

CORE MODULES: HNC Electrical and Electronic Engineering

You must take units worth 120 credits at each level of the course. Each unit is worth a specified number of credits.

Level 4 (HNC)

Engineering Design (15 credits)

- *The tremendous possibilities of the techniques and processes developed by engineers can only be realised by great design. Design turns an idea into a useful artefact, the problem into a solution, or something ugly and inefficient into an elegant, desirable and cost effective everyday object. Without a sound understanding of the design process the engineer works in isolation without the links between theory and the needs of the end user. The aim of this unit is to introduce students to the methodical steps that engineers use in creating functional products and processes; from a design brief to the work, and the stages involved in identifying and justifying a solution to a given engineering need. Among the topics included in this unit are: Gantt charts and critical path analysis, stakeholder requirements, market analysis, design process management, modelling and prototyping, manufacturability, reliability life cycle, safety and risk, management, calculations, drawings and concepts and ergonomics. On successful completion of this unit students will be able to prepare an engineering design specification that satisfies stakeholders' requirements, implement best practice when analysing and evaluating possible design solutions, prepare a written technical design report, and present their finalised design to a customer or audience.*

Engineering Maths (15 credits)

- *The mathematics that is delivered in this unit is that which is directly applicable to the engineering industry, and it will help to increase students' knowledge of the broad underlying principles within this discipline. The aim of this unit is to develop students' skills in the mathematical principles and theories that underpin the engineering curriculum. Students will be introduced to mathematical methods and statistical techniques in order to analyse and solve problems within an engineering context. On successful completion of this unit students will be able to employ mathematical methods within a variety of contextualised examples, interpret data using statistical techniques, and use analytical and computational methods to evaluate and solve engineering problems.*

Engineering Science (15 credits)

- *Engineering is a discipline that uses scientific theory to design, develop or maintain structures, machines, systems, and processes. Engineers are therefore required to have a broad knowledge of the science that is applicable to the industry around them. This unit introduces students to the fundamental laws and applications of the physical sciences within engineering and how to apply this knowledge to find solutions to a variety of engineering problems. Among the topics included in this unit are: international system of units, interpreting data, static and dynamic forces, fluid mechanics and thermodynamics, material properties and failure, and A.C./D.C. circuit theories. On successful completion of this unit students will be able to interpret and present qualitative and quantitative data using computer software, calculate unknown parameters within mechanical systems, explain a variety of material properties and use electromagnetic theory in an applied context.*

Managing a Professional Engineering Project (15 credits)

- *The responsibilities of the engineer go far beyond completing the task in hand. Reflecting on their role in a wider ethical, environmental and sustainability context starts the process of becoming a professional engineer – a vital requirement for career progression. Engineers seldom work in isolation and most tasks they undertake require a range of expertise, designing, developing, manufacturing, constructing, operating and maintaining the physical infrastructure and content of our world. The bringing together of these skills, expertise and experience is often managed through the creation of a project. This unit introduces students to the techniques and best practices required to successfully create and manage an engineering project designed to identify a solution to an engineering need. While carrying out this project students will consider the role and function of engineering in our society, the professional duties and responsibilities expected of engineers together with the behaviours that accompany their actions. Among the topics covered in this unit are: roles, responsibilities and behaviours of a professional engineer, planning a project, project management stages, devising solutions, theories and calculations, management using a Gantt chart, evaluation techniques, communication skills, and the creation and presentation of a project report. On successful completion of this unit students will be able to conceive, plan, develop and execute a successful engineering project, and produce and present a project report outlining and reflecting on the outcomes of each of the project processes and stages. As a result, they will develop skills such as critical thinking, analysis, reasoning, interpretation, decision-making, information literacy, and information and communication technology, and skills in professional and confident self-presentation. This unit is assessed by a Pearson-set assignment. The project brief will be set by the centre, based on a theme provided by Pearson (this will change annually). The theme and chosen project within the theme will enable students to explore and examine a relevant and current topical aspect of professional engineering.*

Electrical and Electronic Principles (15 credits)

