Post-Graduate Diploma Course on Optoelectronic Device Fabrication

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR
Post-Graduate Diploma in Device Fabrication
SEMESTERSYSTEMEXAMINATION-2025-2026
Department of Physics, Panjab University Chandigarh

Contents

SEMESTER I (Credits = 20, Marks = 500)		**SEMESTER II (Credits = 20, Marks = 500)**	
DF- 01	Fundamentals of Electronic and Optoelectronic Devices Credits- 4 (T) Marks – 100	DF - 06	Device Integration and Packaging Credits – 4 (T) Marks - 100
DF – 02	Materials for Device Fabrication Credits – 4 (T) Marks – 100	DF – 07	Characterization of Devices Credits – 4 (T) Marks - 100
DF – 03	Device Fabrication Techniques Credits – 4 (T) Marks – 100	DF - 08	Project Work, Hands on Training and Device Fabrication Credits – 12 (P) Marks - 300
DF – 04	Clean Room Laboratory Training Credits – 4 (T) Marks – 100		
DF – 05	Project Work, Hands on Training and Device Fabrication Credits – 4 (P) Marks – 100		

Course Duration:1 Year (2 Semester)

Mode of Delivery: Blended (Theoretical Lectures+ Laboratory Sessions+Project Work)

1 Course Objectives

- To provide comprehensive knowledge of the principles, materials, and techniques involved in electronic and optoelectronic device fabrication.
- Toequipstudentswithhands-onexperienceindevicefabricationprocesses, including thin-film deposition, photolithography, and packaging.
- Todevelopskillsforcharacterizingandanalyzingelectronicandoptoelectronic devices.
- Toencourageinnovationthroughproject-basedlearningandindustry-relevant applications.

2 Expected Outcome

By the end of this course, participants will:

- Haveasolidfoundationintheprinciplesandtechniquesofdevicefabrication.
- Gain hands-on experience with state-of-the-art equipment and processes.
- Developcriticalproblem-solvingskillsapplicabletoindustryandresearch.
- Bepreparedtocontributetoinnovationsinelectronicsandoptoelectronics.

3 Target Audience

- Graduate and postgraduate students in Physics, Materials Science, Electronics, and Engineering.
- Industry professionals seeking skill enhancement in device fabrication.

4 Eligibility

Master'sdegreeinPhysicsorChemistry/Bachelor'sdegreeinMaterialsScience,Elec- trical Engineering, Electronics or a closely related field.

5 Syllabus

5.1 Semester I

5.1.1 Paper1:Fundamentals of Electronic and Optoelectronic Devices

100 marks(4credits)

- Introduction to electronic and optoelectronic devices.
- Key components: semiconductors, conductors, and insulators.
- Principles of operation: p-n junction diodes, transistors, LEDs, solar cells, pho- to detectors.
- Overview of device applications : consumer electronics, communications, renew- able energy.

5.1.2 Paper2:MaterialsforDeviceFabrication

100 marks(4credits)

- Semi conductor materials: Silicon, III-V compounds, and perovskites.
- Transparent conducting oxides and organic materials.
- Substrates: Glass, silicon wafers, flexible polymers.
- Doping techniques and their role in device performance
- Oxide Preparation by Thermal Oxidation

5.1.3 Paper3:Device Fabrication Techniques

100 marks(4credits)

- Thin film deposition techniques: Physical and chemical
- Quantum dots and 2D materials fabrication techniques
- Nano structure synthesis by top-down and bottom-up approach
- Other advanced device fabrication techniques

5.1.4 Paper4: Clean Room Laboratory Training

100marks(4credits)

- Purpose and Importance of a Clean Room
- Design and Infrastructure of a Clean Room
- Environmental Controls:
- Clean Room Classification
- Entry and Exit Procedures
- Gowning and Personal Protective Equipment(PPE)
- Clean Room Behavior Protocols
- Emergency Procedures

5.1.5 Paper5:Project Work, Hands on Training and Device Fabrication

100 marks (4credits)

Project1: Fabrication of a Solar Cell by thin film deposition technique
Project2: Development of a Photo detector
Project3: Design and Integration of a Flexible LED

5.2 Semester II

5.2.1 Paper6:Device Integration and Packaging

100 marks(4credits)

- Contact formation: Metal deposition and annealing.
- Inter connection techniques: Wire bonding, flip-chip bonding.
- Encapsulation and thermal management.
- Flexible and stretch able device fabrication techniques.

5.2.2 Paper7:CharacterizationofDevices

100marks(4credits)

- Electrical characterization: IV curves, capacitance-voltage(C-V) profiling.
- Optical characterization : Photoluminescence (PL),electroluminescence(EL), and absorption measurements.
- Structural characterization: XRD,SEM, TEM, AFM.
- Environmental stability testing and reliability assessment.

5.2.3 Paper8:ProjectWork, Hands on Training and Device Fabrication

300 marks(12credits)

Project4: Fabrication of a High-Performance Capacitor
Project5: Flexible Photovoltaic Device **Project 6**: Development of a Quantum dot LED **Project 7**:Development of Sensor

5.3 Reference Book

- BhattacharyaP.,*SemiconductorOptoelectronicDevices*,PrenticeHall,Engle- wood Cliffs, NJ 07632
- Plummer, J. D., Deal, M. D.,& Griffin, P. B..*Silicon VLSI Technology : Fundamentals, Practice, and Modeling*, Prentice Hall.
- Campbell, S.A. *The Science and Engineering of Microelectronic Fabrication*, Oxford University Press.
- Madou, M.J..*Fundamentals of Micro fabrication and Nanotechnology*.CRC Press.
- Kasap.S.O. *Optoelectronics and Photonics*, Pearson Prentice Hall, Second Edition.
- Agrawal G.P., Dutta. N. K. *Semiconductor Lasers*, Second Edition, Springer-Verlag.
- Rosencher E., B.Vinter, *Optoelectronics*, Cambridge University Press.
- Sze S., *Physics of Semi conductor Devices*, New York, Wiley-Inter science.
- Smith R.A., *Semiconductors*, Cambridge University Press.

5.4 Laboratory Equipment and Resources

- Thin-film deposition systems(PVD,CVD,ALD).
- Photolithography tools and mask aligners.
- Characterization equipment (IV measurement set up, PL spectrometer ,SEM, XRD).
- Glove box and thermal annealing furnace.

5.5 Assessment Criteria

- Module-wisequizzesandassignments:30%.
- Laboratoryperformance:30%.
- Capstoneproject:40%.

5.6 Project Deliverables

- **Prototype Device**: Fabricated and tested as per the project objectives.
- **Project Report**: A comprehensive report detailing methodology, results, and analysis.
- **Presentation**: Oral presentation with visual aids summarizing the project outcomes.

5.7 Evaluation Criteria

- **PrototypePerformance**:40%
- **InnovativeApproach**:20%
- **ReportQuality**:20%
- **Presentation**:20%