



## **Arrangements for:**

### **HNC in Mechanical Engineering**

**Group Award Code: G840 15**

### **HND in Mechanical Engineering**

**Group Award Code: G841 16**

### **HNC in Manufacturing Engineering**

**Group Award Code: G83Y 15**

### **HND in Manufacturing Engineering**

**Group Award Code: G83X 16**

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## **Acknowledgement**

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

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## History of changes

It is anticipated that changes will take place during the life of the qualification and this section will record these changes. This document is the latest version and incorporates the changes summarised below. Centres are advised to check SQA's APS Navigator to confirm they are using the up to date qualification structure.

**NOTE:** Where a Unit is revised by another Unit:

- ◆ No new centres may be approved to offer the Unit which has been revised.
- ◆ Centres should only enter candidates for the Unit which has been revised where they are expected to complete the Unit before its finish date.

Version number	Description	Date
10	Production Planning and Control from DT63 35 (lapse date 31/07/2012, finish date 31/07/2014) to H1KS 35 for the following group awards: G83X 16  Revision of Unit: DE1K 33 Workplace Communication in English has been revised by H8T2 33 and finishes on 31/07/2016.	07/05/15
09	Removal of finish date from unit DG4P 35 <i>Mathematics for Engineering 3</i> . Addition of Credit Transfer Table <i>see Page 43</i> .	16/01/14
08	<b>Revision of Units:</b> D77G 34 <i>Communication: Practical Skills</i> revised by H7MB 34. DT5X 33 <i>Mathematics for Engineering 1: Mechanical and Manufacturing</i> revised by H7K0 33 <i>Engineering Mathematics 1</i> . DG4L 34 <i>Mathematics for Engineering 2</i> revised by H7K1 34 <i>Engineering Mathematics 2</i> on <b>HNC</b> and <b>HND</b> frameworks finishing 31/07/2016.	21/10/14
07	<i>Engineering Mathematics 3</i> (H7K2 34), <i>Engineering Mathematics 4</i> (H7K3 35) and <i>Engineering Mathematics 5</i> (H7K4 35) added as optional Units to both HND frameworks.	25/08/14
06	<b>Addition of optional Units:</b> <i>Energy Overview</i> (H4J5 34) and <i>Energy Technologies</i> (H4J6 35)	09/08/13
05	<b>Added to Framework (HND Mech. Eng.):</b> <i>Project Management for IT</i> F1W0 34 as an optional alternative to <i>Project Management</i> A6AX 34	15/01/13
04	<b>Changes to code:</b> <i>Electrical Machine Principles</i> from DN4J 34 (lapse date 31/07/2011, finish date 31/07/2013) to H01T 34. <b>Changes to codes and titles:</b> <i>Process and Equipment Selection</i> from DT62 35 (lapse date 31/07/2012, finish date 31/07/2014) to <i>Manufacturing: Process and Equipment Selection</i> H292 35. <i>Single Phase AC Circuits</i> from DG54 34 (lapse date 31/07/2011, finish date 31/07/2013) to <i>DC and AC Principles</i> FY9E 34.	17/10/12
03	Broadening Units added to framework. Core Skills in old Communication Unit clarified in credit transfer grid etc.	09/01/08
02	Removal of Graded Units — see website for Graded Units	24/10/06

# 1 Introduction

This Arrangements Document has been written in order to assist in preparing for the approval of the new HNC and HND in Mechanical Engineering and HNC and HND Manufacturing Engineering and maintaining these awards thereafter. These four awards were developed under the new SQA HN Design Principles, were validated in June 2005, and replace the existing HNC Engineering: Mechanical, HND Engineering: Mechanical, HNC Engineering: Manufacturing Systems and HND Engineering: Manufacturing Systems.

This document includes details on the background to the development of the new awards, their aims (both general and specific) and rationale, recommended access requirements, information about the structure of the awards, recommendations on delivery and assessment and other guidance to centres.

## 2 Rationale for the revision of the award

### 2.1 Mechanical and Manufacturing Engineering

The term Mechanical Engineering in the context of this document covers the range of subjects traditionally included in SQA Higher National awards in Mechanical Engineering. Such subjects include Engineering Principles, Engineering Drawing/ CAD, Heat Transfer and Fluid Mechanics, Industrial Maintenance, Materials, Pneumatics and Hydraulics, Quality Systems, Plant Systems and Thermofluids. The title Mechanical Engineering is intended to provide candidates, lecturers, Higher Education, employers and professional bodies with a clear, unambiguous title.

In a similar way the term Manufacturing Engineering is used in this document to cover the wide range of Manufacturing Engineering subjects previously covered in SQA HNC and HND Manufacturing Systems awards. Such subjects include Design for Manufacture, Economics of Manufacture, Engineering Drawing, Engineering Measurement, Engineering Principles, Economics of Manufacture, Materials, Quality Systems and Tool Design. Like the title Mechanical Engineering, Manufacturing Engineering has been adopted to provide candidates, lecturers, Higher Education, employers and professional bodies with a clear, unambiguous title.

### 2.2 HN Engineering Framework

In 1996 the SQA validated nationally a large number of new HN Engineering awards including four awards entitled HNC Engineering: Mechanical, HND Engineering: Mechanical, HNC Engineering: Manufacturing Systems and HND Engineering: Manufacturing Systems. A major difference between these and previous awards were that they all sat within an HN Engineering Framework which in general terms consisted, for both HNC and HND, of a common core of Units (Units common to all HNC and HND Engineering awards), a principles/technology and optional sections.

The benefits of this Framework structure were seen to include the following:

- ◆ provide a wide range of HN Engineering qualifications to meet the needs of different engineering sectors
- ◆ improve the credibility and esteem of individual HN Engineering awards
- ◆ clarify those competencies that were general to all incorporated engineers and those that were specific to particular engineering disciplines
- ◆ provide opportunities for the efficient delivery of HN Engineering Units by, for example, incorporating Units that were common to a number of different HN awards
- ◆ facilitate better progression between HNC, HND and degree engineering awards

Prior to the development of any HN Engineering awards a major consultation exercise was undertaken on the overarching HN Engineering Framework to test the validity of the Framework. This consultation comprised the following five strands:

- ◆ a questionnaire survey with stakeholders of HN Engineering awards
- ◆ a series of meetings with various interested stakeholders of HN Engineering awards
- ◆ desk based research
- ◆ discussions (followed by endorsement) of a proposed HN Engineering Framework at a HN Engineering Steering Group meeting
- ◆ a major consultation event with FE colleges on 24 May 2002 which included a questionnaire survey

The consultation revealed continuing strong support for an overarching HN Engineering Framework but with the following modifications:

- ◆ a reduction in the number of common core Units
- ◆ a strengthening of the Principles/Technology section with an even stronger emphasis on the teaching of core engineering principles and technologies

Optional sections are retained in all HNC and HND Engineering awards.

The revised HNC and HND Engineering Frameworks are shown in block diagram form in Figures 2.1 and 2.2. It should be noted that the PDAs shown in both diagrams may be developed if sufficient market demand for such specialist awards arise: currently no PDAs exist.

