

## **Proposal for the Revised UG Curriculum of Physics Department**

### **B.Tech. (Engineering Physics)**

The Curriculum Review Committee (CRC) of the Physics Department through a series of meetings and lengthy discussions have come up with the following framework for the existing undergraduate program of the Department viz. *B.Tech. (Engineering Physics)*. This proposal, after discussion and approval in the DFB, is being submitted for consideration by the UCIC.

### **Review Process**

The review of this UG program has been carried out as per the guidelines of the relevant *concept paper*, prepared by the CRC of the Institute and approved by the Senate. In addition, the CRC of the Department took into consideration feedback provided by the students and faculty members.

The salient points of the proposed course structure are as follows:

- All existing courses are thoroughly revised, and the problem of overlapping of topics among various courses was specifically addressed. In each case, course contents were revised by taking inputs from faculty colleagues, who have taught the course earlier.
- The total number of departmental core credits, including theory and lab, remain almost the same as before.
- Computational Physics, which was earlier a departmental elective, has now been made departmental core.
- A number of new departmental electives have been added.
- Theme-based laboratory courses are formed, and appropriately positioned in the 8-Semester program, to ensure that students have been exposed to the basic theoretical concepts before conducting experiments. The theory courses are also placed accordingly in the Program.
- Maximum possible Program Linked (PL) courses have been included, in addition to Open Category (OC) courses, to give an interdisciplinary flavor to the Program.
- Basket of courses for Departmental Specialization (DS) and Minor Area (MA) schemes has been created.

## Proposed Credit Structure

The overall credit structure for a regular B.Tech. (Engineering Physics) is as follows:

| Undergraduate Core (UC) |         | Undergraduate Elective (UE) |         |
|-------------------------|---------|-----------------------------|---------|
| Category                | Credits | Category                    | Credits |
| DC                      | 58      | DE                          | 12      |
| BS                      | 22      | HU                          | 15      |
| EAS                     | 18      | OC                          | 10      |
| PL                      | 14.5    |                             |         |
| TOTAL                   | 112.5   | TOTAL                       | 37      |

**Total credits=149.5 + non-graded requirement of 15 credits for the B.Tech Degree.**

In the new UG Curriculum, there is a provision for students to opt for “Departmental Specialization”, which refers to a group of courses in a specific area in which an interested student can specialize. Towards this, he/she would be required to earn 20 Credits from the basket of courses under a specific ‘Departmental Specialization’. The Department proposes that only those students who earn at least 70 credits by the end of four semesters, with a CGPA of 7.0 and above, would be eligible to opt for Departmental Specialization.

Those who opt for the ‘Departmental Specialization’ (or ‘Minor Area’) need not do the 10 credits under OC, and therefore, effectively, by earning additional 10 credits one can obtain a B.Tech Degree with Departmental Specialization (or Minor Area). Thus -

### **For the B.Tech. Degree with Departmental Specialization or Minor Area:**

Total credits = 159.5 + non-graded requirement of 15 credits

### **For the B.Tech. Degree with Departmental Specialization and Minor Area:**

Total credits = 179.5 + non-graded requirement of 15 credits

## **List of courses**

### **Basic Science (BS) Core**

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|                      |                                             |                |           |
|----------------------|---------------------------------------------|----------------|-----------|
| 1. PHL100            | Electromagnetic Waves and Quantum Mechanics | 3-0-0          | 3         |
| 2. CYL100            | Introduction to Chemistry                   | 3-0-0          | 3         |
| 3. MAL100            | Calculus                                    | 3-1-0          | 4         |
| 4. MAL101            | Linear Algebra & Differential Equations     | 3-1-0          | 4         |
| 5. SBL100            | Introductory Biology for Engineers          | 3-0-2          | 4         |
| 6. PHP100            | Physics Laboratory                          | 0-0-4          | 2         |
| 7. CYP100            | Chemistry Laboratory                        | 0-0-4          | 2         |
| <b>Total BS Core</b> |                                             | <b>15-2-10</b> | <b>22</b> |

