacy, autonomy, confidentiality and anonymity
7. The funding and sponsorship of research.

(c) **PUBLICATION ETHICS**

1. Publication ethics: definition introduction and importance
2. Best practices/standards setting initiatives and guidelines: COPE (Committee of Publication Ethics), WAME (World Association of Medical Editors), 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 contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals
8. The role of the researchers.

PRACTICE

(d) OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHERPA (Securing a Hybrid Environment for Research Preservation and Access) /RoMEO (Rights MEtadata for Open Archiving) online resource to check publisher copyright & self-archiving policies .
3. Software tool to identify predatory publications developed by SPPU (Sabitribai Phula Pune University)
4. Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester etc.

(e) PUBLICATION MISCONDUCT

A. Group Discussions

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

Use of plagiarism software like Turnitin, Urkund and other open-source software tools

(f) DATABASES AND RESEARCH METRICS

A. Databases

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

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

SECTION-C
Basic knowledge of Computer Application **Marks 10**

1. MS Word
2. Power Point Presentation
3. Spread Sheet / Excel Sheet
4. Use of Internet

ELCPHD 102: Statistical and Computational Tools Marks 50

Computer applications and Statistical methods used in electronics related problems, ANOVA, Numerical Methods advance Level, Electronics Design using LT SPICE. Python/ MATLAB programming, Graphical Data presentation using ORIGIN/MATLAB.

ELCPHD 103: (Any one of the ELCPHD 103A, ELCPHD 103B, ELCPHD 103C, ELCPHD 103D and ELCPHD 103E)

ELCPHD 103A: Electronic Materials Marks : 50

Electronic energy band theory: Approximation methods for calculation of energy bands, Many-electron theory, Hartree-Fock approximations for exchange and correlation energies. Electronic structures, physical and electronic properties of semiconductors, metals, and dielectrics, piezoelectric. Growth and structure of thin films. Preparation methods and thickness measurement. Electrical resistivity in bulk and thin films, Hall Effect, Magnetoresistance, Impedance spectroscopy.
X-ray diffraction (XRD); Transmission Electron Microscopy (TEM); Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Microanalysis (EDS), Neutron diffraction – Reflection High energy electron Diffraction (RHEED), Low energy Electron Diffraction (LEED), Atomic force microscopy (AFM), Raman spectroscopy and Thermal Gravimetric Analysis (TGA), Vector network analyser (VNA).

OR

ELCPHD103B: Advanced Semiconductor Devices Marks: 50

1. Diodes: P-N Junction, M-S contact, Schottky Effect, Thermionic Emission Theory, Barrier Height, Calculation and Measurement, Ohmic Contact, Heterojunction

2. Transistors: Transistor Fundamentals, Microwave Transistors, Power Transistors, Switching Transistors, Heterojunction Transistors, Hot Electron Transistors, Single Electron Transistors.
3. Field Effect Devices: JFET, MESFET, HEMT, MOSFET, Short Channel Effect, FinFET
4. Photonic Devices: Photo Diode, PIN Photo Diode, Avalanche Photo Diode, Solar Cell, Photo Transistors, OPFET, LED, Semiconductor Laser
5. Special Devices: Varactor Diode, Gunn Diode, Impatt Diode, SCR, UJT

OR

ELCPHD103C: Optical Communication Marks: 50

1. Overview of Optical Fiber Communication system: Historical development, advantages, disadvantages and applications of Optical Fiber Communication, Optical fiber structure, fiber materials, Light propagation within the fiber, numerical aperture of fiber, acceptance angle, step index and graded index fibers.
2. Transmission characteristics of optical fibers: Attenuation, losses and dispersions in optical fiber communication, dispersion-shifted fibers and dispersion-compenating fibers.
3. Optical sources: LED- LED structures, Internal quantum efficiency, Linearity, Radiation pattern and spectra, Modulation characteristics, Transient response; Lasers: Stimulated emission and lasing, Laser structures, Radiation pattern and spectra, Narrow-line width lasers, Modulation characteristics: Threshold current and its temperature sensitivity, Turn-on delay, Linearity; Gas Laser, Semiconductor laser.
4. Optical detections: Optical receiver operation, receiver sensitivity, Photoconductors, Semiconductor Photodiodes, Photo Transistors, noise, quantum limit of optical receiver, eye diagram, coherent detection and non-coherent detection, infrared sensors, burst mode receiver operation, analog receivers.
5. Fiber Couplers and connectors: Fiber alignment and joint loss, single mode fiber joints, fiber splices, fiber connectors and fiber couplers.
6. Analog and digital links: Overview of analog links, CNR, multichannel transmission techniques, RF over fiber, key link parameters, radio over fibe links, microwave photonics; digital links-overview of digital links, point-to-point links, system considerations, link power budget, short wavelength band, transmission distance for single mode fibers, power penalties, nodal noise and chirping.
7. Non-linear Optics and photonics: Nonlinear optical media, second and thied order nonlinear optical effects-wave mixing and conjugation, coupled wave theory, anisotropic and dispersive nonlinear media, optical solitons, photonic crystals-basic principle, Photonic crystal beam splitter, power combiner, resonator, photonic crystal based fibers as waveguides, negative refractive index based materials, surface Plasmon resonance
8. WDM concepts, components and networks: WDM operation, WDM standards, Mach-Zehender interferometer, multiplexer, isolators and circulators, direct thin film filters, active optical components, Optical amplifiers- Doped fiber amplifier, Raman gain amplifier, Brillouin gain amplifier, semiconductor optical amplifier, concept of MEM technology, variable optical attenuators, dynamic gain equalizers, optical drop

multiplexers, SONET/SDH, Optical interfaces, SONET/SDH rings, high-speed light waveguides,.