## HNC ENGINEERING FRAMEWORK

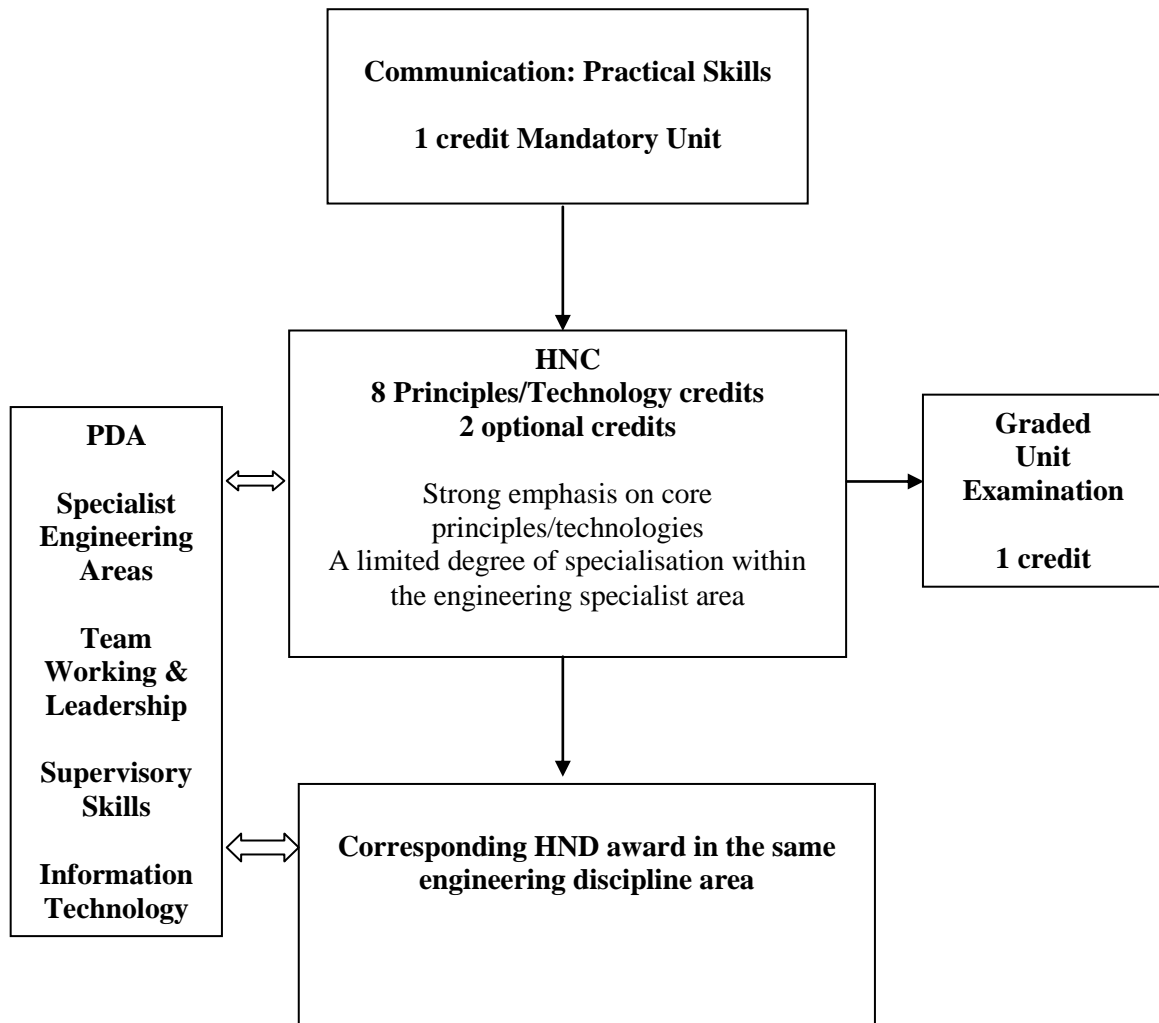


Figure 2.1



# HND ENGINEERING FRAMEWORK

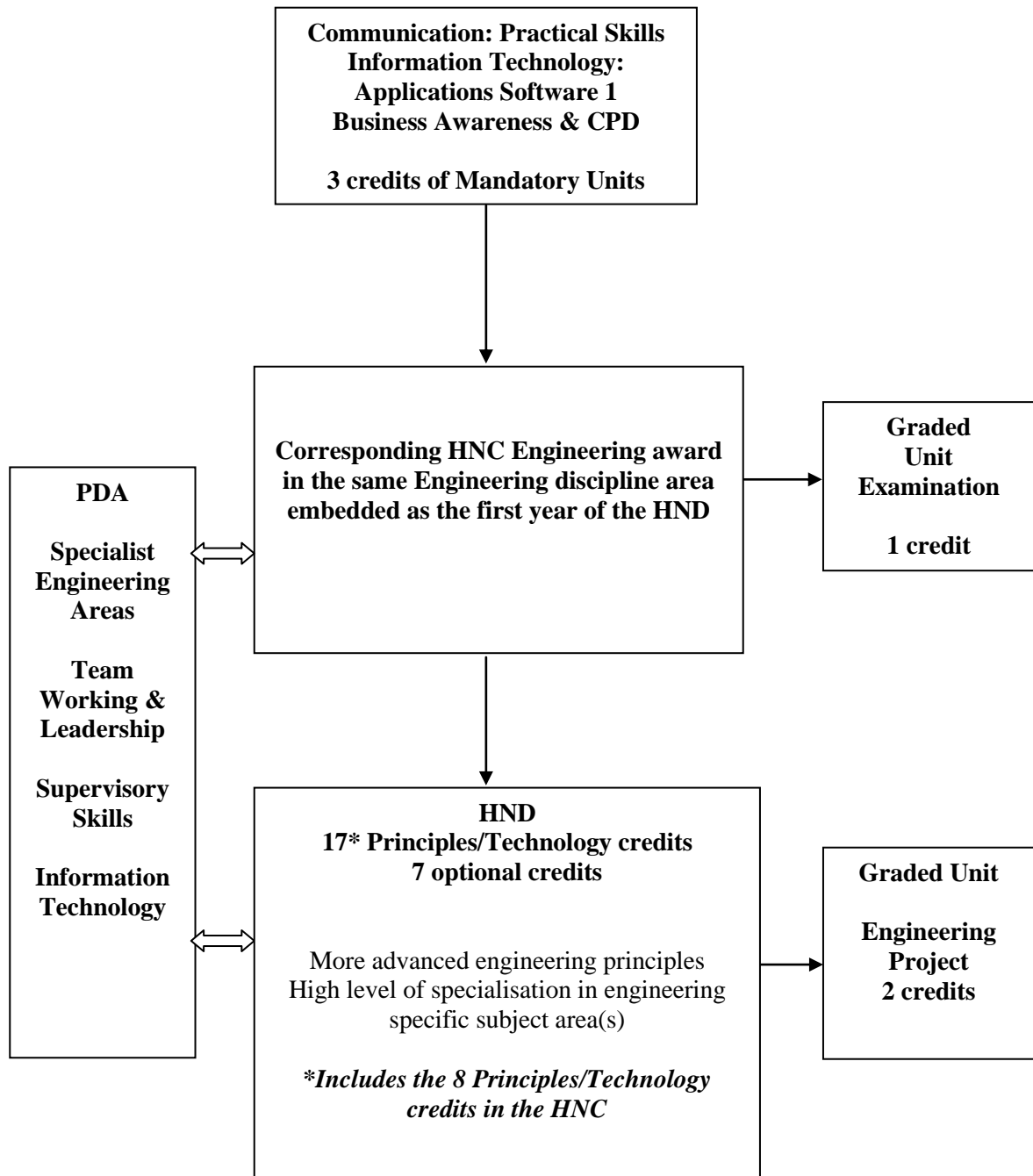


Figure 2.2

## 2.3 History and Market Research to support the HNC and HND Mechanical and HNC and HND Manufacturing Engineering

### 2.3.1 History of the HNC and HND Mechanical and HNC and HND Manufacturing Engineering awards

HNCs in Mechanical and Manufacturing Engineering were first converted to a competence based format in 1989. In 1995 and 1996 the HNC and HND in Engineering: Mechanical awards were totally harmonised (ie the HNC formed 12-credits within the HND) as part of a major SCOTVEC national development which saw the introduction of an overarching HN Engineering Framework. The same total harmonisation also occurred with the HNC and HND in Engineering: Manufacturing Systems as part of this national development. The four awards presented in this document represent a further development of Higher National awards in Mechanical and Manufacturing Engineering in as much as they take into account fully the new SQA HN Design Principles and the latest developments in technology, working practices and education.

### 2.3.2 Market Research

The development of the new HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering awards included extensive market research which is summarised in Figure 2.3.

Stakeholder	Method
All	Major desk based research gathering and analysing data from various sources (eg SEMTA, FutureSkills Scotland etc.)
Delivery Centres	Two national seminars with workshop sessions were held designed to seek delivery staff views on a range of issues relating to HN Mechanical / Manufacturing developments.  Draft Units, assessment exemplars and outlines of graded Units were made available to centres.
Employers	Consultation took place principally through members of the Qualifications Design Team consulting industrial contacts on the framework structure and Unit content.
Higher Education	Letters of support for articulation between the new HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering and degree awards were received from four Higher Education institutions.

Stakeholder	Method
Professional Bodies	A representative of the Institute of Incorporated Engineers advised the Qualification Design Team on the status of the four awards in relation to membership of the IET.
Candidates	Whilst not consulted directly details of candidate experience of the current HNC and HND Engineering: Mechanical and HNC and HND Engineering: Manufacturing Systems were provided by Qualification Design Team members and other centre staff involved in the delivery of the current awards. These experiences were fully taken into account in the design of the new awards.

**Figure 2.3: Groups consulted on HN developments**

## **2.4 Candidates**

### **2.4.1 HNC Candidates**

Candidates at HNC level may already be in employment and will attend centres on a day-release or other part-time basis. The HNC framework structures are flexible enough to allow centres to deliver the two HNC awards by various modes of delivery for example, two-year day-release, evening attendance etc.

The options chosen by employed candidates may reflect the branch of industry in which they are employed or may be used to gain knowledge of other areas within mechanical or manufacturing engineering in order to improve their career opportunities in the employment market. Part-time candidates may also use the HNC award to gain entry to degree level studies.

Full-time HNC candidates may be school leavers who have not gained the required university entry qualifications and who are using either of the awards as an alternative means of gaining access to a university education. Full-time candidates may also be more mature persons who are seeking a change of employment.

Since the HNC awards form an integral part of their corresponding HND award, it is likely that full-time candidates will complete 15 Unit credits in the first year of the course, 12 of these being the HNC requirements. Full-time candidates will therefore have completed the first year of the HND programme and may, if they wish, continue to the second year of the HND award.

In addition to university entrance, successful full-time HNC candidates will have enhanced their prospects of gaining employment in the Mechanical or Manufacturing industries.

## 2.4.2 HND Candidates

HND award programmes will normally be delivered on a two-year full-time basis, although this does not preclude other delivery patterns. This being the case, HND candidates will normally be school leavers who have an interest in some aspect of mechanical or manufacturing engineering and wish to include this in their career path. The typical HND candidate will therefore be a young person who has not gained the required university entrance qualifications from school or who feels the need to gain a more in-depth knowledge of mechanical or manufacturing engineering before embarking on a university career. The Units of the HNC/HND framework have been designed to introduce candidates to mechanical or manufacturing engineering and to take topics to a more advanced level than is possible in an HNC.

Mature candidates may also embark on either of the HND programmes. The Qualifications Design Team and Unit writers are aware that such candidates may not have studied for some time and will require additional support in developing their learning skills. The HN Mechanical and Manufacturing Units have been designed as far as possible to provide candidates with opportunities to develop critical knowledge and understanding of theory and practical hands-on skills required by practising mechanical or manufacturing incorporated engineers.

## 2.5 Articulation and Professional Body Requirements

The Qualifications Design Team have written to a number of universities in Scotland regarding possible articulation routes between the HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards and degree courses offered by the universities. In general terms, universities will allow candidates with an HNC to enter the first year of their mechanical engineering (or related engineering) degree programmes. Candidates with an HND will normally be allowed to enter the second or third year of a degree programme provided they have the Unit Mathematics for Engineering 3.

The Qualifications Design Team has been advised by the IET that the HNC and HND Mechanical Engineering and the HNC and HND Manufacturing Engineering awards partially meet the academic requirements for registration as an Incorporated Engineer and fully meet the requirements for registration as an Engineering Technician.

## 3 Aims of the award

### 3.1 General Aims of the HNC Mechanical Engineering and HNC Manufacturing Engineering

The general aims of the awards are to:

- ◆ enhance candidates' employment prospects
- ◆ support candidates' Continuing Professional Development and career development
- ◆ enable progression within the SCQF (Scottish Credit and Qualifications Framework)
- ◆ develop candidates' ability to apply analysis and synthesis skills to the solution of mechanical or manufacturing engineering problems
- ◆ develop learning and transferable skills (including Core Skills)

### 3.2 Specific Aims of the HNC Mechanical Engineering and HNC Manufacturing Engineering

*The specific aims common to the two HNC awards are to:*

- ◆ provide awards that will allow candidates to work now, or in the future, as mechanical or manufacturing technicians or incorporated engineers
- ◆ provide awards that create a route towards meeting the academic requirements for Incorporated Engineer status
- ◆ develop awards that on successful completion will allow candidates to progress to HND Mechanical Engineering or HND Manufacturing Engineering or a degree in Mechanical or Manufacturing Engineering or related subject discipline area
- ◆ develop a range of Communication knowledge and skills relevant to the needs of mechanical or manufacturing incorporated engineers
- ◆ on successful completion of the award, achieve the Core Skill of Communication at Higher level. The candidate will also be provided with opportunities to develop the following Core Skills: Information Technology, Numeracy, Problem Solving and Working with Others at Higher level

*Aims specific to the HNC Mechanical Engineering:*

- ◆ develop knowledge, understanding and skills in a range of core principles and technologies by undertaking Units in Mathematics, Quality Systems, Engineering Principles, Materials Selection, Statics and Strength of Materials, Dynamics, Thermofluids and Pneumatics and Hydraulics
- ◆ achieve a degree of specialisation within the following areas: engineering drawing, CNC, CAD, Design for Manufacture, Control Systems, Industrial System, PLC, Information Technology Application Software, Economics of Manufacture, Engineering Measurement and Mathematics

*Aims specific to the HNC Manufacturing Engineering:*

- ◆ develop knowledge, understanding and skills in a range of core principles and technologies by undertaking Units in Mathematics, Engineering Drawing, Quality Systems, Engineering Principles, Materials Selection, Economics of Manufacture, Process and Equipment Selection and Engineering Measurement
- ◆ achieve a degree of specialisation within the following areas: Engineering Measurement, CNC, CAD, Design for Manufacture, Control Systems, Metal and Plastic Manufacture, Jigs and Fixtures, Industrial Systems, Statics and Strength of Materials, Information Technology Application Software and Mathematics

### 3.3 General Aims of the HND Mechanical Engineering and HND Manufacturing Engineering

The same as for the HNC Mechanical Engineering and Manufacturing Engineering awards but with the addition of the following:

- ◆ develop candidates' knowledge and skills in planning, scheduling and project management
- ◆ develop investigation skills

### 3.4 Specific Aims of the HND Mechanical Engineering and HND Manufacturing Engineering

*The same as for the HNC Mechanical Engineering and HNC Manufacturing Engineering but with the addition of the following:*

- ◆ develop an award that on successful completion will allow candidates to progress to a degree in Mechanical or Manufacturing Engineering or related subject discipline area
- ◆ develop knowledge and understanding of the external and internal factors that influence the performance of modern companies
- ◆ recognise the important role Continuing Professional Development plays in career development
- ◆ on successful completion of either award, achieve the Core Skills in Communication at Higher level, Information Technology at Higher level, Problem Solving at Higher level and the Using Number component of Numeracy at Higher level. Candidates will also be provided with opportunities to develop the Core Skill Working with Others at Higher

*Aims specific to the HND Mechanical Engineering:*

- ◆ expand on the range of knowledge, understanding and skills in the core HNC Mechanical Principles and Technologies section by undertaking Units in Information Technology Applications Software, Engineering Skills, Plant Systems, Heat Transfer and Fluid Mechanics, Applied Industrial Plant Maintenance, Strength of Materials Advanced and Mathematics
- ◆ allow for further specialisation within the following subject areas: CNC, CAD, Design for Manufacture, Engineering Measurement, Control Systems, Mathematics, Single Phase AC Circuits, Three Phase Systems, Electrical Motor Principles, Electrical Motor Drive Systems, Analogue and Digital Electronics, PLC, Industrial Systems, Process and Equipment Selection, Metal and Plastic Component Manufacture, Safety Engineering, Robotics, Project Management and HVAC Design and Practice

*Aims specific to the HND Manufacturing Engineering:*

- ◆ expand on the range of knowledge, understanding and skills in the core HNC Manufacturing Principles and Technologies section by including Units in Information Technology Applications Software, Mathematics, Engineering Skills, Simulation of Advanced Manufacturing Systems, Production Planning, Project Management, Facilities Layout and Mathematics
- ◆ allow for further specialisation within the following subject areas: CNC, CAD, Computer Aided Engineering and Prototyping, Design for Manufacture, Control Systems, Jigs and Fixtures, Tool Design, Pneumatics and Hydraulics, Industrial Systems, Metal and Plastic Component Manufacture, PLC, Robotic Systems, Statics and Strength of Materials and Mathematics.