### **Engineering Arts and Science (EAS) Core**

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|                       |                                           |                  |           |
|-----------------------|-------------------------------------------|------------------|-----------|
| 1. AML100             | Engineering Mechanics                     | 3-1-0            | 4         |
| 2. CSL100             | Introduction to Computer Science          | 3-0-2            | 4         |
| 3. EEL100             | Introduction to Electrical Engineering    | 3-0-2            | 4         |
| 4. MEP100             | Introduction to Engineering Visualization | 0.5-0-3          | 2         |
| 5. MEP101             | Product Realization by Manufacturing      | 0-0-4            | 2         |
| 6. CEL140             | Environmental Science                     | 2-0-0            | 2         |
| <b>Total EAS Core</b> |                                           | <b>11.5-1-11</b> | <b>18</b> |

### **Program Linked (PL)**

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|                      |                                            |       |             |
|----------------------|--------------------------------------------|-------|-------------|
| 1. EEL201            | Digital Electronics                        | 3-0-3 | 4.5         |
| 2. EEL205            | Signals & Systems                          | 3-1-0 | 4           |
| 3. ESL350            | Energy Conservation & Management           | 3-0-0 | 3           |
| 4. CYLxxx            | Chemical Synthesis of Functional Materials | 3-0-0 | 3           |
| <b>Total PL Core</b> |                                            |       | <b>14.5</b> |

### **Departmental Core (DC)**

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|            |                                              |       |   |
|------------|----------------------------------------------|-------|---|
| 1. EPL101  | Electrodynamics                              | 3-1-0 | 4 |
| 2. EPL102  | Quantum Mechanics                            | 3-1-0 | 4 |
| 3. EPL103  | Mathematical Physics                         | 3-1-0 | 4 |
| 4. EPL104  | Solid State Physics                          | 3-1-0 | 4 |
| 5. EPL105  | Applied Optics                               | 3-1-0 | 4 |
| 6. EPL106  | Elements of Materials Processing             | 3-1-0 | 4 |
| 7. EPL201  | Fundamentals of Dielectrics & Semiconductors | 3-1-0 | 4 |
| 8. EPL202  | Statistical Physics                          | 3-1-0 | 4 |
| 9. EPL203  | Classical Mechanics & Relativity             | 3-1-0 | 4 |
| 10. EPL204 | Computational Physics                        | 3-1-0 | 4 |

|                                               |       |   |
|-----------------------------------------------|-------|---|
| 11. EPP211 Engineering Physics Laboratory-I   | 0-0-6 | 3 |
| 12. EPP212 Engineering Physics Laboratory-II  | 0-0-6 | 3 |
| 13. EPP221 Engineering Physics Laboratory-III | 0-0-8 | 4 |
| 14. EPP222 Engineering Physics Laboratory-IV  | 0-0-8 | 4 |
| 15. EPD401 Project-I                          | 0-0-8 | 4 |

### **Department Electives (DE)**

|                                                     |       |   |
|-----------------------------------------------------|-------|---|
| 1. EPL301 Vacuum Technology & Surface Science       | 3-0-0 | 3 |
| 2. EPL302 Nuclear Science and Engineering           | 3-0-0 | 3 |
| 3. EPL303 Materials Science and Engineering         | 3-0-0 | 3 |
| 4. EPL304 Superconductivity and Applications        | 3-0-0 | 3 |
| 5. EPL305 Engineering Applications of Plasmas       | 3-0-0 | 3 |
| 6. EPL306 Microelectronic Devices                   | 3-0-0 | 3 |
| 7. EPS300 Independent Study                         | 0-3-0 | 3 |
| 8. EPD404 Project III                               | 0-0-8 | 4 |
| 9. EPL311 Lasers                                    | 3-0-0 | 3 |
| 10. EPL312 Semiconductor Optoelectronics            | 3-0-0 | 3 |
| 11. EPL313 Fourier Optics and Holography            | 3-0-0 | 3 |
| 12. EPL321 Low Dimensional Physics                  | 3-0-0 | 3 |
| 13. EPL322 Nanoscale Fabrication                    | 3-0-0 | 3 |
| 14. EPL323 Nanoscale Microscopy                     | 2-0-0 | 2 |
| 15. EPL324 Spectroscopy of Nanomaterials            | 2-0-0 | 2 |
| 16. EPL331 Applied Quantum Mechanics                | 3-0-0 | 3 |
| 17. EPL332 General Theory of Relativity & Cosmology | 3-0-0 | 3 |
| 18. EPL411 Quantum Electronics                      | 3-0-0 | 3 |
| 19. EPL412 Ultrafast Laser Systems and Applications | 3-0-0 | 3 |
| 20. EPL413 Fiber and Integrated Optics              | 3-0-0 | 3 |
| 21. EPL414 Engineering Optics                       | 3-0-0 | 3 |
| 22. EPV418 Selected Topics in Photonics             | 2-0-0 | 2 |
| 23. EPV419 Special Topics in Photonics              | 1-0-0 | 1 |
| 24. EPL421 Functional Nanostructures                | 3-0-0 | 3 |
| 25. EPL422 Spintronics                              | 3-0-0 | 3 |
| 26. EPL423 Nanoscale Energy Materials & Devices     | 3-0-0 | 3 |
| 27. EPV428 Selected Topics in Nanotechnology        | 2-0-0 | 2 |
| 28. EPV429 Special Topics in Nanotechnology         | 1-0-0 | 1 |
| 29. EPL431 Relativistic Quantum Mechanics           | 2-0-0 | 2 |
| 30. EPL432 Quantum Electrodynamics                  | 3-0-0 | 3 |
| 31. EPL433 Introduction to Gauge Field Theories     | 2-0-0 | 2 |
| 32. EPL434 Particle Accelerators                    | 2-0-0 | 2 |
| 33. EPV438 Selected Topics in Theoretical Physics   | 2-0-0 | 2 |
| 34. EPV439 Special Topics in Theoretical Physics    | 1-0-0 | 1 |

