

# Advanced PG Diploma in Electronic Product Design and Manufacturing (Certified Embedded Product Design Engineer)

## Preamble:

Emergence of India as a global economy has opened up a huge demand for electronic products. National Policy on Electronics and Make in India initiative of Government of India has resulted in setting up of many industries in the Electronics Sector and has led to a huge demand for trained man power in Electronics System Design and Manufacturing (ESDM) Industry.

## Objective:

This 1 year unique industry oriented training program has been specifically designed to address the major gap in competencies required to design, manufacture and market state-of-the art electronics products. Candidates will acquire knowledge to specify, design, develop and test the electronic product in professional manner.

## Duration:

**Theory: 225 hrs + Practical: 315 hrs + 180 hrs Project + 720 hrs of Internship**

**This course shall be offered as full time intensive course.**

## Expected Job Roles:

- Hardware Design Engineer
- Board Design Engineer
- Embedded Product Design Engineer
- Embedded System Design Engineer

## Course Outline:

| Sl. No | Module Title                             | Duration (Hours) |             |             | Credits        |                   |
|--------|--|------------------|-------------|-------------|----------------|-------------------|
|        |  | Theory           | Lab         | Total       | Theory (hr/15) | Practical (hr/30) |
| 1      | Industrial Design of Electronic Products | 30               | 30          | 70          | 2              | 1                 |
| 2      | Electronic Circuit Design                | 45               | 45          | 105         | 3              | 2                 |
| 3      | Electronic board design and bring up     | 45               | 75          | 140         | 3              | 3                 |
| 4      | Processor based System Design            | 60               | 90          | 175         | 4              | 3                 |
| 5      | Networking & IOT                         | 45               | 75          | 140         | 3              | 3                 |
| 6      | Project Work                             | -                | 180         | 210         |                | 6                 |
| 7      | Internship                               | -                | 720         | 840         |                | 24                |
|        | <b>Total hours</b>                       | <b>225</b>       | <b>1215</b> | <b>1440</b> | <b>57</b>      |                   |

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## Prerequisites:

Concepts of Basic Electronics and C Programming

## Eligibility:

BTech/BE in ECE/EEE/AEI/CSE/IT/Biomedical and allied branches)/ M.Sc (Electronics). Students undergoing BTech/ MSc are also eligible, however they will be issued course certificate only on production of their degree certificate.

## Detailed Syllabus and Learning Outcome:

| S. No | Module Title                                    | Topics   | Duration (Hours) |     | Learning Outcome   |
|-------|---|--|------------------|-----|--|
|       |   |  | Theory           | Lab |  |
| 1     | <b>Industrial Design of Electronic Products</b> | <ul style="list-style-type: none"> <li>Product Planning, Product requirements and specifications,</li> <li>Concept development, Product Architecture, Project Management</li> <li>19 Inch Rack System based Design</li> <li>Aesthetic, Ergonomic, Manufacturing, Cost, Thermal, EMI/EMC</li> <li>DFMA, DFT, Prototyping, Patents &amp; IPR, Product Development Economics, NEMA,CE,DIN standards for design and fabrication Quality Concepts, QFD, ISO9000</li> <li>CAD modeling and 3D printing concepts</li> </ul> | 30               | 30  | After successful completion of the module, candidate shall be able to provide complete product development solutions covering: <ul style="list-style-type: none"> <li>Product planning</li> <li>Customer need identification</li> <li>Concept development</li> <li>Industrial design</li> <li>Thermal design</li> <li>EMIEMC</li> <li>Standards</li> <li>Quality concepts</li> <li>CAD modeling</li> <li>3D printing etc.</li> </ul> |
| 2     | <b>Electronic Circuit Design</b>                | <ul style="list-style-type: none"> <li>Electronics Fundamentals-Semiconductors and Electronic Devices fundamentals</li> <li>Fundamentals of Circuit Design-Basic circuit Laws (KVL, KCL etc.), Transistor Amplifier Circuits (BJT, FET,</li> </ul>   | 45               | 45  | After successful completion of the module, the students shall be able to: <ul style="list-style-type: none"> <li>Design complete circuit based on requirement</li> <li>Design Amplifier based electronic circuit for</li> </ul>  |