### 3.5 How the General Aims are met in the HNC and HND Award Structures and Content

Aim No.	How it is met in HNC and HND
3.1.1	For many years HNC and HND Mechanical and Manufacturing Engineering qualifications have equipped candidates to seek employment in a wide range of manufacturing, service and public sector organisations. Market research indicates that HNC and HND Mechanical and Manufacturing Engineering awards are still regarded as the minimum qualifications required by many organisations to work at engineering technician or incorporated engineer level.
3.1.2	There has been a long tradition of candidates in employment taking HNC Mechanical or HNC Manufacturing Engineering on a part-time basis to increase their knowledge of Mechanical or Manufacturing Engineering and enhance their career development. In recent years, with increased commonality between HNC and HND awards and greater flexibility in the way these awards are delivered, candidates in employment have increasingly taken HNDs on a part-time basis to expand their knowledge and skills in Mechanical and/or Manufacturing and improve their career prospects. The four new awards contain a balance of core principles and up to date knowledge and skills in Mechanical and Manufacturing Engineering which lend themselves to the Continuous Professional Development and career development of candidates working at technician and incorporated engineer levels. Furthermore, the award structures have been designed to allow for easy progression between HNC and HND awards.
3.1.3	All Units within the new HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards have been levelled at SCQF levels 6, 7 or 8. The four new awards also conform to the SQA levelling requirements for HNC and HND awards. Thus, successful completion of any of the awards will allow progression within the SCQF.
3.1.4	The nature of Mechanical and Manufacturing Engineering disciplines is such that they lend themselves to both the analysis and synthesis of problems. For example, when a complex mechanical or manufacturing system is analysed (using, say, a block diagram approach) by breaking it down into separate functional parts or alternatively the synthesis of a complex system from simpler mechanical systems. The four new awards allow these important skills to be developed further both in the technical subjects and in the core Communication, Information Technology and Business Awareness and Continuing Professional Development Units.

Aim No.	How it is met in HNC and HND
3.1.5	<p>The new HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards provide centres with an opportunity to enhance learning skills not least by creating opportunities for candidates to combine theory and practice to achieve a real understanding of a subject. For example, some Units recommend significant use of practical work and/or computer simulation to reinforce learning. It is also anticipated that centres will use innovative delivery approaches that may make use of sophisticated mechanical and/or manufacturing laboratory equipment and/or on-line delivery and/or Virtual Learning Environments to enhance candidate learning.</p> <p>By their very nature Engineering courses require the transfer of technical knowledge and skills from one area to another. For example, a significant level of Engineering Principles and Mathematics has been included in both HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards because these subjects provide underpinning knowledge, understanding and skills which are used elsewhere in both awards. Candidates will also have an opportunity to use the Communication and Information Technology knowledge and skills developed in the mandatory core Units in other parts of the awards to support such activities as report writing, presentation and the application of specialist software packages. Core Skills in general, and problem solving in particular, have been regarded as very important by the Qualification Design Team since it is recognised that a good level of competence in these is essential in the work of an incorporated engineering technician.</p>
3.3.1	<p>The double credit (16 SCQF points) Engineering Project Graded Unit in both the HND Mechanical Engineering and HND Manufacturing Engineering awards provide opportunities for candidates to develop planning, scheduling and project management knowledge and skills. The Project Management Unit in the HND Mechanical Engineering also provides opportunities for candidates to develop these knowledge and skills.</p>
3.3.2	<p>The Business Awareness and Continuing Professional Development Unit provides candidates with opportunities to develop their investigative skills by exploring the external and internal factors that affect the performance of a modern company and the different ways that people learn. The Engineering Project also requires candidates to undertake some investigations into the background to an engineering project and a range of solutions for the project.</p>



### 3.6 How the Specific Aims are met in the HNC and HND Award Structures and Content

Aim No.	How it is met in HNC and HND
3.2.1	<p>An HNC/HND Mechanical Engineering and an HNC/HND Manufacturing Engineering have been recognised for many years by employers and other stakeholders of these awards as appropriate qualifications for persons wishing to work at engineering technician or senior technician levels. Market research indicates that there is still a demand for people with technician level skills in mechanical and/or manufacturing engineering especially as companies automate a lot more of their processes. Thus, it is confidently anticipated that those achieving the HNC/D Mechanical Engineering or the HNC/D Manufacturing Engineering awards will find employment as engineering technicians and senior engineering technicians in a wide range of small, medium and large companies.</p>
3.2.2 & 3.2.3	<p>The IET has advised that the HNC and HND Mechanical Engineering and the HNC and HND Manufacturing Engineering awards partially meet the academic requirements for registration as an Incorporated Engineer (a degree is required to fully meet the requirements) and fully meets the requirements for registration as an Engineering Technician.</p> <p>Given the clear progression routes that have been established between existing HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards and degree courses by many FE colleges and universities, it is strongly anticipated that similar progression routes will also be developed between the new HNC and HND awards and degree courses. Thus, HNC/HND Mechanical Engineering and the HNC/HND Manufacturing Engineering awards will continue to form very important ‘stepping stones’ towards candidates achieving degrees (and, thus, satisfy fully the academic requirements for Incorporated Engineer status). Progression arrangements between HNCs, HNDs and degrees can only be strengthened with the full implementation of the SCQF.</p>
3.2.4	<p>Previously validated HNC and HND Engineering awards contain separate Communication and Information Technology Applications Units within their mandatory cores. The market research information gathered through various consultations indicates that there continues to be solid support for the inclusion of a distinct Communication Unit in the mandatory core of the HNC and a Communication and Information Technology Unit within the mandatory core of the HND Engineering award. The benefit of having separate Communication and Information Technology Units is that it significantly improves the prospect of sufficient attention being given to the teaching of these two key subjects. Separate Units also make it possible to ensure that the Communication and Information Technology Core Skills at Higher level are fully embedded within the respective Units within the</p>

Aim No.	How it is met in HNC and HND
	<p>HND. Award designers considered this a more appropriate way to ensure that these Core Skills are included in HN Engineering awards than trying to embed such Core Skills across, say, a range of engineering Units, except at HNC level where they believe there are considerable opportunities to develop Information Technology Core Skills within Mechanical and Manufacturing Units. It should also be noted that opportunities to develop Communication and Information Technology Core Skills are signposted in a number of the Mechanical and Manufacturing Units.</p>
3.2.5	<p>The Communication Core Skill at Higher level has been incorporated into the HNC Mechanical Engineering and HNC Manufacturing Engineering awards through the mandatory core Unit, Communication: Practical Skills.</p> <p>Opportunities to develop the Core Skills Information Technology, Numeracy, Problem Solving and Working with Others are signposted within individual Unit specifications. Candidates may achieve the Information Technology Core Skill at Higher level if they take the optional Units in Information Technology: Applications Software 1 in the HNC. Likewise candidates may achieve the Using Number Core Skill component if they take the optional Unit in Mathematics for Engineering: Mechanical and Manufacturing.</p>
3.2.6	<p>As indicated in section 2.1.4 market research shows that employers place a high priority on employees having the correct technical and practical skills to function effectively in their job. Whilst there continues to be a debate about the precise nature of such technical and practical skills it is clearly important that mechanical technicians and incorporated engineers have a sound knowledge and understanding of core mechanical principles. Such knowledge and understanding will serve candidates well in employment and provide the platform for learning more advanced technical skills. The Principles/Technology section of the new HNC Mechanical Engineering award reflects this concentration on core principles by providing studies in the key areas of Mechanical Engineering namely: Mathematics, Quality Systems, Engineering Principles, Materials Selection, Statics and Strength of Materials, Dynamics, Thermofluids and Pneumatics and Hydraulics.</p>
3.2.7	<p>In the 2-credit optional section candidates will be able to specialise further in the following areas: Engineering Drawing, CNC, CAD, Design for Manufacture, Control Systems, Industrial Systems, PLC, Information Technology Application Software, Economics of Manufacture, Engineering Measurement and Mathematics. <b>The Qualification Development Team would strongly recommend that candidates with little Mathematical skills do the Mathematics for Engineering 1: Mechanical and Manufacture Unit as part of their optional studies.</b></p>

Aim No.	How it is met in HNC and HND
3.2.8	Same as per 3.2.6. The Principles/Technology section of the new HNC Manufacturing Engineering award contains studies in the following key areas of Manufacturing Engineering namely: Mathematics, Engineering Drawing, Quality Systems, Engineering Principles, Materials Selection, Economics Of Manufacture, Process And Equipment Selection and Engineering Measurement.
3.2.9	Same as per 3.2.7. Candidates will be able to specialise in the following areas of Manufacturing: CNC, CAD, Design for Manufacture, Control Systems, Engineering Measurement, Jigs and Fixtures, Industrial Systems, Statics and Strength of Materials, Metal and Plastic Component Manufacture, Information Technology Application Software and Mathematics.
3.4.1	See comments under 3.2.2 and 3.2.3.
3.4.2 & 3.4.3	It has been a tradition to deliver some form of Business Studies Unit in HND Engineering awards looking at issues such as costing/pricing of products and services. However, the focus of the new Business Awareness and Continuing Professional Development Unit is quite different looking as it does at the changing industrial environment in which incorporated engineers have to work nowadays. This environment is characterised by globalisation of the market place leading to world-wide marketing opportunities and competitive pressures; greater use of advanced technologies and the predominance of Small and Medium Sized Enterprises in the British economy. It is important that HND Engineering candidates are suitably prepared to work in this ever-changing employment environment. The Business Awareness and Continuing Professional Development Unit seeks to do this by allowing candidates to explore the external factors that affect the performance of modern companies and the ways in which companies are responding to these external pressures internally. The Unit also has an Outcome on the important role that continuous learning and Continuing Professional Development will increasingly play in helping candidates to obtain sustainable and rewarding employment. Consultation with the FE sector and other interested stakeholders of HND Engineering awards has shown a strong measure of support for the Business Awareness and Continuing Professional Development Unit.

Aim No.	How it is met in HNC and HND
3.4.4	The Communication and Information Technology Core Skills at Higher level have been incorporated into the HND Mechanical and Manufacturing Engineering awards through the mandatory core Units Communication: Practical Skills and Information Technology: Application Software respectively. The Core Skill Problem Solving at Higher level is embedded within the 2 credit HND Engineering Project Graded Unit in both the HND Mechanical Engineering and HND Manufacturing Engineering awards. The Using Number Core Skill component at Higher level is embedded within the Mathematics for Engineering: Mechanical and Manufacturing Unit. Opportunities to develop the Core Skills component Using Graphical Information and the Working with Others Core Skill are signposted within individual Unit specifications in the two HND awards.
3.4.5	The P/T (Principles/Technology) section of the HND Mechanical Engineering award contains all the Units in the P/T section of the HNC Mechanical Engineering award. In addition, within the P/T section of the HND Mechanical Engineering awards there are Units which allow candidates to expand their knowledge, understanding and skills in the following subject areas: Information Technology Applications Software, Mathematics, Engineering Skills, Plant Systems, Heat Transfer and Fluid Mechanics, Applied Industrial Plant Maintenance and Strength of Materials Advanced.
3.4.6	In the 7-credit optional section of the HND Mechanical Engineering candidates will be able to specialise further in the following areas: CNC, CAD, Design for Manufacture, Engineering Measurement, Control Systems, Single Phase AC, Three Phase Systems, Electrical Motor Principles, Electrical Motor Drive Systems, Analogue and Digital Electronics, PLC, Process and Equipment Selection, Metal and Plastic Component Manufacture, Robotics, Safety Engineering, Project Management, HVAC Design and Practice and Mathematics.
3.4.7	Same as per 3.4.5. In addition, within the P/T section of the HND Manufacturing Engineering awards there are Units which allow candidates to expand their knowledge, understanding and skills in the following subject areas: Information Technology Applications Software, Mathematics, Engineering Skills, Simulation of Advanced Manufacturing Systems, Production Planning, Project Management and Facilities Layout.
3.4.8	Same as per 3.4.6. Candidates will be able to specialise in CNC, CAD, Computer Aided Engineering and Prototyping, Design for Manufacture, Control Systems, Jigs and Fixtures, Pneumatics and Hydraulics, Industrial Systems, Metal and Plastic Component Manufacture, PLC, Robotic Systems, Statics and Strength of Materials and Mathematics.

## **4 Access to awards**

### **4.1 Access requirements**

Admission to the HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards should be based on a broad approach to candidate selection but, at the same time, should ensure that candidates are chosen who have the potential and ability to complete the awards successfully. To this end the following are simply recommendations and should not be seen as a definitive or prescriptive list of entry requirements. Their purpose is simply to give guidance on the selection of candidates. It is recommended that candidates should possess the following:

- ◆ One Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1-2/ Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- ◆ National Certificate Group Award in Engineering.
- ◆ Qualification comparable to the above, gained through other awarding bodies such as City & Guilds, Edexcel etc.
- ◆ At the discretion of the Principal of the presenting centre for applicants with a different experiential background who could benefit from taking the course or Units within the course, eg adult returners, overseas students with relevant work experience.

### **4.2 Alternative Access Arrangements**

The presenting centre may operate alternative access arrangements in cases where the candidate is convinced that he/she already has the required competences in a given area. These arrangements are as follows:

- ◆ Assessment on demand
- ◆ Credit transfer
- ◆ Accreditation of prior learning
- ◆ Relevant work experience

Individual presenting centres will require to outline their systems for each of these as a part of any approval procedure.

