Programme Specification

Pearson Higher Nationals in Engineering

June 2021

Transforming Lives Through Learning

Programme Specification:
Pearson Higher Nationals in General Engineering

This specification provides a summary of the main features of the programme and the learning outcomes that a typical student would be expected to achieve if they take full advantage of the learning opportunities provided.

1. Awarding body	Pearson BTEC
2. Teaching location	Milton Keynes College, Chaffron Way Campus. Chaffron Way, Milton Keynes, MK6 5LP
3. Learning modes	On-site; Distance-learning
4. Accreditation details	N/A
5. Final Awards	Higher National Certificate Higher National Diploma
6. Name of Awards	Pearson BTEC Level 4 Higher National Certificate in Engineering: (General Engineering) Pearson BTEC Level 5 Higher National Diploma in Engineering: (General Engineering)
7. Codes	
a. UCAS codes	Part-time HNC: Direct-application only HND: Direct-application only
b. MK College course codes	Full-time HNC: A576 - 1/1 Part-time HNC: A576 -1/2, A576 – 2/2 HND: A577 1/1
c. Pearson programme codes	HNC: 603/0450/9 HND: 603/0451/0
8. QAA Subject Benchmark of other external reference such as published by Pearson if the course is a higher national	https://qualifications.pearson.com/en/qualifications/btec-higher-nationals/general-engineering-2017.html
9. Date this specification applies from	01/07/2021

Approved by:

Clifford Clarke – Deputy Head of Engineering

Transforming Lives Through Learning

Educational Aims of the Programme

Level 4 Higher National Certificate

Graduates of the HNC programme will have developed sound mathematical, scientific, and logical thinking skills, as well as a good understanding of a variety of engineering skills which are vital for technician-level industrial employment. They will have had to learned to tackle an array of engineering problems in different ways, giving them a robust problem-solving skill set. They will be able to perform effectively in diverse engineering roles from assembly, maintenance, technician, repair, and more.

Level 5 Higher National Diploma

Graduates of the HND programme will have further developed their mathematical, scientific, and logical thinking skills beyond that of HNC. They will have learned important skills in modelling engineering problems as well as developing academic skills that will allow them to progress to university to complete a degree. They will be able to work in more diverse engineering roles that may include design, prototyping, analysis, or management.

Programme aims:

- To equip students with sector-specific skills, knowledge, and understanding which is necessary to achieve high performance in the engineering industry.
- To provide a clear programme of progression for possible degree entrants to engineering which emphasises contextualised vocational scenarios and assessment with relevance to the engineering workplace.
- To provide insight and understanding into the diversity of roles in the engineering industry with a recognition of the importance of collaboration between levels and departments.
- To equip students with knowledge and understanding of industry practices from a variety of vocational viewpoints.
- To provide opportunities for students to progress to higher qualifications such as a bachelor's degree, masters, or PhD in engineering or related subjects.
- To understand the role of the engineer in society and their obligation to creating a sustainable future for every person, regardless of their location, culture, or nationality.
- To support students to understand the local, regional, and global context of the engineering profession.
- To provide opportunities for students to achieve a nationally-recognised professional qualification.
- To enhance students' employability skills.
- To enhance students' academic skills.
- To allow flexibility of study and to meet local and specialist needs.

We meet these objectives by:

- Providing a team of experienced tutors who have had extensive experience working in the engineering industry.
- Drawing on practical knowledge and experience of staff to deliver challenging and demanding learning activities to enhance the student learning experience.
- Equipping students with the knowledge, understanding, and skills for roles within the engineering profession.
- Enabling progression to university degree programmes by supporting the development of appropriate academic study skills.

Intended Learning Outcomes

HNC:

Unit 1: Engineering design
By the end of this unit, a student will be able to:
Engage with stakeholders to determine their product needs; be able to translate this into an engineering design by undergoing a multi-stage iterative design process; use industry-standard evaluation tools to help refine product design; apply appropriate planning methods to ensure design projects are completed to schedule; present design ideas in ways that are relevant and appropriate to stakeholders and the public.