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|    |   | <p>OPAMP) etc.</p> <ul style="list-style-type: none"> <li>Digital Electronic Circuits (Counter, Register, ADC.DAC) etc.</li> <li>Power Supply Design- Power Supply types, requirements, Selection and Management; Calculation of Power loss in electronic product</li> </ul>  |    |    | <p>various applications</p> <ul style="list-style-type: none"> <li>Design of power scheduler, power management unit of an electronic product.</li> </ul>  |
| 3. | <b>Electronic Board Design and Bring up</b> | <ul style="list-style-type: none"> <li>Evolution and Classification of Printed Circuit Boards</li> <li>PCB design considerations/ design rules for analog, digital and power applications,</li> <li>Electromagnetic interference in electronic systems and its impact, Concept of grounding and its significance</li> <li>Analysis of electronic circuit from noise emission point of view</li> <li>Thermal management of electronic devices and systems.</li> <li>Semiconductor Packages- types and advanced packages, hybrid circuits</li> <li>Introduction to high speed PCB design (SI,PI and Thermal Analysis), Types of Connectors and Wire harness</li> <li>Multilayer PCB design guide lines-PCB Stack up, Differential pair routing, Length matching, Generation of different types of reports.</li> </ul> | 45 | 75 | <p>After successful completion of the module, the students shall be able to:</p> <ul style="list-style-type: none"> <li>Specify and design a complete multilayer PCB based on requirements</li> <li>Verify to check if design is feasible to develop within the framework of the specification</li> <li>Able to make an efficient board design which give the best performance, uses optimal power and in minimal area</li> </ul> |

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|    |                                      |   |    |     |  |
|----|--------------------------------------|---|----|-----|--|
| 4. | <b>Processor based System Design</b> | <ul style="list-style-type: none"> <li>• C Programming and Embedded C</li> <li>• Introduction to ARM Cortex Architecture</li> <li>• Cortex Mx Microcontrollers &amp; Peripherals</li> <li>• Cortex Mx Microcontrollers &amp; Peripherals Programming</li> <li>• Cortex Mx debugging technique</li> <li>• Introduction to STM32 Cube MX graphical configuration</li> <li>• Modular Project</li> </ul>  | 80 | 95  | <ul style="list-style-type: none"> <li>• After successful completion of this module, students should be able to:</li> <li>• Develop ARM cortex Mx Processor based System Design</li> <li>• create models with Cortex ARM processor involving Capturing Specification and Interfacing,</li> </ul> |
| 5. | <b>Networking and IOT</b>            | <ul style="list-style-type: none"> <li>• Networking &amp; Communication Technologies (TCP/OSI Models, Wifi, Zigbee, Bluetooth protocols etc.)</li> <li>• IoT Entities, Standards and Application Development with Embedded Hardware</li> <li>• Mobile Programming Languages- (Design &amp; Development of Mobile User Interfaces and Application Development)</li> <li>• Python - Introduction to Python, Basic Syntax, Data Types, Variables, Operators, Function, Dictionaries and OOPs concept</li> <li>• Introduction to Image Processing Applications using Open CV</li> </ul> | 60 | 90  | <p>After successful completion of the module, the students shall be able</p> <ul style="list-style-type: none"> <li>• Access and Control Electronics Product via Remote Connectivity</li> <li>• Analyze the data received from various sensors</li> </ul>  |
| 6. | <b>Project Work</b>                  | Done as a group project where students will be working on a   | 0  | 180 | After successful completion of the module,   |

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|                           |                   |   |     |      |  |
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|                           |                   | real life problem and developing a complete product; right from identifying customer requirements and translating them into product specifications and realization of the product specifications through electronic, mechanical and industrial design within the cost and time constraints. |     |      | the participants shall be able to demonstrate working knowledge in the entire flow from electronic product design life cycle |
| 7.                        | <b>Internship</b> | Students will require to undergone to a 6-month internship at an electronic sector industry/company   |     | 720  | Candidates will develop the capability to take up real-life product development tasks for industry.                          |
| <b>Total Hours = 1680</b> |                   |   | 225 | 1215 |  |

### Examination & Certification:

NIELIT's NSQF Examination pattern will be followed for Examination & Certification.

| Sl No | Examination Pattern              | Modules Covered | Duration in Minutes | Maximum Marks |
|-------|----------------------------------|-----------------|---------------------|---------------|
| 1     | Theory Paper – 1                 | Module 1 & 2    | 90                  | 100           |
| 2     | Theory Paper – 2                 | Module 3        | 90                  | 100           |
| 3     | Theory Paper – 3                 | Module 4        | 90                  | 100           |
| 4     | Theory Paper – 4                 | Module 5        | 90                  | 100           |
| 5     | Practical -1                     | Module 1,2 & 3  | 180                 | 90            |
| 6     | Practical -2                     | Module 4 & 5    | 180                 | 90            |
| 7     | Internal Assessment              | Module 1 to 5   | -                   | 60            |
| 8     | Project/Presentation /Assignment | Module 1 to 5   | -                   | 60            |
| 9     | Major Project/Dissertation -1    | Module 6        | -                   | 100           |
| 10    | Major Project/Dissertation - 2   | Module 7        | -                   | 100           |
|       | <b>Total</b>                     |                 |                     | <b>900</b>    |