## 5 Award(s) structure

### 5.1 HNC Mechanical Engineering 12 Unit Credits

Award Number: G840 15

#### Mandatory Units (9 Credits)

Section	Credit Value	SCQF level	Product Code	Product Title
Common Core	1	7	H7MB 34**	Communication: Practical Skills
Principles and Technology  (8 Credits)	1	6	H7K0 33**	Engineering Mathematics 1
	1	7	DT8Y 34	Quality Management: An Introduction
	1	7	DR3L 34	Engineering Principles
	1	7	DT46 34	Materials Selection
	1	7	DR1T 34	Statics and Strength of Materials
	1	7	DT9T 34	Dynamics
	1	7	DT9P 34	Thermofluids
	1	7	DT9X 34	Pneumatics and Hydraulics

#### Optional Units (max 2 Credits)

Credit Value	SCQF level	Product Code	Product Title
1	7	DR1W 34	Engineering Drawing
1	7	D75X 34	Information Technology: Applications Software 1
1	7	DT5P 34	CNC
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	8	DR3M 35	Design for Manufacture
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
1	8	DT5V 35	Industrial Systems
1	7	DG31 34	Applications of Programmable Logic Controllers
1	7	H7K1 34**	Engineering Mathematics 2
1	7	DT5R 34	Economics of Manufacture
1	7	DT9R 34	Engineering Measurement
1	7	DE3R 34	Personal Development Planning
1	6	H8T2 33**	Workplace Communication in English
1	7	H4J5 34**	Energy Overview

#### Graded Unit (1 Mandatory Credit)

Credit Value	SCQF level	Product Code	Product Title
1	7	DV11 34	Mechanical Engineering: Graded Unit 1 Examination

\*\*Refer to History of Changes for revision changes.

## 5.2 HND Mechanical Engineering 30 Unit Credits

Award Number: G841 16

### Mandatory Units (20 Credits)

Section	Credit Value	SCQF level	Product Code	Product Title
Common Core (3 Credits)	1	7	H7MB 34**	Communication: Practical Skills
	1	7	D75X 34	Information Technology: Applications Software 1
	1	8	DG3D 35	Business Awareness and Continuing Professional Development
Principles and Technology (17 Credits)	1	6	H7K0 33**	Engineering Mathematics 1
	1	7	DT8Y 34	Quality Management: An Introduction
	1	7	DR3L 34	Engineering Principles
	1	7	DT46 34	Materials Selection
	1	7	DR1T 34	Statics and Strength of Materials
	1	7	DT9T 34	Dynamics
	1	7	DT9P 34	Thermofluids
	1	7	DT9X 34	Pneumatics and Hydraulics
	1	7	DR1W 34	Engineering Drawing
	1	7	H7K1 34**	Engineering Mathematics 2
	2	7	DR1V 34	Engineering Skills
	2	8	DT60 35	Plant Systems
	1	8	DT5T 35	Heat Transfer and Fluid Mechanics
	1	8	DV01 35	Strength of Materials: Advanced
1	8	DT9W 35	Applied Industrial Plant Maintenance	

### Optional Units (max 7 Credits)

Credit Value	SCQF level	Product Code	Product Title
1	8	DT5V 35	Industrial Systems
1	7	DG31 34	Application of Programmable Logic Controllers
1	7	DT5P 34	CNC
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	8	DR3M 35	Design for Manufacture
1	7	DT9R 34	Engineering Measurement
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
2	8	DG4P 35	Mathematics for Engineering 3
1	7	DR2D 34	Safety Engineering and the Environment
1	6	DN46 33	Analogue Electronics: An Introduction
1	7	DN4E 34	Digital Electronics
1	7	DT5R 34	Economics of Manufacture
1	7	FY9E 34**	DC and AC Principles
1	7	DN47 34	Three Phase Systems*
2	7	H01T 34**	Electrical Machine Principles*
1	8	DN4K 35	Electrical Motor Drive Systems*
1	7	DT5Y 34	Metal Component Manufacture
1	7	DT61 34	Plastic Component Manufacture
2	8	H292 35**	Manufacturing: Process and Equipment Selection
1	8	DT9Y 35	Robotic Systems
1	7	A6AX 34 F1W0 34**	Project Management <b>or</b> Project Management for IT
1	8	DT9V 35	Heating, Ventilation and Air Conditioning Practice and Design
1	7	DE3R 34	Personal Development Planning

1	6	H8T2 33**	Workplace Communication in English
3	7	DG6E 34	Work Role Effectiveness (2003) <b>or</b>
3	8	DG6G 35	Work Role Effectiveness (2003)
1	7	H4J5 34**	Energy Overview
1	8	H4J6 35**	Energy Technologies
1	7	H7K2 34**	Engineering Mathematics 3
1	8	H7K3 35**	Engineering Mathematics 4
1	8	H7K4 35**	Engineering Mathematics 5

\*\*Refer to History of Changes for revision changes.

### Graded Unit (3 Mandatory Credits)

Credit Value	SCQF level	Product Code	Product Title
1	7	DV11 34	Mechanical Engineering: Graded Unit 1 Examination
2	8	DV12 35	Mechanical Engineering: Graded Unit 2 Project

\* These Units have been added to the optional section of the HND Mechanical Engineering to satisfy Marine Engineering requirements.



### 5.3 HNC Manufacturing Engineering 12 Unit Credits

Award Number: G83Y 15

#### Mandatory Units (9 Credits)

Section	Credit Value	SCQF level	Product Code	Product Title
Common Core	1	7	H7MB 34**	Communication: Practical Skills
Principles and Technology  (8 Credits)	1	6	H7K0 33**	Engineering Mathematics 1
	1	7	DT8Y 34	Quality Management: An Introduction
	1	7	DR3L 34	Engineering Principles
	1	7	DT46 34	Materials Selection
	1	7	DT5R 34	Economics of Manufacture
	2	8	H292 35**	Manufacturing: Process and Equipment Selection
	1	7	DR1W 34	Engineering Drawing

#### Optional Units (max 2 Credits)

Credit Value	SCQF level	Product Code	Product Title
1	7	DT9R 34	Engineering Measurement
1	7	DR1T 34	Statics and Strength of Materials
1	7	D75X 34	Information Technology: Applications Software 1
1	7	DT5P 34	CNC
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	8	DR3M 35	Design for Manufacture
1	8	DT5W 35	Jig and Fixture Design
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
1	8	DT5V 35	Industrial Systems
1	7	H7K1 34**	Engineering Mathematics 2
1	7	DT5Y 34	Metal Component Manufacture
1	7	DT61 34	Plastic Component Manufacture
1	7	DE3R 34	Personal Development Planning
1	6	H8T2 33**	Workplace Communication in English
1	7	H0PP 34	Lean Manufacturing
1	7	H4J5 34**	Energy Overview

#### Graded Unit (1 Mandatory Credit)

Credit Value	SCQF level	Product Code	Product Title
1	7	DV13 34	Manufacturing Engineering: Graded Unit 1 Examination

\*\*Refer to History of Changes for revision changes.

## 5.4 HND Manufacturing Engineering

30 Unit Credits

Award Number: G83X 16

Mandatory Units (20 Credits)

Section	Credit Value	SCQF level	Product Code	Product Title
Common Core (3 Credits)	1	7	H7MB 34**	Communication: Practical Skills
	1	7	D75X 34	Information Technology: Applications Software 1
	1	8	DG3D 35	Business Awareness and Continuing Professional Development
Principles and Technology (17 Credits)	1	6	H7K0 33**	Engineering Mathematics 1
	1	7	DT8Y 34	Quality Management: An Introduction
	1	7	DR3L 34	Engineering Principles
	1	7	DT46 34	Materials Selection
	2	7	DR1V 34	Engineering Skills
	1	7	DT5R 34	Economics of Manufacture
	2	8	H292 35**	Manufacturing: Process and Equipment Selection
	1	7	DR1W 34	Engineering Drawing
	1	7	DT9R 34	Engineering Measurement
	1	7	H7K1 34**	Engineering Mathematics 2
	1	8	DV00 35	Simulation of Advanced Manufacturing Systems
	1	8	H1KS 35**	Production Planning and Control
	1	7	A6AX 34 F1W0 34	Project Management <b>or</b> Project Management for IT
	1	8	DT5N 35	Facilities Layout and Analysis
1	8	D7CY 35	Information Technology: Applications Software 2	

Optional Units (max 7 Credits)

Credit Value	SCQF level	Product Code	Product Title
1	8	DT64 35	Tool Design
1	7	DG31 34	Application of Programmable Logic Controllers
1	7	DR1T 34	Statics and Strength of Materials
1	7	DT5P 34	CNC
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	8	DR3M 35	Design for Manufacture
1	8	DT5W 35	Jig and Fixture Design
2	8	DG4P 35	Mathematics for Engineering 3
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
1	8	DT5V 35	Industrial Systems
1	7	DT5Y 34	Metal Component Manufacture
1	7	DT61 34	Plastic Component Manufacture
1	8	DT9Y 35	Robotic Systems
2	8	DR1R 35	Computer Aided Engineering and Prototyping
1	7	DT9X 34	Pneumatics and Hydraulics
1	7	DE3R 34	Personal Development Planning
1	6	H8T2 33**	Workplace Communication in English
1	7	H0PP 34	Lean Manufacturing
3	7	DG6E 34	Work Role Effectiveness (2003) <b>or</b>
3	8	DG6G 35	Work Role Effectiveness (2003)
1	7	H4J5 34**	Energy Overview
1	8	H4J6 35**	Energy Technologies
1	7	H7K2 34**	Engineering Mathematics 3
1	8	H7K3 35**	Engineering Mathematics 4
1	8	H7K4 35**	Engineering Mathematics 5

## Graded Unit (3 Mandatory Credits)

Credit Value	SCQF level	Product Code	Product Title
1	7	DV13 34	Manufacturing Engineering: Graded Unit 1 Examination
2	8	DV14 35	Manufacturing Engineering: Graded Unit 2 Project

\*\*Refer to History of Changes for revision changes.

### 5.5 Graded Units

The purpose of the Graded Unit for both the HNC and HND awards is to assess the candidate's ability to apply and integrate knowledge and/or skills gained within individual Units. By this means candidates will demonstrate that they have achieved the specific aims of the awards as detailed in Sections 3.2 and 3.4. The Graded Units also provide the means by which candidate achievement can be graded.

HNC Mechanical Engineering candidates will undertake a **1** Credit Graded Unit at level 7. This will be in the form of a 3-hour written examination.

Likewise HNC Manufacturing Engineering candidates will undertake a **1** Credit Graded Unit at level 7. This will also be in the form of a 3-hour written examination.

HND Mechanical Engineering candidates will also do the HNC Mechanical Engineering Graded Unit but, in addition, will undertake a **2** Credit Graded Unit at level 8. This will take the form of a practical assignment/project.

In a similar way HND Manufacturing Engineering candidates will also do the HNC Manufacturing Engineering Graded Unit but, in addition, will undertake a **2** Credit Graded Unit at level 8. This will also take the form of a practical assignment/project.

#### 5.5.1 Types of Graded Units

##### **Mechanical Engineering: Graded Unit 1 — Examination** **Manufacturing Engineering: Graded Unit 1 — Examination**

It will be noted that both Graded Units draw on Outcomes in the Principles/Technology sections of the respective HNC Mechanical Engineering or HNC Manufacturing Engineering. These Units are studied by **all** HNC Mechanical Engineering or HNC Manufacturing Engineering candidates irrespective of which optional Units they select.

It is recommended that candidates do not sit either Graded Unit examination until the end of the HNC (1st Year of the HND), given the range of Units that both Graded Units draw on.

## **Mechanical Engineering: Graded Unit 2 — Project**

### **Manufacturing Engineering: Graded Unit 2 — Project**

The nature of the project activity detailed in both Specifications is such that it is likely that centres will wish their candidates to embark on project work from the start of the second year of the HND Mechanical Engineering or HND Manufacturing Engineering programmes. As it is anticipated that centres will deliver the HNC Mechanical Engineering or HNC Manufacturing Engineering as part of the first year of their respective HNDs, it is recommended that candidates have completed all HNC Mechanical Engineering or HNC Manufacturing Engineering Units, including the HNC Graded Unit, before commencing the project.

In principle, the Mechanical Engineering project can draw on any Units in the HND Mechanical Engineering framework although the majority of Units should be at SCQF level 8. The project can be taken from one Mechanical Engineering area or it can span more than one technical area. However, its principal purpose is not to integrate technical content (this is covered in the Mechanical Engineering: Graded Unit 1) but rather to combine such knowledge and skills as planning, scheduling, construction, testing, evaluating and reporting.