Unit 2: Engineering Maths
By the end of this unit, a student will be able to:
Use dimensional analysis to balance equations; solve problems with arithmetic and geometric progressions; solve problems modelled with exponential, logarithmic, trigonometric, and hyperbolic functions; make predictions using statistical information; solve problems involving sinusoidal wave functions; solve engineering problems in three-dimensions using vector manipulation; apply differential and integral calculus to the modelling of engineering problems.

Unit 3: Engineering Science
By the end of this unit, a student will be able to:
Apply static and dynamic mechanical principles and electrical engineering principles including; The scientific method, including the design and execution of scientific tests; units of measurement and how they are applied in the wider context of engineering science; Static engineering principles, materials properties of both metallic and non-metallic compounds along with their modes of degradation and failure; Dynamic Engineering principles including energy balance and D'Alembert's principles, and linked to this the principles of fluid dynamics and thermodynamics; DC and AC circuit theorems and analysis and the application of magnetic and electromagnetic principles.

Unit 4: Managing a Professional Engineering Project
By the end of this unit, a student will be able to:
Identify a suitable engineering problem to solve independently; plan their problem solving steps before beginning work; propose a project using a professional-style proposal form with appropriate technical language; undertake research relating to their chosen problem; appropriately respond to the engineering challenge using concepts and skills gained in other units; analyse project outcomes; produce a professional engineering technical report; be able to present the outcomes to an audience using appropriate techniques.

Unit 8: Mechanical Principles
By the end of this unit, a student will be able to:
Understand, explain and solve problems relating to Mechanical principles; Static mechanical systems including the selection of rolled steel beams and columns to satisfy a given loading case; The torsion of shafts and the interpretation of experimental data; The principles of energy and work to explain and solve problems related to energy and work-energy transfer, in both linear and rotational systems, including the analysis of gyroscopic effects and real-world planar mechanisms such as slider crank systems; Understand, explain, analyse and investigate failures in mechanical power transmission systems such as gear trains, screw jacks, universal couplings and mechanical energy storage systems; Harmonic motion in typical engineering systems, considering the natural frequency of vibration, damped and forced systems and how these relate to resonance.

Unit 15: Automation, Robotics, and Programmable Logic Controllers
By the end of this unit, a student will be able to:
Explain the function of a PLC; identify the different physical configurations of a PLC; explain PLC internal architecture; understand principles of automation; understand a variety of PLC programming languages; apply ladder logic to PLC programming; configure PLC inputs and outputs; understand the elements of robotics including the types used in industry; understand and apply robot programming methods; understand the kinematics, design, dynamics, vision systems, and user interfaces of robots; understand and apply operational robotic safety.

Unit 20: Digital Principles
By the end of this unit, a student will be able to:
Understand logic and truth tables; Boolean algebra; Karnaugh maps; understand basic number systems used in computing such as binary and hexadecimal; understand computing memory technologies including RAM and flash memory; understand discrete logic families, CMOS, and TTL; be able to construct simple logic circuits with user interfaces such as LEDs and multi-segment displays; and understand digital subsystems such as multiplexers, shift registers, and data transmission.

Unit 23: Computer-Aided Design and Manufacture (CAD/CAM)
By the end of this unit, a student will be able to:
Describe key principles of manufacturing using CAD/CAM such as hardware, software, inputs, outputs, programming methods, component set-up, work holding, and tooling; produce solid 3D models of components suitable for manufacture using extrusions, cuts, fillets, chamfers, sweeps, revolutions, etc; manipulate models geometrically with mirrors, rotations, arrays; draw components in multiple views and include information such as material, tolerance, finishes; use CAM software to generate manufacturing simulations of solid models, including speeds and feeds, profiling, cutter paths, and program editing; produce a dimensionally accurate component on a CNC machine using a CAD/CAM system including studying the systems, data transfer methods, and inspection of components.

HND:

Unit 34: Research Project
By the end of this unit, a student will be able to:
Identify a research question to be answered; create a professional research project proposal; Identify sources of academic literature and use academic search engines; review literature to extract relevant information; use Harvard referencing appropriately; synthesise new ideas from research; suggest essential answers to their engineering question based on peer-reviewed research; create a professional research report; present research findings to an audience using appropriate media.