### **Departmental Specializations**

As per provision in the Concept Paper, a Project of 8 credits will also be available to those opting for Departmental Specialization; this Project could be a continuation of the DC course Project-I. The departmental CRC has proposed the following two specializations, and the corresponding basket of courses:

#### **I. Photonics Technology**

|                                             |        |   |
|---------------------------------------------|--------|---|
| 1. EPL311 Lasers                            | 3-0-0  | 3 |
| 2. EPL312 Semiconductor Optoelectronics     | 3-0-0  | 3 |
| 3. EPL313 Fourier Optics and Holography     | 3-0-0  | 3 |
| 4. EPL411 Quantum Electronics               | 3-0-0  | 3 |
| 5. EPL412 Ultrafast Laser Systems and Appl. | 3-0-0  | 3 |
| 6. EPL413 Fiber and Integrated Optics       | 3-0-0  | 3 |
| 7. EPL414 Engineering Optics                | 3-0-0  | 3 |
| 8. EPV418 Selected Topics in Photonics      | 2-0-0  | 2 |
| 9. EPV419 Special Topics in Photonics       | 1-0-0  | 1 |
| 10. EPD 402 Project-II                      | 0-0-16 | 8 |

This Departmental Specialization is also offered as a 'Minor Area' for students outside the EP Program, with EPL102: Quantum Mechanics and EPL105: Applied Optics as core courses for the Minor Area.

#### **II. Nano-Science & Technology**

|                                                |        |   |
|------------------------------------------------|--------|---|
| 1. EPL321 Low Dimensional Physics              | 3-0-0  | 3 |
| 2. EPL322 Nanoscale Fabrication                | 3-0-0  | 3 |
| 3. EPL323 Nanoscale Microscopy                 | 2-0-0  | 2 |
| 4. EPL324 Spectroscopy of Nanomaterials        | 2-0-0  | 2 |
| 5. EPL421 Functional Nanostructures            | 3-0-0  | 3 |
| 6. EPL422 Spintronics                          | 3-0-0  | 3 |
| 7. EPL423 Nanoscale Energy Materials & Devices | 3-0-0  | 3 |
| 8. EPV428 Selected Topics in Nanotechnology    | 2-0-0  | 2 |
| 9. EPV429 Special Topics in Nanotechnology     | 1-0-0  | 1 |
| 10. EPD402 Project-II                          | 0-0-16 | 8 |

This Departmental Specialization is also offered as a Minor Area for students outside the EP Program with EPL102: Quantum Mechanics and EPL201: Fundamentals of Dielectrics & Semiconductors as core courses for the Minor Area.