Note:

1. Pass percentage would be 50% marks in each component, with aggregate pass percentage of 50% and above.
2. Grading will be as under:

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| Grade              | S           | A                         | B                         | C                         | D                         |
|--------------------|-------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Marks Range (in %) | $\geq 85\%$ | $\geq 75\%$ -<br>$< 85\%$ | $\geq 65\%$ -<br>$< 75\%$ | $\geq 55\%$ -<br>$< 65\%$ | $\geq 50\%$ -<br>$< 55\%$ |

3. Theory examination would be conducted online and the paper comprise of MCQ and each question will carry 1 mark.
4. Practical examination/Internal Assessment/ Project/Presentation/Assignment would be evaluated internally.
5. Major Project/Dissertation would be evaluated preferably by External / Subject Expert including NIELIT Officials.
6. Candidate may apply for re-examination within the validity of registration.
7. The examinations would be conducted in English Language only.

### Recommended hardware/software tools:

1. 32-bit ARM Microcontroller Development Systems – ARM Cortex-M3/M4 STM32
2. Cadence Allegro PCB Designer-Cadence Design System
3. Mentor Graphics-HyperLynx SI, PI, Thermal, and EMI/EMC Analysis tool
4. MATLAB -Image Processing Toolbox and Open CV
5. Raspberry PI , Intel Galileo and Arduino Boards
6. KEIL Microvision and Truestudio
7. GSM/ GPRS/ GPS/ Zigbee/ Bluetooth/ WiFi Modems.
8. Digital Storage & Mixed Signal Oscilloscopes

### Faculty & Support / Lab Instructor:

1. Two Faculties with MTech/MEin ECE/VLSI/Embedded or equivalent Or BTech/BE in ECE/EEE or equivalent +PGD in VLSI/Embedded/Product Design Or BTech/BE in ECE/EEE with good Experience in Electronic System Design.
2. One Support / Lab Instructor with at least Diploma in ECE/EEE or equivalent with good knowledge and Experience in Electronic System Design

### References:

1. Product Design and Development by Karl T Ulrich, Tata McGraw Hill.
2. Electronic Circuit Design by Robert L. Boylestad
3. Let us C by Yashwant Kanetkar.
4. Printed Circuit Boards, R S Khandpur, Tata McGraw Hill.
5. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner
6. High Speed Digital Design: A Handbook of Black Magic by Johnson
7. Signal Integrity by Samuel H. Russ, Springer

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8. The Definitive Guide to the ARM Cortex M3, Joseph Yiu, Newnes.
9. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
10. Embedded C, Pont, Michael J
11. Embedded Systems an Integrated Approach: Lyla B Das, Pearson
12. C Programming language, Kernighan, Brian W, Ritchie, Dennis M
13. Art of C Programming, JONES, ROBIN, STEWART, IAN
14. C Programming for Embedded systems, Zurell, Kirk
15. ARM System Developer's Guide - Designing and Optimizing System Software by: Andrew N Sloss, Dominic Symes, Chris Wright; 2004, Elseiver.
16. Cortex M3 Reference manual.
17. STM32 datasheets, reference manuals & Application notes.
18. ARM Technical Reference manual.
19. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
20. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
21. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning
22. Internet of Things (A Hands-on-Approach), Vijay Madiseti, Arshdeep Bahga
23. Designing the Internet of Things, Adrian McEwen (Author), Hakim Cassimally
24. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
25. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
26. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
27. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
28. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009.
29. Relevant Data sheets and application notes

|                      |   |                            |                                |
|----------------------|---|----------------------------|--------------------------------|
| <b>Course Name</b>   | Advanced PG Diploma in Electronic Product Design and Manufacturing (Certified Embedded Product Design Engineer) | <b>Vertical</b>            | Electronic Product Engineering |
| <b>Course Code</b>   |   | <b>Rev No</b>              | R4                             |
| <b>Prepared By</b>   | Ishant Kumar Bajpai   | <b>Proposed NSQF Level</b> | 8                              |
| <b>NIELIT Centre</b> | Calicut   | <b>Last Revised on</b>     | 03.06.2019                     |



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