Exactly the same reasoning applies to the Manufacturing Engineering: Graded Unit 2 as was presented for the Mechanical Engineering: Graded Unit 2 in the previous paragraph.

#### **5.5.2 Rationale for the Graded Units Assessment**

The assessment methods i.e. an examination for Graded Unit 1 and a project for Graded Unit 2 were decided through consultation with industry and delivering centres during initial consultation on the overarching HN Engineering Framework (see HNC and HND Electronics Validation Document for more details).

The consultation indicated that an ‘examination’ provided a more accurate way of assessing candidates’ abilities to apply and integrate knowledge and understanding from various technical and related areas, such as Communication. Furthermore, it was considered that during their HNC studies candidates would not normally develop fully the necessary knowledge and skills to complete a project.

A project was preferred at HND level because a project-based assignment provides candidates with opportunities to demonstrate not only their knowledge and skills in a technical area(s) but also in areas such as planning, scheduling, construction, testing, evaluating and reporting which are important aims within the HND Mechanical Engineering and HND Manufacturing Engineering awards.

#### **5.6 Core Skills**

The HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards have been designed using the new HN Design Principles and therefore the importance of Core Skills has been recognised and highlighted, where appropriate, throughout the awards.

## 5.6.1 Core Skills

### HNC Mechanical Engineering/HNC Manufacturing Engineering

#### Core Skills Exit Profile

A candidate who successfully achieves an HNC Mechanical Engineering or HNC Manufacturing Engineering will automatically obtain the following Core Skills exit profile:

- ◆ Communication Higher (fully embedded in the Unit Communication: Practical Skills)
- ◆ Using Number Higher (fully embedded in the Mathematics for Engineering 1: Mechanical and Manufacturing Unit)

#### Core Skills Entry Profile

The Core Skills Entry profile for both the HNC Mechanical Engineering and the HNC Manufacturing Engineering is as follows:

- ◆ Communication Intermediate 2
- ◆ Information Technology Intermediate 2
- ◆ Numeracy Intermediate 2
- ◆ Problem Solving Intermediate 2
- ◆ Working with Others Intermediate 1

### HND Mechanical Engineering/HND Manufacturing Engineering

#### Core Skills Exit Profile

A candidate who successfully achieves an HND Mechanical Engineering or HND Manufacturing Engineering will automatically obtain the following Core Skills exit profile:

- ◆ Communication Higher (fully embedded in the Unit Communication: Practical Skills)
- ◆ Using Number Higher (fully embedded in the Mathematics for Engineering 1: Mechanical and Manufacturing Unit)
- ◆ Information Technology Higher (fully embedded in the Unit Information Technology: Applications Software 1)
- ◆ Problem Solving Higher (fully embedded in the Unit Mechanical Engineering: Graded Unit 2 or Manufacturing Engineering: Graded Unit 2)

#### Core Skills Entry Profile

The recommended Core Skills entry profile for both the HND Mechanical Engineering and the HND Manufacturing Engineering is as follows:

- ◆ Communication Intermediate 2
- ◆ Information Technology Intermediate 2
- ◆ Numeracy Intermediate 2

- ◆ Problem Solving Intermediate 2
- ◆ Working with Others Intermediate 1

Unit writers have also identified in individual Units opportunities to develop Core Skills. These development opportunities are summarised in Table 5.6.1.

## 5.7 Conditions of the Award

The conditions of award for HNC and HND Mechanical and HNC and HND Manufacturing Engineering qualifications are as follows:

### 5.7.1 HNC Mechanical Engineering

A candidate will be awarded HNC Mechanical Engineering on successful completion of 11 Unit credits plus 1 Graded Unit based on the HNC Mechanical Engineering award structure shown in Section 5.1. More specifically this award structure requires that candidates achieve the following:

- ◆ The 1 Unit credit Communication: Practical Skills
- ◆ 8 Unit credits from the Principles/Technology section
- ◆ 2 Unit credits from the optional section
- ◆ Mechanical Engineering: Graded Unit 1

### 5.7.2 HND Mechanical Engineering

A candidate will be awarded HND Mechanical Engineering on successful completion of 27 Unit credits plus 3 Graded Unit Assessment credits based on the HND Mechanical Engineering award structure shown in Section 5.2. More specifically this award structure requires that candidates achieve the following:

- ◆ the 3 Unit credits Communication: Practical Skills, Information Technology: Applications Software 1 and Business Awareness and Continuing Professional Development
- ◆ 17 Unit credits from the Principles/Technology section
- ◆ 7 Unit credits from the optional section
- ◆ Mechanical Engineering: Graded Unit 1 and Mechanical Engineering: Graded Unit 2

### 5.7.3 HNC Manufacturing Engineering

A candidate will be awarded HNC Manufacturing Engineering on successful completion of 11 Unit credits plus 1 Graded Unit based on the HNC Manufacturing Engineering award structure shown in Section 5.3. More specifically this award structure requires that candidates achieve the following:

- ◆ the 1 Unit credit Communication: Practical Skills
- ◆ 8 Unit credits from the Principles/Technology section
- ◆ 2 Unit credits from the optional section
- ◆ Manufacturing Engineering: Graded Unit 1

#### 5.7.4 HND Manufacturing Engineering

A candidate will be awarded HND Manufacturing Engineering on successful completion of 27 Unit credits plus 3 Graded Unit Assessment credits based on the HND Manufacturing Engineering award structure shown in Section 5.4. More specifically this award structure requires that candidates achieve the following:

- ◆ the 3 Unit credits Communication: Practical Skills, Information Technology: Applications Software 1 and Business Awareness and Continuing Professional Development
- ◆ 17 Unit credits from the Principles/Technology section
- ◆ 7 Unit credits from the optional section
- ◆ Manufacturing Engineering: Graded Unit 1 and Manufacturing Engineering: Graded Unit 2

### Figure 5.6.1 HN Mechanical/Manufacturing Units — Core Skills Development Opportunities

Note: CT = Critical Thinking; P & O = Planning & Organisation and R and E = Reviewing & Evaluating

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Engineering Drawing					SCQF 6					
Quality Management: An Introduction		SCQF 5			SCQF 5		SCQF 6			
Engineering Principles		SCQF 5					SCQF 6			
Robotic Systems		SCQF 6		SCQF 6			SCQF 6		SCQF 6	SCQF 6 Opportunities to work in groups for investigations on robotic systems
Materials Selection		SCQF 6					SCQF 6		SCQF 6	SCQF 6 Opportunities to work in groups for laboratory investigations
Statics and Strength of Materials				SCQF 6			SCQF 6			



Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Dynamics				SCQF 6			SCQF 6			
Fundamentals of Control Systems and Transducers	SCQF 6	SCQF 6			SCQF 6		SCQF 6			SCQF 4 Opportunities to work in groups for laboratory investigations
Thermofluids				SCQF 6			SCQF 6			
Pneumatics and Hydraulics		SCQF 5					SCQF 6			
Economics of Manufacture		SCQF 6		SCQF 5	SCQF 5		SCQF 6			
Manufacturing: Process and Equipment Selection		SCQF 6					SCQF 6	SCQF 6	SCQF 6	SCQF 6 Especially with regard to Outcome 3 Record, analyse and determine set up times.
Engineering Measurement					SCQF 6					

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Heating, Ventilation and Air Conditioning Practice and Design		SCQF 6		SCQF 6			SCQF 6		SCQ F 6	SCQF 6 Opportunities to work in groups for laboratory investigations
Mathematics for Engineering 1: Mechanical and Manufacturing										
CNC		SCQF 5				SCQF 6	SCQF 5			
CAD for Engineers						SCQF 6				
Design for Manufacture		SCQF 6	SCQF 6				SCQF 6	SCQF 6	SCQ F 6	SCQF 6 Opportunities to develop these skills as member of Design Team
Industrial Systems		SCQF 6	SCQF 6	SCQF 6			SCQF 6		SCQ F 6	SCQF 6

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Application of Programmable Logic Controllers	SCQF 6	SCQF 6		SCQF 6	SCQF 6	SCQF 5 Opportunities to search on the Internet for manufacturers' information on the Internet	SCQF 6	SCQF 6	SCQF 6	
Engineering Skills							SCQF 6		SCQF 6	
Plant Systems		SCQF 6		SCQF 6	SCQF 6		SCQF 6	SCQF 6		
Heat Transfer and Fluid Mechanics		SCQF 6		SCQF 6	SCQF 6		SCQF 6		SCQF 6	
Metal Component Manufacture		SCQF 6	SCQF 6		SCQF 6		SCQF 6			
Plastic Component Manufacture		SCQF 6			SCQF 6		SCQF 6			
Strength of Materials: Advanced				SCQF 6			SCQF 6			

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Applied Industrial Plant Maintenance						SCQF 6	SCQF 6			
Jig and Fixture Design	SCQF 6	SCQF 6					SCQF 6			
Tool Design		SCQF 6			SCQF 6		SCQF 6			
Simulation of Advanced Manufacturing Systems	SCQF 6	SCQF 6				SCQF 6	SCQF 6	SCQF 6	SCQF 6	
Production Planning and Control		SCQF 6					SCQF 6			
Computer Aided Engineering (CAE) and Prototyping						SCQF 6	SCQF 6		SCQF 6	
Project Management										
Facilities Layout and Analysis		SCQF 6				SCQF 6	SCQF 6			SCQF 5

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Inform.	Using Information Technology	CT	P&O	R&E	Working with Others
Mechanical Engineering: Graded Unit 1/ Manufacturing Engineering: Graded Unit 1		SCQF 6		SCQF 6			SCQF 6			

## 5.8 SCQF levels

Tables 5.8.1 and 5.8.2 show the distribution of SCQF levels in the HNC and HND Mechanical Engineering awards respectively in the Common Core, Principles/Technology and Graded Unit sections. It can be seen from Table 5.8.1 that all mandatory Units in the HNC Mechanical Engineering are at level 7 except the Mathematics for Engineering 1: Mechanical and Manufacturing Unit. This Unit has been designed as a SCQF level 6 Unit to meet the mathematical abilities of the majority of candidates entering the HNC programme. The Qualification Design Team used as their benchmarks for levelling Mechanical Units, the Higher in Mechanical Engineering, various NQ Engineering Units and their knowledge of the content of existing degree courses in Mechanical Engineering. Table 5.8.1 shows that the number of SCQF Level 7 credit points substantially exceeds the minimum of 48 SCQF credit points required to be in an HNC to satisfy the new HN Design Principles.

It can be seen from Table 5.8.2 that the minimum number of SCQF level 8 Units a candidate has to take in the HND Mechanical Engineering is 64 SCQF credit points which meets the minimum requirement of 64 SCQF credit points as stated in the HN Design Principles. However, it is anticipated that most candidates will undertake some optional Units at level 8 which will mean that they will comfortably exceed this minimum requirement. A number of the SCQF level 8 Units in the HND follow on from corresponding level 7 Units and are, therefore, appropriately levelled at SCQF level 8. The Qualification Design Team also used their knowledge of existing second year degree courses to level Units in the HND Mechanical Engineering award.

Tables 5.8.3 and 5.8.4 show the corresponding levelling tables for the HNC Manufacturing Engineering and HND Manufacturing Engineering respectively. It can be seen from Table 5.8.3 that at 56 credit points the number of SCQF level 7 points exceeds the 48 required to satisfy the HN Design Principles. Table 5.8.4 shows that candidates have to take a minimum of 72 points worth of SCQF level 8 Units which exceeds the 64 SCQF points required by the HN Design Principles.

**Table 5.8.1**

### **Distribution of SCQF levels in the HNC Mechanical Engineering**

<b>Level 6</b>	<b>Level 7</b>	<b>Level 8</b>	<b>Totals</b>	<b>SQA Minimum Requirement for Level 7 Units</b>
8 SCQF cp	72 SCQF cp	0 SCQF cp	<b>80</b>	48 SCQF cp

cp = credit points

**Table 5.8.2**

**Distribution of SCQF levels in the HND Mechanical Engineering**

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 8 Units
8 SCQF cp	112 SCQF cp	64 SCQF cp	<b>184</b>	64 SCQF cp

cp = credit points

**Table 5.8.3**

**Distribution of SCQF levels in the HNC Manufacturing Engineering**

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 7 Units
8 SCQF cp	56 SCQF cp	16 SCQF cp	<b>80</b>	48 SCQF cp

cp = credit points

**Table 5.8.4**

**Distribution of SCQF levels in the HND Manufacturing Engineering**

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 8 Units
8 SCQF cp	104 SCQF cp	72 SCQF cp	<b>184</b>	64 SCQF cp

## **6 Approaches to delivery and assessment**

### **6.1 Content and Context**

Throughout the design and development of the HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering awards the Qualification Design Team has placed a high priority on producing awards that allow candidates to develop appropriate technical and practical skills. Unfortunately, it is not possible to quantify such technical and practical skills in exact detail. However, the Design Team has

taken the view that the best way to prepare candidates to meet the changing technical and practical requirements of industry is to ensure candidates have a solid foundation of theory and practice upon which they can build new knowledge, understanding and skills. Thus, the Principles/Technology section of the HNC Mechanical Engineering contains fundamental studies in engineering principles, mathematics, materials selection and quality systems. The HND Mechanical Engineering Principles/Technology section builds on and extends these studies. The HNC Manufacturing Engineering follows a similar pattern concentrating on fundamental studies in engineering principles, mathematics, materials selection, quality systems, economics of manufacture and process and equipment selection. The corresponding HND builds on and expands these studies.