OR

ELCPHD103D: Advanced Electromagnetism, Radiation (Antenna) and Computational Electromagnetics
Marks: 50

1. **Transmission line:** Two wire Transmission line, Coaxial cable, Twisted cable, Planar structure transmission lines.
2. **Waveguide:** Rectangular, Circular, Dielectric wave guide.
3. **Antennas:** Dipole Antenna, Planar antenna, Aperture antenna, Waveguide and Horn antenna, Reflector antenna, Leaky wave antenna, Travelling wave antenna, Reconfigurable antenna, Fractal antenna, Frequency independent antenna. Antenna array.
4. **Antenna applications:** In communication, advanced wireless systems, Medical and Biological systems.
5. **Computational electromagnetic:** Introduction to FDTD/MoM.
6. **Optimisation techniques:** Introduction to Artificial Neural Network (ANN)/Genetic Algorithm/ Artificial Intelligence.
7. **Antenna simulation, fabrication and measurement:** Design and simulation of antennas using electromagnetic simulators, Fabrication and measurement of antenna,

(Subject may be discussed elaborately or briefly depending on research interest)

OR

ELCPHD103E: Antenna Theory and Microstrip antenna Marks: 50

1. Antennas: Introduction, types of antennas, radiation mechanism, current distribution on a thin wire antenna, historical advancement
2. Fundamental parameters of Antennas: Introduction, radiation pattern, radiation intensity, radiation power density, beamwidth, directivity, Efficiency, gain, bandwidth, polarization, input impedance, antenna vector effective length and equivalent areas, Friss transmission equation and radar range equation, antenna temperature
3. Arrays: Introduction, two element arrays, N element linear array: uniform amplitude and spacing, N element linear array: directivity, design procedure, N element linear array, three-dimensional characteristics, rectangular to polar graphical solution, N element linear array: uniform spacing, non uniform amplitude- super directivity_plannar array-design consideration, circular array.
4. Microstrip antennas: Introduction, Different types of patches, quality factor, bandwidth, efficiency, input impedance, coupling, circular polarization, arrays and feed network
5. Antenna measurements: Introduction, antenna ranges, radiation patterns, gain measurements, directivity measurements, radiation efficiency, impedance measurements, current measurement, polarization measurement, scale measurement.

ELCPHD104: Emerging Issues in core Areas of Research: Research assignment/Term Paper/ Term Project / Literature survey

Submission of dissertation: 25 marks

Presentation: 25 Marks

References

1. Richard Veit, Christopher Gould & John Clifford – Writing, Reading and Research (2nd Edn.).
2. Norman Blaikie – Approaches to Social Enquiry.
3. C. R. Kothari & Gaurav Garg – Research Methodology – Methods and Techniques (3rd Edn.)
4. Kate L. Turabian – A Manual for Writers of Research papers, Theses and Dissertation.
5. Jonathan Anderson, Barry H. Durston, Millicent Poole – Theses and Assignment
6. Bird A (2006) *Philosophy of Science.* Routledge.
7. MacIntyre, Alasdair (1967) *A Short History of Ethics, London*.
8. P. Chaddah, (2018): Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-9387480865
9. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition.* National Academies Press.
10. Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences,* 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfrn Beall, J. (2012). Predatory publishers are corrupting open access; **Nature**,489(7415),179-179.https://doi.org/10.1038/489l79a
11. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-l-7. (www.insaindia.res.in/pdf/EthicsBook.pdf)
12. Oliver Paul: *The Students Guide to Research Ethics*, Open University Press, McGrew Hill
13. H. Martyn and Anna Trainanou: *Ethics in Qualitative Research: Controversies and Contexts*, Sage, New Delhi.
14. Materials Characterization-Yang Lang
15. Semiconductor material and device characterization, Dieter K. Schroder
16. Introduction to Solid State Physics, Charles Kittel, 2nd Edition, 2005.
17. Materials Characterization Techniques- Sam Zhang, Lin Li, Ashok Kumar
18. Electronic Properties of Materials, R.E. Hummel, Springer-Verlag, 3rd edition, 2001
19. Functional and Smart Materials, Z. L. Wang and Z.C. Kang, Springer, 1998.
20. John Wilson and John Howkes, Opto Electronics: An Introduction, PHI.
21. Liao, Microwave Devices and Circuits, PHI.
22. Michel Shur, Physics of Semiconductor Device, PHI.
23. Pallab Bhattacharya, Semiconductor Opto Electronic Devices, PHI.

24. S. M. Sze, Physics of Semiconductor Device, Wiley-India edition.
25. S. M. Sze, Semiconductor Device: Physics and Technology, Wiley-India edition.
26. Optical Fiber Communication-G. Keiser, 4th Edition, MGH, 2008
27. Optical Fiber Communication-J. M. Senior, Pearon Education 3rd Impression, 2007

28. Introduction to fiber optics- A. K. Ghatak and K. Thyagarajan, Cambridge University Press, UK, 1998.

29. Raman amplifiers for telecommunications 1: Physical principles- M. N. Islam, Springer-Verlag, New York, 2003.

30. Photonic crystals: molding the flow of light- J. D. Joannopoulos, S. G. Johnson, J. N. Winn and R. D. Meade, Princeton University Press, Chicago, 2011.

31. Antenna theory and microstrip antennas by D.G Fang
32. Antenna Theory analysis and design by C.A Balanis
33. Compact and broadband microstrip antennas by Kin Lu Wong