Unit 35: Professional Engineering Management
By the end of this unit, a student will be able to:
Understand and apply risk evaluation theories to the management of the engineering business environment; understand essentials of business operations including organisational structures, business strategy, total quality management, legal obligations and corporate responsibility; understand the relationships between various departments in an engineering organisation; produce an engineering services delivery plan for an appropriate engineering sector; understand effective leadership styles, meeting management, communication skills, negotiation skills, and coaching/mentoring styles; illustrate appropriate business ethics; justify the need for continuing professional development.

Unit 36: Advanced Mechanical Principles
By the end of this unit, a student will be able to:
Determine the behavioural characteristics of materials subjected to complex loading including Poisson's Ratio, elastic constants, and volumetric strain and volume changes; assess the strength of loaded beams and pressurised vessels considering bending moments, deflection, and both thin and thick-walled pressure vessels; analyse specifications of power transmission system elements such as belt drives, friction clutches, and gearing systems; examine operational constraints of dynamic rotating systems such as flywheels and rotating mass systems.

Unit 39: Further Mathematics
By the end of this unit, a student will be able to:
Convert between number bases; explain the categories of number; use complex numbers and be able to apply de Moivre's theorem to complex numbers; understand and perform matrix operations including inverse matrices and determinants; be able to approximately sketch standard functions after identifying axis crossings and asymptotes; be able to find roots of multiple functions using the method of bisection and the Newton-Raphson method; perform numerical integration; calculate the result of ordinary differential equations of first and second order; apply differential equations to the analysis of engineering problems; use a variety of methods including separation of variables, integrating factor, undetermined coefficients, and variation of parameters to solve differential equations; use Laplace transforms and partial-fractions to solve differential equations.

Unit 46: Embedded Systems
By the end of this unit, a student will be able to:
Explain the function of microcontrollers including architecture and computational components; Design simple circuitry external to and interfacing with microcontrollers; Write well-structured code in an appropriate programming language, simulate, test, and debug the code; Evaluate and explain applications of embedded systems from motor vehicles to the internet of things.

Unit 49: Lean Manufacturing
By the end of this unit, a student will be able to:
Explain the origins and principles of lean manufacturing; explain why an organisation would adopt a lean manufacturing philosophy; explain the benefits of lean manufacturing to both the organisation and the customer; understand the challenges of implementing a lean manufacturing system; understand and explain the Toyota production system and its place both in and outside of manufacturing; specify a range of process improvement tools such as Kanban, just-in-time, Poke Yoke, total preventative maintenance, and root-cause analysis; communicate the application and use of lean tools; identify factors that influence engagement, facilitation, and change management.

Unit 51: Sustainability
By the end of this unit, a student will be able to:
Explain the global sustainability agenda using Brundtland definitions; explain the change in global demographics and its impact on the wider society; explain how urbanisation is changing the balance of natural spaces; explain climate change and planetary energy balance; evaluate carbon capture and carbon trading systems; articulate various types of socio-technical systems including the Kyoto Protocol and COP21; understand sustainable infrastructures including green building, power storage systems, and sustainable logistics; evaluate forms of alternative energy generation including solar, nuclear, geothermal, and biomass; be able to perform a carbon footprint analysis on a variety of types of companies and explain the boundaries of corporate responsibility.

Throughout the courses, learners will be assessed using varied forms of evidence which include, but are not limited to:

• Technical reports • Essay answers • Presentations • Case studies • Practical testing	• Interviews • Technical drawings • Mathematical papers • Spreadsheets • Simulations

Formative assessments

Formative assessment will take many forms over the delivery of the unit and will include activities such as:

- Interactive lectures and question/answer sessions which can be used to examine student understanding and identify needs for additional guidance.
- Group activities which involve students actively contributing to, leading, and participating in discussions and/or practical activities on a range of subjects.
- Student-lead tutorial sessions where students identify the areas they need to work on and support with a subject specialist present to assist and guide students with their learning.
- Extension activities including quizzes and discussion forums on the Moodle virtual learning environment.
- Each formal set assignment brief is able to be formatively assessed before the final deadline which allows students to receive feedback and guidance to help them prepare their work before submission.