### Note:

1. A student can register for either Project II (if opted for Departmental Specialization) or Project III. Further, Project II or Project III could be continuation of Project I. The students will be eligible to do Project II or Project III, if he/she secures a grade not below 'A(-)' in the core B.Tech project (Project I). In all, not more than two Project courses can be taken in the Program.
2. The course placement grid for the Engineering Physics Program is shown below. Suggested plan of course work for students opting for Departmental Specialization is also indicated. The placement of DC courses in the semester plan would remain fixed; however, the DE/DS/OC/PL courses may be opted by the student as per availability/convenience.

### Course Placement Grid (B.Tech.)

|             |                                                                               |                                                            |                                                                  |                                                    |                                                                     |                                                    |                                                          |               |
|-------------|-------------------------------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------|---------------|
| I<br>Year   | EEL100/ AML100                                                                | MEP100/ CSL100                                             | PHL100/ CYL100                                                   | MAL100/ MAL101                                     |                                                                     | EEL100/PHP100/MEP100/ MEP101/<br>SL100/CYP100      |                                                          | 18            |
|             | EEL100/ AML100                                                                | MEP100/ CSL100                                             | PHL100/CYL100                                                    | MAL100/MAL101                                      |                                                                     | EEL100/PHP100/MEP100/<br>MEP101/CSL100/CYP100      |                                                          | 16            |
| II<br>Year  | EPL101:<br>Electrodynamics<br>(DC) (3-1-0)                                    | EPL103:<br>Mathematical<br>Physics (DC)<br>(3-1-0)         | EPL105:<br>Applied Optics (DC)<br>(3-1-0)                        | HU-1<br>(3-1-0)                                    | CEL140:<br>Environ.<br>Science<br>(2-0-0)                           | EPP211:<br>Engineering Phys.<br>Lab I (DC) (0-0-6) | Intro. to Engineering<br>Physics (0-0-2)<br>(Non-graded) | 21            |
|             | EPL102: Quantum<br>Mechanics (DC)<br>(3-1-0)                                  | EPL104:<br>Solid State Phys.<br>(DC) (3-1-0)               | EPL106: Elements<br>of Materials<br>Processing<br>(DC) (3-1-0)   | EEL201:<br>Digital<br>Electronics<br>(PL-1)(3-0-0) | EEP201: Lab<br>(PL-1)<br>(0-0-3)                                    | EPP212: Engineering Phys. Lab II (DC)<br>(0-0-6)   |                                                          | 19.5          |
| III<br>Year | EPL201:<br>Fundamentals of<br>Dielectrics &<br>Semiconductors<br>(DC) (3-1-0) | EPL203:<br>Classical Mech.<br>& Relativity (DC)<br>(3-1-0) | EEL205: Signals &<br>Systems<br>(PL-2) (3-1-0)                   | HU-2<br>(3-1-0)                                    | Chemical<br>Syn. of<br>Functional<br>Materials<br>(PL-3)<br>(3-0-0) | EPP221: Engineering Phys. Lab III (DC)<br>(0-0-8)  |                                                          | 23 +<br>DS    |
|             | EPL202:<br>Statistical Physics<br>(DC) (3-1-0)                                | EPL204:<br>Computational<br>Physics (DC)<br>(3-1-0)        | ESL350: Energy<br>Conservation &<br>Management<br>(PL-4) (3-0-0) | HU-3<br>(3-1-0)                                    | SBL100:<br>Introduct.<br>Biology for<br>Engineers<br>(3-0-2)        | EPP222: Engineering Phys. Lab IV (DC)<br>(0-0-8)   |                                                          | 23 +<br>DS    |
| IV<br>Year  | DE-1<br>(3-0-0)                                                               | DE-2<br>(3-0-0)                                            | OC-1 or DS<br>(3-0-0)                                            | HU-4<br>(3-0-0)                                    |                                                                     | EPD401: Project- I (DC) (0-0-8)                    |                                                          | 16 +<br>DS    |
|             | DE-3<br>(3-0-0)                                                               | DE-4<br>(3-0-0)                                            | OC-2 or DS<br>(3-1-0)                                            | OC-3 or DS<br>(3-0-0)                              |                                                                     | DS                                                 |                                                          | 13 +<br>DS    |
|             |                                                                               |                                                            |                                                                  |                                                    |                                                                     | Total Credits                                      |                                                          | 149.5<br>+ DS |