B.Sc. Physical Sciences Electronics

PROGRAM OUTCOMES

❖ **Learning outcomes-based approach to curriculum planning and development**

The learning outcomes-based curriculum framework for a B.Sc degree in Physical Sciences with Electronics discipline is intended to provide a comprehensive foundation to the subject, and to help students develop the ability to successfully continue with further studies and research in the subject. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in term of the knowledge and skills in Electronics, as well develop scientific orientation, enquiring spirit, problem solving skills and values which foster rational and critical thinking.

Due to the extreme diversity of our country, a central university like the University of Delhi gets students from very different academic backgrounds, regions and language zones. While maintaining high standards, the learning outcome-based curriculum provides enough flexibility to teachers and colleges to respond to diverse needs of students.

The learning outcome-based curriculum framework for undergraduate courses in Physical Sciences with Electronics discipline also allows for flexibility and innovation in the programme design to adopt latest teaching and assessment methods, and include introduction to news areas of knowledge in the fast-evolving subject domains. The process of learning is defined by the following steps which form the basis of final assessment of the achievement at the end of the program.

- Development of an understanding and knowledge of basic Electronics. This involves exposure to basics facts of nature discovered by Physics and Electronics through observations and experiments. The other core component of this development is introduction to Electronics concepts and principles, their theoretical relationships in laws of Electronics, and deepening of their understanding via appropriate problems.

- The ability to use this knowledge to analyze new situations and learn skills and tools like laboratory techniques, computational methods, applied mathematics, embedded systems and smart modules to find solution, interpret results and make meaningful predictions.

- The ability to synthesize the acquired knowledge and experience for an improved comprehension of the physical problems and to create new skills and tools for their possible solutions.

❖ Nature and Extent of the Programme

The UG programs, B.Sc. Physical Science with Electronics discipline is builds on the basic Physics taught at the +2 level in all the schools in the country. Ideally, the +2 senior secondary school education should aim and achieve a sound grounding in understanding the basic and applied Physics with sufficient content of topics from modern Physics and contemporary areas of exciting developments in physical sciences. The curricula and syllabi should be framed and implemented in such a way that the basic connection between theory and experiment and its importance in understanding electronics is made clear to students. This is very critical in developing a scientific temperament and the urge to learn and innovate in electronics and other allied disciplines. Unfortunately the condition of our school system in most parts of the country lacks the facilities to achieve the above goal, and it is incumbent upon the college/university system to fill gaps in the scientific knowledge and understanding of our country's youth who complete school curricula and enter university education. Electronics, a subdivision of Physics, is an experimental science that studies systematically the applied aspects of the laws of nature operating at length scales from the sub-atomic domains to the entire universe. The scope of electronics as a subject is very broad. The core areas of study within the disciplinary/subject area of an UG programme in Electronics are: Network Analysis and Analog Electronics, Linear and Digital Integrated Circuits, Communication Electronics, and Microprocessor and Microcontroller, and specialized tools of electronics and their applications in different branches of the subject. Along with the theoretical course work students also learn laboratory methods for different branches of Electronics, specialized electronics tools and software, and scientific report writing. The latest addition to Electronics pedagogy incorporated in the LOCF framework is computational and Laboratory work, which involves adaptation of problems for algorithmic solutions, as well as modelling and simulation of Electronics circuits and embedded system. The elective modules of the framework offer students choice to gain knowledge and expertise in more specialized domains of Electronics like Semiconductor Devices, Instrumentation, Digital Signal Processing, Verilog and FPGA based system Design, Photonic Devices, Power Electronics, Antenna Theory, wireless Network The Electronics-based knowledge and skills learnt by students also equip them to be successful in careers other than research and teaching in Electronics.

❖ Aims of Bachelor's Degree Programme in B.Sc. Physical Sciences

The LOCF based UG educational program in B.Sc. Physical Science with Electronics aims to

- create the facilities and learning environment in educational institutions to consolidate the knowledge acquired at +2 level, motivate students to develop a deep interest in applied Physics and Electronics, and to gain a broad and balanced

knowledge and understanding of physical concepts, principles and theories of Electronics.

- provide opportunities to students to learn, design and perform experiments in lab, gain an understanding of laboratory methods, design and analysis of electronic circuits and report writing, and acquire a deeper understanding of concepts, principles and theories learned in the classroom through laboratory demonstration, and computational problems and modelling.
- to prepare students for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas, as Electronics is among the most important branches of applied science necessary for interdisciplinary and multidisciplinary research.
- to prepare students for developing new industrial technologies and theoretical tools for applications in diverse branches of the corporate and economic life of the country, as Electronics is one of the branches of applied science which contribute directly to technological development, and
- in light of all of the above to provide students with the knowledge and skill base that would enable them to undertake further studies in Electronics and related areas, or in interdisciplinary/multidisciplinary areas, or join and be successful in diverse professional streams including entrepreneurship and startups.