Summative Assessments

- Each unit will include at least one formal assignment which will cover one or more learning outcomes as described in the BTEC qualification manual which is available to students on our Moodle virtual learning environment.
- Assignments are released to students as close to the course start date as possible to allow students to work on their assessment outside of the classroom as the material is delivered to ensure they pace their self-study appropriately to meet stated deadlines.
- Individual written feedback is given to students within 15 working days of submission. This feedback highlights any assessment criteria that have been met as well as ways students can improve their submissions in the future.

Programme Structure

Course Structure

Students entering the HNC programme must meet standard entry requirements including a full level-3 qualification in a related field or significant industry experience. Entry into the HND programme requires students to hold an existing RQF version of the HNC in general engineering (other pathways may be acceptable for top-up on a case-by-case basis, subject to the rules of combination).

HNC	Level	Credits
Engineering Design	4	15
Engineering Maths	4	15
Engineering Science	4	15
Managing a Professional Engineering Project	4	15
Mechanical Principles	4	15
Automation, Robotics, and Programmable Logic Controllers	4	15
Digital Principles	4	15
Computer-Aided Design and Manufacture (CAD/CAM)	4	15
Total Credits		120

HND	Level	Credits
Research Project	5	30
Professional Engineering Management	5	15
Advanced Mechanical Principles	5	15
Further Mathematics	5	15
Lean Manufacturing	5	15
Sustainability	5	15
Embedded Systems	5	15
Credits carried over from HNC	4	120
Total Credits		240

Total Qualification Time (TQT), and Guided Learning Hours (GLH)

Examples of activities which can contribute to Total Qualification Time include:

- Independent and unsupervised research/learning
- Unsupervised compilation of a portfolio
- Unsupervised e-learning
- Unsupervised coursework
- Watching a pre-recorded Teams lesson or suggested online video

Total Qualification Time for the HNC is 1200 hours.
Total Qualification Time for the HND is 2400 hours, 1200 of which are carried over from the HNC.

Total Guided Learning Hours for the HNC is 480 hours.
Total Guided Learning Hours for the HND is 960 hours, 480 of which are carried over from the HNC.

Units, credits, and qualification grading

Pearson BTEC Level 4 Higher National Certificate in Engineering (General Engineering)

- Qualification final award credit value: a minimum of 120 credits.
  - Mandatory core unit credit: 60
  - Optional general unit credit: 60
  - Completed/attempted 120 credits, achieved at least pass in 105 credits at level 4.

Pearson BTEC Level 5 Higher National Diploma in Engineering (General Engineering)

- Qualification final award credit value: a minimum of 240 credits, of which 120 are carried over from HNC.
  - Mandatory core unit credit: 45
  - Specialist unit credit: 30
  - Optional general unit credit: 45
  - Completed/attempted 120 credits, achieved at least pass in 105 credits at level 4 and 105 credits at level 5.

Calculation of the final qualification grade

Learners will be awarded a pass, merit, or distinction qualification grade by the accumulation of points gained through successful completion of individual units. The graded section of each qualification is determined by all 120 credits taken at the level of the qualification, level 4 for HNC or level 5 for HND. The number of points available is dependent on the unit grade achieved and the credit size of the unit.

Units that have been attempted but not achieved, and subsequently granted compensation by the assessment board, will appear as “unclassified”, or a “U” grade, on the student’s Notification of Performance which is issued with the student’s certificate.

Points available per credit at specified unit grades

Points per credit		
Pass	Merit	Distinction
4	6	8

Qualification grades Pearson BTEC Level 4 and Level 5

Point Boundaries	**Grade**	
420-599	Pass	P
600-839	Merit	M
840+	Distinction	D

Compensation provisions for the HNC

Students can still be awarded an HNC if they have attempted but not achieved a Pass in one of the 15-credit units completed, but have completed and passed the remaining units.