The optional sections of the HNC/HND Mechanical Engineering and HNC/HND Manufacturing Engineering provide candidates with the opportunity to specialise in technical and/or non-technical subjects. In line with normal good practice centres are encouraged to advise candidates to choose those options that best meet their future career and educational aspirations.

The Qualification Design Team has also ensured that the new awards contain opportunities for candidates to develop a range of related skills which would make the holder of the awards better prepared for employment and/or degree studies. For example, the Communication: Practical Skills Unit has been included within the mandatory cores of both HNC and HND awards to provide candidates with the opportunity to develop their written and group discussion skills about complex vocational issues.

Whilst a discrete Information Technology Unit is no longer included within the mandatory sections of the HNC Mechanical Engineering and HNC Manufacturing Engineering, centres will still have the opportunity to access such a Unit via the optional section of either HNC (Information Technology: Applications Software 1). Even where centres choose not to select this Unit from the optional section there are a number of opportunities to develop Information Technology knowledge and skills within individual Units. The Information Technology: Applications Software 1 Unit has been included within the core of the HND to allow centres to concentrate on business applications, such as word processing, spreadsheets, databases, or engineering specific applications or a combination of the two.

A new type of Business Studies Unit, entitled Business Awareness and Continuing Professional Development, has been included within the mandatory core of both the HND Mechanical Engineering and HND Manufacturing Engineering. This Unit focuses on two areas which the Qualification Design Team considered important to working in the modern industry: namely the external and internal factors that affect business performance and the need for continuing learning and development if candidates are to have sustainable and rewarding employment in the future.

## **6.2 Delivery and Assessment**

### **Delivery**

The new HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering awards can be delivered on a full-time, block-release, part-time day or part-time evening basis. Traditionally both the HNC Mechanical Engineering and HNC Manufacturing Engineering have been offered on a day-release and evening class basis to candidates in employment. With the full integration of the HNC Mechanical Engineering and HNC Manufacturing



Engineering within their corresponding HND greater scope exists to offer the two HNDs on a part-time basis. Centres may wish to use APEL or assessment on demand mechanisms to accredit candidates in employment who can evidence knowledge, understanding and skills in certain areas of Mechanical or Manufacturing Engineering.

Centres, working on their own or in partnership, might also wish to consider using open and distance and/or e-learning techniques to deliver part or all of the HNC and HND Mechanical and Manufacturing Engineering awards. Such delivery approaches may include, but not be limited to, the following:

- ◆ identification and sharing of good candidate learning support materials on the Internet
- ◆ use of the Internet by candidates to undertake more in-depth investigations in given subject areas
- ◆ development or purchase of paper-based and/or electronic candidate learning support and assessment materials for individual Units
- ◆ development of on-line Unit and graded Unit assessment materials
- ◆ use of e-mentoring arrangements to support candidates who study at a distance

In timetabling the two new awards, centre staff should take account of information contained in the Recommended Prior Knowledge and Skills statement in Unit specifications in sequencing the delivery of Units. For example, the Engineering Principles Unit would normally be delivered before the Statics and Strength of Materials and Dynamics Units. Examples of a 2-year full-time HND Manufacturing Engineering and 2-year part-time HNC Mechanical Engineering timetables are shown in Appendix 1.

One of the key reasons the Qualification Design Team has sought to reduce the time candidates have to spend on summative Unit assessment is to provide lecturers with more time to deliver Units. Lecturers are encouraged, in particular, to use this additional time to reinforce learning in core mechanical and manufacturing principles and technologies and enhance the development of candidates' practical mechanical, practical manufacturing and Core Skills.

Lecturers may use a variety of teaching and learning approaches in delivering the Units in the HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering awards. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate software packages), project work and case studies. The use of open and distance learning and on-line materials may help to supplement and support the learning that takes place in the classroom, laboratory or workshop.

Industrial visits are encouraged wherever possible to provide 'real life' industrial examples of the application of the theory and practice learnt in the classroom, laboratory or workshop.

The Qualification Design Team recognises the very important role computer simulation plays in modern industry, especially in Manufacturing. The Team would actively encourage the use of computer simulation wherever appropriate but not at the expense of candidates doing practical work. The Team believe it is very important that candidates get as much exposure as possible to practical hand skills, the use of measuring equipment and other practical mechanical/manufacturing activities if they are to be suitably prepared to work in industry.

Lecturers should also seek opportunities to integrate Core Skills within their teaching and learning programmes. Such opportunities may include the following:

### **Communication**

- ◆ Providing candidates opportunities to develop their oral skills by allowing them to give full answers to questions asked by the lecturer and by giving an oral presentation in the HND Mechanical and Manufacturing Engineering Graded Unit project.
- ◆ Develop complex, vocationally specific reading skills (eg Fundamentals of Control Systems and Transducers, Applications of PLCs etc.)
- ◆ Develop report writing skills in a number of Units (eg Design for Manufacture, Plant Systems etc.)
- ◆ Allowing candidates to develop their Communication skills in group work activities (eg Communication: Practical Skills, Material Selection).

### **Numeracy**

- ◆ Reinforcing Numeracy and Mathematical skills when teaching mechanical engineering principles (eg Dynamics, Strength of Materials: Advanced etc.)
- ◆ Reinforcing Using Graphical information skills by use of a range of graphical representations (eg Engineering Measurement, Metal Component Manufacture etc.)

### **Information Technology**

- ◆ Develop Information Technology skills through the application of IT within a Mechanical or Manufacturing Engineering context (eg CAD for Engineers, Applied Industrial Plant Maintenance, Jig and Fixture Design etc.)

### **Problem Solving Skills**

- ◆ Develop Critical Thinking Skills through the application of mechanical and manufacturing engineering principles and technologies to solve mechanical and manufacturing engineering problems.
- ◆ Develop Planning and Organisational skills (eg Design for Manufacture, Plant Systems, Simulation of Advanced Manufacturing Systems etc.)
- ◆ Develop reviewing and evaluation skills through, for example, the review and evaluation of the Outcomes of assignments and project work (eg Robotic Systems, Heating, Ventilation and Air Conditioning Practice and Design etc.)

### **Working with Others**

- ◆ Develop Working with Others skills through group discussion on the solution to mechanical and manufacturing engineering problems (eg Material Selection, Robotic Systems etc.)

### **Assessment**

From the outset of development the Qualification Design Team recognised the need to have an appropriate assessment strategy in place for the HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering awards. Such a strategy was developed and is shown below:

## **Aims**

The aims of the strategy are to ensure that:

- (1) Consistent, rigorous and efficient approaches are adopted to the development and administration of HN Engineering assessment instruments at both Unit and graded Unit levels, which satisfy nationally agreed standards.
- (2) The assessment load on candidates and staff is sensible and that assessment does not unduly detract from teaching and learning.
- (3) As far as possible reliable and rigorous moderation processes are put in place in order to ensure that consistent national standards are achieved for all HN Mechanical and Manufacturing Engineering assessments.

## **Objectives**

Listed below are the measures that have been put in place to meet the aims:

- (1) Develop nationally at least one assessment exemplar pack for each mandatory and Principles/Technology Unit, which clearly sets out the standards of assessment expected in the Unit.
- (2) Adopt a holistic approach to Unit assessment. The implications of this are as follows:
  - (i) Assessment instruments will normally be designed only to sample knowledge and skills in a Unit (this is consistent with the new HN Unit format).
  - (ii) A Unit assessment strategy will be adopted, where possible, to produce a single assessment instrument for the whole Unit. Where this is not possible the assessment strategy will seek to ensure that the minimum number of assessment instruments are required consistent with maintaining agreed national standards.
- (3) Whilst not seeking to be entirely prescriptive with regard to the time spent on assessment in each HN Unit, over assessment should be avoided if the following guidelines are adopted for the maximum time spent on HN Unit assessment:
  - (i) One and a half hours per Unit credit for HN Units at SCQF levels 6 and level 7.
  - (ii) Two hours per Unit credit for HN Units at SCQF level 8.
- (4) Produce assessment exemplar packs for the four graded Units. For each graded Unit examination produce at least one sample exam paper to show the standards expected in such a paper. Likewise, for the 2 credit Graded Unit Mechanical Engineering and Manufacturing Engineering Projects produce sets of materials which clearly set out the standards of candidate response required to achieve a Grade A and Grade C.

- (5) Actively encourage centres to work in partnership in producing graded Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual colleges.
- (6) Ensure that consistent and rigorous internal and external moderation procedures operate through both HN Unit level and graded Unit assessment processes. This places a clear responsibility on both centres and the SQA.

As far as has been practical the above objectives have been adhered to when developing assessment exemplar and graded Unit materials.

### **Assessment Exemplar Materials**

Assessment exemplar packs have been produced for all Principles/Technology and graded Units in the HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering awards.

### **Formative Assessment**

Formative assessment should be used throughout the delivery of Units to reinforce learning, build candidates' confidence and prepare candidates for summative assessment.

### **Unit Assessment Information**

A table showing details of assessment on an individual Unit basis is shown in Appendix 2. This table has been included to assist centre staff in timetabling, assessment scheduling and controlling assessment loading.

## **6.3 Open and Distance Learning**

Advice on the use of open and distance learning is given in individual Unit specifications. However, where it is used with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that the assessment or assessments were conducted under the conditions specified in the Unit specification. For example, in the case of a Unit which involved a Unit end test a centre would have to make arrangements for the test to be conducted under controlled, supervised conditions. Likewise, where a Unit involves a practical based assessment, a centre would have to make arrangements for candidates to come into the centre to undertake the assessment under the conditions specified in the Unit specification.

It should be noted that the same requirements as specified in the previous paragraph apply where part or all of a Unit is delivered on-line.

## 6.4 Credit Transfer Arrangements

A document, entitled HNC/HND Mechanical/Manufacturing Engineering — Credit Transfer Decisions, has been developed which contains information on credit transfer arrangements between old HN Mechanical/Manufacturing Engineering Units (those developed as part of the 1996 HN Engineering developments) and the new HN Mechanical/Manufacturing Units (the Units written as part of this development). A copy of this document is included in Appendix 3. This document has been designed to make it as straightforward as possible for course admission tutors to work out the level of credit transfer a candidate with ‘old’ HN Units or an ‘old’ HNC Mechanical or Manufacturing Engineering award can count towards the new HNC and HND Mechanical Engineering and HNC and HND Manufacturing Engineering. The use of these documents is illustrated below.

### An Example of the use of the Guide to Credit Transfer Document

A candidate has an HNC Engineering: Mechanical having successfully achieved the list of Units shown below. She now wishes to study for a new HND Mechanical Engineering. A course admission tutor has been given the task of determining the level of credit transfer the candidate has towards the HND Mechanical Engineering.