❖ Graduate Attributes

Some of the characteristic attributes of a graduate in Electronics are

- Disciplinary knowledge

(i) comprehensive knowledge and understanding of major concepts, theoretical principles and experimental developments in Electronics and its different subfields like Analog Electronics, Digital Electronics, Network Analysis, VLSI technology, Communication Electronics, Microprocessor and Microcontrollers, Semiconductor Devices, Instrumentation, Digital Signal Processing, Verilog and FPGA Design, Photonic Devices, Power Electronics, Antenna Theory, wireless Network and other related fields of study, including broader interdisciplinary subfields like Physics, Chemistry, Mathematics, Life sciences, Environmental sciences, Computer science, Information Technology etc.
(ii) ability to use Electronics laboratory skills and modern instrumentation for designing and implementing new circuits and smart systems in Electronics, interdisciplinary/multidisciplinary research areas and industrial research.

- Skilled communicator:

Ability to transmit abstract concepts and complex information relating to all areas in Electronics in a clear and concise manner through scientific report writing. Ability to express complex relationships and information through graphical methods, circuit diagrams and proper tabulation. Ability to explain complex processes through simulation and modelling. Ability to express complex and technical concepts orally in a simple, precise and straightforward language for better understanding.

Critical thinking:
Ability to distinguish between relevant and irrelevant facts and information, discriminate between objective and biased information, apply logic to arrive at definitive conclusions, find out if conclusions are based upon sufficient evidence, derive correct quantitative results, make rational evaluations, and arrive at qualitative judgments according to established rules.

Sense of inquiry:
Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Electronics. Planning, executing and reporting the results of a theoretical or experimental investigation.

Team player/worker:
Capable of working effectively in diverse teams in both classroom, laboratory, Electronics workshop and in field-based situations.

Skilled project manager:
Capable of identifying/mobilizing appropriate resources required for a project, and managing a project through to completion, while observing responsible and ethical scientific conduct, safety and laboratory hygiene regulations and practices.

Digitally Efficient:
Capable of using computers for computational and simulation studies in Electronics. Proficiency in appropriate software for numerical and statistical analysis of data, accessing and using modern e-library search tools, ability to locate, retrieve, and evaluate Electronics information from renowned archives, proficiency in accessing observational and experimental data made available by renowned research labs for further analysis. Excellence in development of smart system and efficient control circuits using suitable electronic components and microcontrollers.

Ethical awareness/analytical reasoning:
The graduates should be capable of demonstrating the ability to think and analyze rationally with modern and scientific outlook and adopt objectives, which are unbiased and truthful in all aspects of their work. They should be capable of identifying ethical issues related to their work. They should be ready to appropriately acknowledge direct and indirect contributions received from all sources, including from other personnels in their field. They should be willing to contribute to the free development of knowledge in all forms. Further, unethical behavior such as fabrication, falsification or misrepresentation of data, or committing plagiarism, or not adhering to intellectual property rights should be avoided.

Social, National and International perspective:
The graduates should be able to develop a perspective about the significance of their knowledge and skills for social well-being and a sense of responsibility towards human

society and the planet. They should have a national as well as an international perspective for their work and career in the chosen field of academic and research activities.

Lifelong learners:
Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and re-skilling in all areas of Electronics.

❖ Program Learning Outcomes

The student graduating with the Degree B.Sc. Physical sciences with Electronics discipline, B.Sc. (PEM) should be able to

● Acquire (i) a systematic and coherent understanding of basic Electronics including the concepts, theories and relevant experimental techniques in the domains of Network Analysis, Analog Electronics, Digital Electronics, Integrated Circuits, Communication Electronics, Microprocessor, Microcontroller and of the specialized field like Semiconductor Devices, Electronic Instrumentation, Digital Signal Processing, Verilog and FPGA Design, Photonic Devices, Power Electronics, Antenna Theory, wirelessNetwork, etc. in their choice of Discipline Specific Elective course.
(ii) a wide ranging and comprehensive experience in Electronics laboratory methods in experiments related to Network Analysis, Analog Electronics, Digital Electronics, Communication, Microcontroller, Semiconductor Devices, Instrumentation, Digital Signal Processing, Verilog and FPGA, Antenna's, etc. Students acquire the ability for systematic designing and analysis of circuits, recording of proper observations, use of scientific research instruments, analysis of observational data, making suitable error estimates and scientific report writing.
(iii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Electronics and multi/interdisciplinary domains, including professionals engaged in research and development, teaching, technology professions and government/public service;
(iv) skills in areas related to their specialization area within the disciplinary/subject area of Electronics.

● Demonstrate the ability to use skills in Electronics and its related areas of technology for formulating and solving problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Electronics and its interface with other subjects studied in the course.

- Recognize the importance of modeling simulation and computing, and the role of approximation and mathematical approaches to describing the Electronic world.

● Plan and execute experiments or investigations related to Electronics and its interface with other subjects studied in the course analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories.

● Demonstrate relevant generic skills and global competencies such as

(i) problem-solving skills that are required to solve different types of Electronics related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary area boundaries;
(ii) investigative skills, including skills of independent investigation of problems;
(iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;
(iv) analytical skills involving paying attention to detail and ability to construct logical arguments, using correct technical language and ability to translate hem with popular language when needed;
(v) ICT skills;
(vi) personal skills such as the ability to work both independently and in a group.

● Demonstrate professional behavior such as
(i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;
(ii) the ability to identify the potential ethical issues in work-related situations;
(iii) be committed to the free development of scientific knowledge and appreciate its universal appeal for the entire humanity;
(iv) appreciation of intellectual property, environmental and sustainability issues; and
(v) promoting safe learning and working environment.