Compensation provisions for the HND

Students can still be awarded an HND if they have attempted but not achieved a Pass in one of the 15-credit units completed at level 4, and similarly if they have attempted but not achieved a Pass in one of the 15-credit units at level 5. However, they must complete and pass the remaining units for an HNC or HND as per the unit rules of combination of the required qualification.

Support for Students and Their Learning

Students are supported in their progression through the course by course tutors as well as a variety of campus services including:

- Students receive an induction programme introducing students to their qualification, higher education skills that need to be developed, and college facilities.
- Students are provided with a variety of mental health and resilience resources.
- Course handbooks and guidebooks are available from our Moodle virtual learning environment.
- Students can access personal academic support which is integrated into teaching and student timetables which is provided by supportive and accessible tutors.
- One-to-one support sessions are available to students at regularly scheduled sessions during the week, and additional support can be booked by students outside of those time slots by request.
- Students have access to modern computing equipment with specialist engineering software to allow students to complete assignments as well as produce computer-aided designs, and PLC and circuit simulations.
- College counselling services are available to students in the event of mental health or personal crisis.
- College welfare and bursary services are available for students with financial difficulty or who meet low-income threshold criteria or other specific bursary requirements.
- Formative assessments with written feedback are provided to students before final deadlines.
- Summative assessments with written feedback are provided to students which identify opportunities for students to improve their performance on future submissions.
- Weekly tutorial support is timetabled and all HE students are invited to attend as needed.
- Continually updated Moodle pages provide information to students as news and events occur.

Employability

At Milton Keynes College, we recognise that students need both relevant qualifications and employability skills to enhance their career prospects and contribute to their overall personal development. A range of employability skills are embedded through the programme in preparation for employment and to enhance the skills of the already employed. In addition to the skills contained within the units delivered, the following skills are embedded across all units:

- Cognitive and problem-solving skills: critical thinking, approaches to routine and novel problems by applying creative solutions founded in solid engineering principles, use of digital technology, generating and communicating ideas creatively and effectively.
- Intrapersonal skills: self-management, adaptability and resilience, self-monitoring and self-development, self-analysis and reflection, planning and prioritising.
- Interpersonal skills: effective communication and articulation of information to others, collaborative working skills, negotiation and influencing skills, self-presentation.
- Commercial skills: sector awareness, stakeholder interaction, sales and marketing, budget management and monitoring.
- Practical skills: risk management, health and safety, handling of materials and chemicals.

Milton Keynes College commitment to student employability

This programme is part of Milton Keynes College's commitment to meeting the needs of local, national, and international employers by delivery a diverse range of educational models including full-time, part-time, work-based, and distance learning programmes for students drawn from a range of backgrounds, including non-traditional backgrounds in addition to internal programme progressions from further education vocational programmes.

As a part of this commitment, Milton Keynes College will:

- Support students by providing professional, impartial advice and guidance to enable students to make considered career decisions before and during their studies to enable them to be prepared for future employment and development by identifying the skills needed for progression to employment and enhancing their existing employment skills.
- Provide subject-related resources and information on local, national, and international labour markets.
- Be responsive to the needs of employers in order to maximise students' employability and career progression prospects.
- Include study skills which will improve students' academic writing and research capabilities to enable further student and facilitate career progression.
- Inform suitable student candidates of employment opportunities which local employers makes us aware of through direct communication or passed on through our business engagement team.
- Support equality and diversity and emphasise inclusive thinking and the value of diverse ways of thinking.
- Minimise barriers to learning as described in the college's equality and diversity policies.

Progression

After completing the HNC, students may have the opportunity to progress to the HND programme. Alternatively, students may go on to pursue employment in the engineering industry or a related field.

After completing the HND, students may have the opportunity to progress to a top-up degree programme at a number of universities both locally and across the country. Alternatively, students may go on to pursue employment in the engineering industry or a related field.

Students should also consider their academic status and enhanced employability having successfully completed their HNC or HND in engineering, should they choose an alternate career path. These programmes provide students with a vast array of transferrable skills that are highly sought by other employers such as scientific, medical, and teaching professions.