### List of Units successfully achieved as part of the HNC Engineering: Mechanical

Unit Number	Unit Title
A6AN 04	Information Technology Applications 2
D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes
BA24 04	Fundamentals of Quality Assurance
D4H7 04	Engineering Project
D4JH 04	Mathematics for Engineering
D4J1 04	Industrial Plant Services: Pneumatics and Hydraulics
D4JM 04	Mechanical Engineering Principles: Thermofluids
D4KC 04	Plant Systems: Utilities
D4FK 04	Applied Thermodynamics: Basic Processes
D4HX 04	Industrial Plant Maintenance
D4HW 04	Heat Transfer and Fluid Mechanics

### Credit Transfer Available to Candidate (using Credit Transfer Decision Document)

Old Unit Title	New Unit Title	Credit Value	Status (Full, Partial or No Credit Transfer)
Information Technology Applications 2	Information Technology: Applications Software 1	1	Full
Communication: Presenting Complex Communication for	Communication: Practical Skills	1	Partial

Old Unit Title	New Unit Title	Credit Value	Status (Full, Partial or No Credit Transfer)
Vocational Purposes			
Fundamentals of Quality Assurance	Quality Management: An Introduction		None
Engineering Project			None*
Mathematics for Engineering	Mathematics for Engineering 1: Mechanical and Manufacturing		Partial Outcomes 1 and 2 of Mathematics for Engineering Unit only (although candidate could get full credit if they have analysed trigonometrical functions and their graphs elsewhere)
Industrial Plant Services: Pneumatics and Hydraulics	Pneumatics and Hydraulics	1	Full
Mechanical Engineering Principles: Thermofluids	Thermofluids	1	Full
Plant Systems: Utilities	Plant Systems		Partial credit transfer only
Applied Thermodynamics: Basic Processes			No transfer available
Industrial Plant Maintenance	Applied Industrial Plant Maintenance	1	Full
Heat Transfer and Fluid Mechanics	Heat Transfer and Fluid Mechanics	1	Full
	<b>Total</b>	<b>6</b>	

It can be seen from the above table that the candidate can obtain 6 full credits plus a number of partial credits towards the HND Mechanical Engineering using the credit transfer documents.

\*With reference to the new two credit, Mechanical Engineering: Graded Unit 2 and Manufacturing Engineering: Graded Unit 2 the Qualification Design Team have taken the view that the old Engineering Project can not be counted for credit transfer purposes towards the new Graded Units because it contains no mechanism for grading candidates on the A, B or C scale.

New Unit Title	New Unit Code	Old Unit Title	Old Unit Code	Credit Transfer Conditions
Engineering Mathematics 1	H7K033	Mathematics for Engineering 1: Electronics and Electrical	DG4H33	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to functions as specified in the Evidence requirements in respect of the first three knowledge/skills in Outcome 1 and relating to vectors as specified in the first three knowledge/skills in outcome 3.
Engineering Mathematics 1	H7K033	Mathematics for Engineering 1: Mechanical and Manufacturing	DT5X33	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to functions as specified in the Evidence requirements in respect of the first three knowledge/skills in Outcome 1 and relating to 3D vectors and complex numbers as specified in the knowledge/skills in outcome 3.
Engineering Mathematics 2	H7K134	Mathematics for Engineering 2	DG4L34	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to trigonometric and hyperbolic functions as specified in the Evidence requirements in respect of Outcome 1.

## 7 General information for centres

### Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements).

### Internal and external verification

All instruments of assessment used within this/these Group Award(s) should be internally verified, using the appropriate policy within the centre and the guidelines set by SQA.

External verification will be carried out by SQA to ensure that internal assessment is within the national guidelines for these qualifications.

Further information on internal and external verification can be found in *SQA's Guide to Assessment* ([www.sqa.org.uk](http://www.sqa.org.uk)).

## 8 General information for candidates

### Mechanical Engineering

The new HNC and HND Mechanical Engineering awards have been designed by an expert team of educators and industrialists with a view to allowing you to meet the educational requirements to work as a mechanical incorporated engineer. The two new qualifications contain up-to-date and relevant mechanical subject content and skills and have also been designed to satisfy the new SQA Higher National Design Principles.

The SQA Qualification Design Team has designed the two new awards so that you will have opportunities to learn and understand the core principles and technologies that underpin Mechanical Engineering. Learning these will be essential in providing you with a platform for tackling many mechanical tasks and in allowing you to develop a more in-depth knowledge of Mechanical Engineering. At the same time studying the new HNC and HND Mechanical Engineering will provide you with opportunities to develop sound practical mechanical investigation, construction, measurement, testing and project skills which are critical to being a good mechanical technician and/or incorporated engineer.

As well as studying Mechanical subjects you will also take Communication with an option to do Information Technology as part of the HNC. Good Communication skills are essential to understanding technical material, and when communicating with others whether on an individual basis or when working as part of a team. Information Technology underpins much of the work in Mechanical Engineering whether this is through computer simulation of mechanical systems or processes or in preparing a written report on the work you have been involved in. Opportunities to develop Information Technology knowledge and skills are available in a number of Units in the HNC, but an optional Unit on Information Technology Applications is also available if you wish to consolidate your skills in this area.



The Communication and Information Technology Units are mandatory within the HND Mechanical Engineering award although you will not need to study these Units if you have already done so as part of the HNC. There is an additional mandatory core Unit in the HND Mechanical Engineering award entitled Business Awareness and Continuing Professional Development. This Unit will provide you with an awareness of the business pressures on modern engineering companies and what strategies they are adopting to meet these pressures. The Unit will also provide you with the opportunity to develop your own career and education action plan for the next five years or so.

As already mentioned, Mechanical Engineering is very much about learning and understanding core principles and technologies whilst also doing practical work such as assembly and manufacturing skills, measurement and project work. Thus, while taking the HNC and HND Mechanical Engineering you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical engineering work, measurement and testing, computer simulation and project work.

The Mechanical Qualification Design Team has ensured that assessments in the two awards meet national standards. The two awards have been designed to optimise assessment so that sufficient time is available for you to learn the mechanical principles and technologies and the practical skills that are essential to being a good mechanical technician and/or incorporated engineer.

You can expect to do assessment at individual Unit level and at qualification level. At Unit level assessment will consist of some form of written end test, or a combination of short written test and practical exercise, computer simulation or a purely practical exercise. Your lecturer should tell you at the start of the Unit what form the Unit assessment will take. In addition to Unit tests there will also be a 3-hour examination at HNC level and a 2-credit project at HND level. Both these assessments have been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt in the two awards as a whole.

The Qualification Design Team does not wish to place any artificial barriers in the way of potential candidates wanting to study the two awards. However, it would be unfair to enrol a candidate into the HNC and HND who did not have a realistic chance of successfully achieving either or both awards. The Qualification Design Team would therefore recommend that a candidate had at least one of the following qualifications before entering the HNC and HND Mechanical Engineering:

- (1) One Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1-2/ Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- (2) A National Certificate in Engineering.
- (3) Equivalent qualifications or experience to those shown in (1) and (2).

An HNC or HND Mechanical Engineering only partially satisfies the academic requirements to become an incorporated engineer (a degree is now required) although they fully satisfy the requirements to be an engineering technician. The new HNC and HND Mechanical Engineering awards provide a very solid platform for candidates to proceed to the advanced stages of a degree programme in Mechanical Engineering. Ask your lecturer about progression arrangements your college has with any university(ies).

## **Manufacturing Engineering**

The new HNC and HND Manufacturing Engineering awards have been designed by an expert team of educators and industrialists with a view to allowing you to meet the educational requirements to work as a manufacturing incorporated engineer. The two new qualifications contain up-to-date and relevant manufacturing subject content and skills and have also been designed to satisfy the new SQA Higher National Design Principles.

The SQA Qualification Design Team has designed the two new awards so that you will have opportunities to learn and understand the core principles and technologies that underpin Manufacturing Engineering. Learning these will be essential in providing you with a platform for tackling many manufacturing tasks and in allowing you to develop a more in-depth knowledge of Manufacturing Engineering. At the same time studying the new HNC and HND Manufacturing Engineering will provide you with opportunities to develop sound practical manufacturing based investigation, construction, measurement, testing and project skills which are critical to being a good manufacturing technician and/or incorporated engineer.

As well as studying Manufacturing subjects you will also take Communication with an option to do Information Technology as part of the HNC. Good Communication skills are essential to understanding technical material when communicating with others whether on an individual basis or when working as part of a team. Information Technology underpins much of the work in Manufacturing Engineering whether this is through computer simulation of the manufacture of a product or process or in preparing a written report on the work you have been involved in. Opportunities to develop Information Technology knowledge and skills are available in a number of Units in the HNC, but an optional Unit on Information Technology Applications is also available if you wish to consolidate your skills in this area.

The Communication and Information Technology Units are mandatory within the HND Manufacturing Engineering award although you will not need to study these Units if you have already done so as part of the HNC. There is an additional mandatory core Unit in the HND Manufacturing Engineering award entitled Business Awareness and Continuing Professional Development. This Unit will provide you with an awareness of the business pressures on modern engineering companies and what strategies they are adopting to meet these pressures. The Unit will also provide you with the opportunity to develop your own career and education action plan for the next five years or so.

As already mentioned, Manufacturing Engineering is very much about learning and understanding core principles and technologies whilst also doing practical work such as assembly and manufacturing skills, measurement, testing and project work. Thus, while taking the HNC and HND Manufacturing Engineering you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical engineering work, measurement and testing, computer simulation and project work.

The Manufacturing Qualification Design Team has ensured that assessments in the two awards meet national standards. The two awards have been designed to optimise assessment so that sufficient time is available for you to learn the manufacturing principles and technologies and the practical skills that are essential to being a good manufacturing technician and/or incorporated engineer.

You can expect to do assessment at individual Unit level and at qualification level. At Unit level assessment will consist of some form of written end test, or a combination of short written test and practical exercise, computer simulation or a purely practical exercise. Your lecturer should tell you at the start of the Unit what form the Unit assessment will take. In addition to Unit tests there will also be a 3-hour examination at HNC level and a 2-credit project at HND level. Both these assessments have been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt in the two awards as a whole.

The Qualification Design Team does not wish to place any artificial barriers in the way of potential candidates wanting to study the two awards. However, it would be unfair to enrol a candidate into the HNC and HND who did not have a realistic chance of successfully achieving either or both awards. The Qualification Design Team would therefore recommend that a candidate had at least one of the following qualifications before entering the HNC and HND Manufacturing Engineering:

- (1) One Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1–2/ Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- (2) A National Certificate in Engineering.
- (3) Equivalent qualifications or experience to those shown in (1) and (2).

An HNC or HND Manufacturing Engineering only partially satisfies the academic requirements to become an incorporated engineer (a degree is now required) although they fully satisfy the requirements to be an engineering technician. The new HNC and HND Manufacturing Engineering awards provide a very solid platform for candidates to proceed to the advanced stages of a degree programme in Manufacturing Engineering. Ask your lecturer about progression arrangements your college has with any university(ies).

## 9 Glossary of terms

**SCQF:** This stands for the Scottish Credit and Qualification Framework, which is a new way of speaking about qualifications and how they inter-relate. We use SCQF terminology throughout this guide to refer to credits and levels. For further information on the SCQF visit the SCQF website at [www.scqf.org.uk](http://www.scqf.org.uk)

**SCQF credits:** One HN credit is equivalent to 8 SCQF credit points. This applies to all HN Units, irrespective of their level.

**SCQF levels:** The SCQF covers 12 levels of learning. HN Units will normally be at levels 6–9. Graded Units will be at level 7 and 8 (see Section 5.8 for further information on this).

**Subject Unit:** Subject Units contain vocational/subject content and are designed to test a specific set of knowledge and skills.

**Graded Unit:** Graded Units assess candidates' ability to integrate what they have learned while working towards the Units of the Group Award. Their purpose is to add value to the Group Award, making it more than the sum of its parts, and to encourage candidates to retain and adapt their skills and knowledge.

**Dedicated Core Skill Unit:** This is a Unit that is written to cover one or more particular Core Skills, eg HN Units in Information Technology or Communications.

**Embedded Core Skills:** This is where the development of a Core Skill is incorporated into the Unit and where the Unit assessment also covers the requirements of Core Skill assessment at a particular level.

**Signposted Core Skills:** This refers to the opportunities to develop a particular Core Skill at a specified level that lie outwith automatic certification.

**Qualification Design Team:** The QDT works in conjunction with a Qualification Manager/Development Manager to steer the development of the HNC/HND from its inception/revision through to validation. The group is made up of key stakeholders representing the interests of centres, employers, universities and other relevant organisations.

**Consortium-devised HNCs and HNDs** are those developments or revisions undertaken by a group of centres in partnership with SQA.

**Specialist single centre and specialist collaborative devised HNCs and HNDs** are those developments or revisions led by a single centre or small group of centres who provide knowledge and skills in a specialist area. Like consortium-devised HNCs and HNDs, these developments or revisions will also be supported by SQA.

## 10 Appendices

- Appendix 1: Sample Teaching Timetables
- Appendix 2: Assessment details on an individual Unit basis
- Appendix 3: HNC/HND Mechanical/Manufacturing Engineering — Credit Transfer Decisions

See following pages for appendices.