- *Electrical engineering is mainly concerned with the movement of energy and power in electrical form, and its generation and consumption. Electronics is mainly concerned with the manipulation of information, which may be acquired, stored, processed or transmitted in electrical form. Both depend on the same set of physical principles, though their applications differ widely. A study of electrical or electronic engineering depends very much on these underlying principles; these form the foundation for any qualification in the field, and are the basis of this unit. The physical principles themselves build initially from our understanding of the atom, the concept of electrical charge, electric fields, and the behaviour of the electron in different types of material. This understanding is readily applied to electric circuits of different types, and the basic circuit laws and electrical components emerge. Another set of principles is built around semiconductor devices, which become the basis of modern electronics. An introduction to semiconductor theory leads to a survey of the key electronic components, primarily different types of diodes and transistors. Electronics is very broadly divided into analogue and digital applications. The final section of the unit introduces the fundamentals of these, using simple applications. Thus, under analogue electronics, the amplifier and its characteristics are introduced. Under digital electronics, voltages are applied as logic values, and simple circuits made from logic gates are considered. On successful completion of this unit students will have a good and wide-ranging grasp of the underlying principles of electrical and electronic circuits and devices, and will be able to proceed with confidence to further study.*

Automation, Robotics and PLCs (15 credits)

- *The word automation was not used until the 1940s and it originated in the automotive manufacturing sector as a method designed to reduce labour costs and improve the quality, accuracy and precision of the finished products. We are all now very familiar with the sight of dancing robots, not only in the production of cars but in everything from washing machines to pharmaceuticals. As a result of this technology the products we purchase may have never been touched by human hands and we all benefit from a reduction in costs and improvement in quality. The aim of this unit is for students to investigate how Programmable Logic Controllers (PLCs) and industrial robots can be programmed to successfully implement automated engineering solutions. Among the topics included in this unit are: PLC system operational characteristics, different types of programming languages, types of robots and cell safety features. On successful completion of this unit students will be able to program PLCs and robotic manipulators to achieve a set task, describe the types and uses of PLCs and robots available, write simple PLC programs, and program industrial robots with straightforward commands and safety factors.*

Digital Principles (15 credits)

- *While the broad field of electronics covers many aspects, it is digital electronics which now has the greatest impact. This is immediately evident in the mobile phone, laptop, and numerous other everyday devices and systems. Digital electronics allows us to process, store, and transmit data in digital form in robust ways, which minimises data degradation. The unit introduces the two main branches of digital electronics, combinational and sequential. Thus the student gains familiarity in the fundamental elements of digital circuits, notably different types of logic gates and bistables. The techniques by which such circuits are analysed are introduced and applied, including Truth Tables, Boolean Algebra, Karnaugh Maps, and Timing Diagrams. The theory of digital electronics has little use unless the circuits can be built – at low cost, high circuit density, and in large quantity. Thus the key digital technologies are introduced. These include the conventional TTL (Transistor-Transistor Logic) and CMOS (Complementary Metal Oxide Semiconductor). Importantly, the unit moves on to programmable logic, including the Field Programmable Gate Array (FPGA). Finally, some standard digital subsystems, which become important elements of major systems such as microprocessors, are introduced and evaluated. On successful completion of this unit students will have a good grasp of the principles of digital electronic circuits, and will be able to proceed with confidence to further study.*

Electronic Circuits and Devices (15 credits)

- *Electronics is all around us today: in our homes, the workplace, cars and even on or in our bodies. It's hard to believe that it was only in 1947 that the transistor was developed by American physicists John Bardeen, Walter Brattain, and William Shockley. The invention of the transistor paved the way for cheaper radios, calculators and computers. This unit introduces students to the use of electronics manufacturers' data to analyse the performance of circuits and devices, the operational characteristics of amplifier circuits, the types and effects of feedback on a circuit performance, and the operation and application of oscillators. They will also be introduced to the application of testing procedures to electronic devices and circuits, and use the findings of the tests to evaluate their operation. Among the topics included in this unit are: power amplifiers, class A, B and AB; operational amplifiers, inverting, non-inverting, differential, summing, integrator, differentiator; types such as open, closed, positive and negative feedback; frequency, stability, frequency drift, distortion, amplitude, wave shapes and testing procedures. On successful completion of this unit students will be able to determine the operational characteristics of amplifier circuits, investigate the types and effects of feedback on an amplifier's performance, examine the operation and application of oscillators and apply testing procedures to electronic devices and circuits.*