Students should always check entry requirements for degree programmes at specific universities.
Not all universities offer a degree top-up programme or direct entry into higher years of a degree programme. Although the higher nationals programmes are nationally-recognised qualifications, some universities do not accept undergraduate transfers.

Related job roles:

• Aerospace engineer • Agricultural engineer • Automotive engineer • Biomedical engineer • Chemical engineer • Civil engineer • Computer engineer • Draughting and Design engineer • Electrical engineer • Environmental engineer • Geological engineer • Marine engineer • Mechanical engineer • Petrochemical engineer • Sales engineer • Software engineer	• Assembly technician • Automotive technician • Electronics technician • Maintenance technician • Optical technician • Robotics technician • Intellectual property manager • Logistics manager • Operations manager • Procurement manager • Supply chain manager • Teacher • Technical consultant • Technical training

Evaluating the Quality of Teaching and Learning

Methods for evaluating and improving the standard of teaching and learning:

- Student feedback
- Student voice participation for HE student council
- Student input into higher education team meetings every half-term
- Annual report with quality improvement plan
- Teaching and learning observations for all delivery staff
- Internal quality assurance process
- External quality assurance process
- Regular delivery team meetings
- Semesterly assessment boards

Regulation of Assessment

An annual review is completed every year, with a quality improvement plan. This is written by the course team leader with the input of the higher education delivery team. This is passed to the assistant principle who has oversight of all college higher education programmes.

Assignments and assignment briefs are regulated by an internal verification system. All assignment briefs are checked for errors and quality by an appropriate member of the delivery team different to the staff who wrote the brief. The results of this internal assessment are given to the tutor who wrote the brief and any necessary actions are undertaken before issuing of the assignment.

After assessment, a sample of student submissions with assessor markings are internally verified to ensure fair and valid assessment decisions are made. Results are given back to the assessor and any actions necessary are undertaken. Internal verification sample sizes are based on perceived risk when considering an assessor's familiarity with the unit and experience in assessment.

External examination of assessment, the course provision, and standards of teaching are regulated by Pearson BTEC. An annual external examination is conducted and an examiner's report is issued to the centre with any relevant actions the centre must take to improve provision. The external examiner works with the course team leader to consider and review the quality of the assessment planning, the validity of the assessment decisions, and the consistency of the internal verification and assessment process.

In addition, the programme is periodically reviewed internally whenever Pearson issues a major change or a new qualification specification.

Quality Improvement

Actions identified in the evaluation processes are developed and incorporated into the departmental plan for the improvement of teaching and learning. A quality improvement plan, generated by the annual review process, is produced as guidance for professional development opportunities.

Good practice in teaching and learning is developed through regular in-house teacher training and CPD. Individual lecturer's knowledge of subject content and modern teaching practices is developed across the college by regularly scheduled training activities and individual training needs are identified and actioned. Individualised training may include visiting companies in industry to learn about the most recent advances in equipment or processes, undertaking of further qualifications in teaching and learning or in a subject specialism (at degree level or higher), attendance at external conferences, or online training as appropriate.

Enhancement of student learning experience takes place with either visits to industry for student tours or the invitation of guest speakers from outside the college who have professional experience in the topics being delivered on programme. Cross-college lecturing is often used to enhance the delivery of elements of units which may benefit from a non-engineering perspective (such as in business or management related topics).

Programme Resources

- Dedicated higher education study room
- Dedicated engineering computer equipment
- Dedicated computer-aided design suite
- Dedicated microcontroller kits
- Mechanical lab
- Electronic lab
- Automation demonstration equipment
- Robotic demonstration equipment
- 3D printers for prototyping
- On-site library with staff assistance for research
- E-library resources including access to academic journals through JSTOR
- A range of external links with industry
- Online virtual learning environment
- Microsoft Office student account access

Please note: This specification provides a summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if they take full advantage of the learning opportunities provided. More details can be found in the course handbook and guidebook on the Moodle virtual learning environment.

Document History
07/07/2020 – Created by Christopher Wolfe (CTL for engineering HE programmes) 23/10/2020 – Removal of UCAS codes 20/01/2021 – Change HND U52 to U46 15/06/2021 – Change HNC U19 to U20 and U76 to U23