## **Appendix 1: Sample Teaching Timetables**

- 1 2-year Full-Time HND Manufacturing Engineering
- 2 2-year Part-Time HNC Mechanical Engineering

## 2–Year, Full-Time HND Manufacturing Engineering Timetable

### First Year, First Semester

Engineering Drawing	Mathematics for Engineering 1: Mechanical & Manufacturing	Engineering Principles	Engineering Skills	Materials Selection	Communication Practical Skills	Engineering Measurement
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### First Year, Second Semester

Quality Management: An Introduction	Mathematics for Engineering 2	Information Technology Applications Software 1	Engineering Skills	Economics of Manufacture	Manufacturing: Process and Equipment Selection	Manufacturing: Process and Equipment Selection	Manufacturing: Graded Unit 1 Examination
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**2–Year, Full-Time HND Manufacturing Engineering Timetable (continued)**

**Second Year, First Semester**

Project Management	Facilities Layout and Analysis	Information Technology Applications Software 2	Business Awareness & CPD	Production Planning and Control	Simulation of Advanced Manufacturing Systems	Manufacturing: Graded Unit 2
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**Second Year, Second Semester**

Option	Option	Option	Option	Option	Option	Manufacturing: Graded Unit 2	Option
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## 2–Year, Part-Time HNC Mechanical Engineering Timetable

### First Year, First Semester

Communication: Practical Skills	Engineering Principles	Mathematics for Engineering 1: Mechanical and Manufacturing
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### First Year, Second Semester

Quality Management: An Introduction	Statics and Strength of Materials	Materials Selection
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**2–Year, Part-Time HNC Mechanical Engineering Timetable (continued)**

**Second Year, First Semester**

Thermofluids	Dynamics	Pneumatics and Hydraulics
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**Second Year, Second Semester**

Option	Option	Mechanical: Graded Unit 2
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## **Appendix 2: Assessment details on an individual Unit basis**

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
DT9W 35	Applied Industrial Plant Maintenance	O.1 & 2 – assessment paper lasting 1 hour and 30 minutes	O.3 – assignment involving the development of a computerised maintenance schedule plus documentation and report		
DT5P 34	CNC	O.1 – assessment paper	O.2 & O.3 – practical assignment culminating in a short report		
DR1X 34	Computer Aided Draughting for Engineers	O.1 – assignment involving CAD drawings	O.2 – assignment involving the production and printing of composite drawings sing ?? standard parts, external drawing files and custom menus	O.3 – assignment involving the production of 3-D drawings	
DR1R 35	Computer Aided Engineering and Prototyping	O.2 – assignment involving the export of CAD data into appropriate engineering software	O.3 – assignment involving the generation of 3-D models using a variety of model creation tools  Assessment for O.2 & O.3 can be combined	O.4 – candidate produces a report or presentation outlining Rapid prototyping Techniques	<b>Note – assessment for O.1 should be integrated into other 3 Outcomes</b>

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
DR3M 35	Design and Manufacture	O.1 - Assessment paper lasting 1 hour	O.2 - Assignment	O.3 - Portfolio plus presentation	
DT9T 34	Dynamics	All Outcomes – assessment paper lasting 1 hours and 30 minutes			
DT5R 34	Economics of Manufacture	O.1 – assessment paper lasting no more than 30 minutes	O.2 & 3 – an assignment, lasting 3 hours, involving the interpretation of given cost data and the application of breakeven analysis. Candidate evidence should be in the form of a report	O.4 – an assignment, lasting 2 hours, involving the evaluation of a project’s viability using financial appraisal techniques. Candidate evidence should be in the form of a report	
DR1W 34	Engineering Drawing	O.1 – short answer question paper plus graphical exercise	O.2 & 3 – graphical assignment. Candidate evidence should be in the form of appropriate engineering drawings		

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
DT9R 34	Engineering Measurement	O.1 & O.3 – measurement assignment plus report	O.2 – using a range of inspection instruments and completing log sheet for each instrument	O.4 – investigation on inspection method or feature that is more specialist plus report	
DR3L 34	Engineering Principles	O.1 – laboratory exercise done in 1 hour plus report	O.2 – laboratory exercise done in 1 hour plus report	O.3 – laboratory exercise done in 1 hour plus report	
DR1V 34	Engineering Skills	Production of artefacts plus log book and inspection sheets			
DT5N 35	Facilities Layout and Analysis	O.1 – assessment paper lasting no more than 1 hour	O.2 & O.3 – assignment plus written report plus oral questioning		
DT5T 35	Heat Transfer and Fluid Mechanics	All Outcomes – assessment paper lasting 2 hours and 30 minutes			
DT9V 35	Heating, Ventilation and Air Conditioning Practice and Design	O.1, 2 & 3 - assessment paper lasting 2 hours	O.4 – laboratory experiment on a refrigeration or HVAC system plus report		

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
DT5V 35	Industrial Systems	All Outcomes – assessment paper lasting 2 hours			
DT5W 35	Jigs and Fixture Design	O.1 –assessment paper lasting 30 minutes	O.2, 3 & 4 – assignment involving the design of a jig or fixture. Separate reports are required for each Outcome.		
DT46 34	Material Selection	O.1, 2 & 3 – assessment paper lasting 1 hour and 30 minutes	O4 – two laboratory based assignment plus report		
DT5Y 34	Metal Component Manufacture	O.1 – study of a manufacturing company plus report	O.2 – study of a manufacturing company plus report	O.3 – 10 minute presentation on the selection of primary and secondary processes	
DT60 35	Plant Systems	O1. to O.5 – assessment paper lasting 3 hours	O.6 – assignment relating to the replacement of one Unit of plant. Assignment should last no longer than 1		

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
			hour and should involve the candidate in developing a complete installation and commissioning plan		
DT61 34	Plastic Component Manufacture	O.1 – short written report covering the material requirements for 5 plastic components	O.2 – short written report describing 4 plastic manufacturing processes	O.3 – assessment paper lasting 30 minutes	O.4 – short written report covering 3 advanced plastic manufacturing techniques
DT9X 34	Pneumatics and Hydraulics	O.1- assessment paper lasting 1 hour	O.2 – assignment in which candidate design, tests and builds pneumatic or hydraulic power and control circuit. Candidate evidence should be in the form of a functional circuit plus report	O.3 – assignment involving fault finding on a practical or simulated faulty fluid power circuit. Candidate evidence should be provided in the form of a report	

Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
H292 35	Manufacturing: Process and Equipment Selection	O.1 – preparation of short report plus planning sheets	O.1 – preparation of short report plus planning sheets	O.1 – preparation of short report plus planning sheets	O.1 – preparation of short report plus planning sheets
DT63 35	Production Planning and Control	Assessment paper - lasting 40 minutes	Gathering of portfolio of evidence on production planning exercises done in 2 hours and 20 minutes		
DT9Y 35	Robotic Systems	O.1 & O.2 – Case study on a robotic system. Candidates answer questions on the study in 2 hours	O.3 – Practical assignment undertaken in 2 hours. Reports can be written up in the candidates own time		
DV00 35	Simulation of Advanced Manufacturing Systems	O.1 –assessment paper lasting 1 hour	O.2 & O.3 – practical assignment plus report plus other relevant documentation		
DR1T 34	Statics and Strength of Materials	Both Outcomes – assessment paper lasting 1 hour and 30 minutes			



Unit Number	Unit Title	Assessment 1	Assessment 2	Assessment 3	Assessment 4
DV01 35	Strength of Materials: Advanced	O.1 – assessment paper lasting no more than 1 hour	O.2 – assignment involving candidates in completing a series of tasks within 8 hours. Candidate evidence should be in the form of a report (s) completed in their own time.		
DT9P 34	Thermofluids	All Outcomes – assessment paper lasting 2 hours			
DT64 35	Tool Design	O.1 – design assignment plus report	O.2 – design assignment plus report	O.3 – design assignment plus report	O.4 – design assignment plus report

## **Appendix 3: HNC/HND Mechanical/Manufacturing Engineering — Credit Transfer Decisions**

<b>Old Unit Number</b>	<b>Old Unit Title</b>	<b>New Unit Number</b>	<b>New Unit Title</b>	<b>Status (Full, Partial or No Credit Transfer)</b>
		DG4L 34	Mathematics for Engineering 2	Maths Decision
		DG4P 35	Mathematics for Engineering 3	Maths Decision
D4FJ 04	Application of Programmable Logic Controllers	DG31 34	Applications of Programmable Logic Controllers	Full
D4FP 04	CNC Machining	DT5P 34	CNC	Full
D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes	D77G 34	Communication: Practical Skills	Partial
D4FW 04	Computer Aided Draughting	DR1X 34	Computer Aided Draughting for Engineers	Full
D4GD 04	Design Drawing and Communication for Engineers	DR1W 34	Engineering Drawing	Full
D4GE 04	Design for Manufacture	DR3M 35	Design for Manufacture	Full
D4GL 04	Economics of Manufacture	DT5R 34	Economics of Manufacture	Full
D4H6 04	Engineering Business Studies	DG3D 35	Business Awareness & CPD	Management Decision

<b>Old Unit Number</b>	<b>Old Unit Title</b>	<b>New Unit Number</b>	<b>New Unit Title</b>	<b>Status (Full, Partial or No Credit Transfer)</b>
D4HL 04	Facilities Layout and Materials Handling Systems	DT5N 35	Facilities Layout & Analysis	Full
BA24 34	Fundamentals of Quality Assurance	DT8Y 34	Quality Management: An Introduction	None
D4HW 04	Heat Transfer and Fluid Mechanics	DT5T 35	Heat Transfer & Fluid Mechanics	Full
D4HX 04	Industrial Plant Maintenance D4HX 04	DT9W 35	Applied Industrial Plant Maintenance	Full
D4J1 04	Industrial Plant Services: Pneumatics and Hydraulics	DT9X 34	Pneumatics and Hydraulics	Full
D4J0 04 D4HY 04	Industrial Plant Services: Steam, Refrigeration and Pumps Industrial Plant Services: Heating, Ventilating and Air Conditioning Systems	DT60 35	Plant Systems	Full
A6AN 04	Information Technology Applications 2	D75X 34	Information Technology: Applications Software 1	Full
D4JE 04 DT62 35	Manufacturing Systems for Discrete Products Process and Equipment Selection	H292 35	Manufacturing: Process and Equipment Selection	None
D4JE 04	Manufacturing Systems for Discrete Products	DV00 35	Simulation of Advanced Manufacturing Systems	Full

<b>Old Unit Number</b>	<b>Old Unit Title</b>	<b>New Unit Number</b>	<b>New Unit Title</b>	<b>Status (Full, Partial or No Credit Transfer)</b>
D4JF 04	Material Selection & Testing	DT46 34	Material Selection	Full
D4JB 04	Introductory Mathematics for Engineering	DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing	Maths Decision
D4JM 04	Mechanical Engineering Principles: Thermofluids	DT9P 34	Thermofluids	Full
D4JR 04	Metal Component Manufacture	DT5Y 34	Metal Component Manufacture	Full
D4JS 04	Metrology:Dimensional	DT9R 34	Engineering Measurement	Full
	No equivalent Unit	DR3L 34	Engineering Principles	None
	No equivalent Unit	DT5V 35	Industrial Systems	None
	No equivalent Unit	DT5W 35	Jigs & Fixtures	None
	No equivalent Unit	DR1R 35	CAE & Prototyping	None

Old Unit Number	Old Unit Title	New Unit Number	New Unit Title	Status (Full, Partial or No Credit Transfer)
D4HY 04 D4J0 04	Industrial Plant Services: Heating, Ventilating and Air Conditioning Systems Industrial Plant Services: Steam, Refrigeration and Pumps	DT9V 35	Heating, Ventilation and Air Conditioning Practice & Design	Full
D4KC 04 D4KD 04	Plant Systems: Utilities Plant Systems Services	DT60 35	Plant Systems	Full
D4KE 04	Plastic Component Manufacture	DT61 34	Plastic Component Manufacture	Full
D4KT 04 D4KV 04 D4FV 04	Product Assembly Skills Product Manufacturing Skills Component Manufacturing Skills	DR1V 34	Engineering Skills	Any 2 from 3 gives Full Credit
D4KW 04 D4KX 04	Production Planning Production Control	DT63 35	Production Planning & Control	Full
A6AX 04	Project Management	A6AX 34	Project Management	Management Decision
D4L5 04	Robotic Systems	DT9Y 35	Robotic Systems	Full

<b>Old Unit Number</b>	<b>Old Unit Title</b>	<b>New Unit Number</b>	<b>New Unit Title</b>	<b>Status (Full, Partial or No Credit Transfer)</b>
D4JL 04 D4HB 04	Statics and Dynamics Strength of Materials: General	DR1T 34 DT9T 34	Statics and Strength of Materials & Dynamics	Full
D4HB 04 D4H8 04	Strength of Materials: General & Strength of Materials: Advanced	DV01 35	Strength of Materials Advanced	Full
D4LL 04	Tooling Processes	DT64 35	Tool Design	Full
D4LM 04 D4G5 04	Transducers Control Fundamentals	DN3Y 34	Fundamentals of Control Systems and Transducers	Full