PEARSON BTEC

LEVEL 4 HNC

IN

ENGINEERING (MANUFACTURING ENGINEERING)

COURSE HANDBOOK 2023-24

Contents

1 Introduction

1.1 Welcome to the Sheffield College

Welcome to your Higher Education (HE) studies at The Sheffield College.

Many studies have shown that individuals who take the bold step to undertake HE study lead enriched lives: they have greater social mobility; can earn more money; have better chances of taking part in democratic processes and can contribute so much to their community.

Studying for a Higher Education course is undoubtedly immensely rewarding and challenging, and here at The Sheffield College we admire all our students who undertake HE study.

At The Sheffield College we have developed a whole range of ways we support our HE students. For example:

- we have Academic study support specialists;
- we have developed our Skills and Attributes Framework to give you the support you need to flourish in your studies and beyond;
- our HE students have enhanced career support, and;
- we have specialists who can help if you have a disability.

Our aim is to create a nurturing and supportive environment with good access to teachers and resources, and we hope that you will enjoy learning in our vibrant academic community.

Your tutors are focussed on supporting your journey and providing a positive HE teaching and learning experience, one in which you will develop as an independent learner and gain a whole range of graduate attributes which are valued by employers.

I hope that you enjoy your time here and make the most of the exciting opportunities ahead.

Tina Harrison
tina.harrison@sheffcol.ac.uk
Assistant Principal, Higher Education

1.2 The College

The Sheffield College has around 20,000 students in total, 600 of which are on university level courses. Higher Education at the Sheffield College operates across 3 campuses; City, Hillsborough and Olive Grove. Higher Education is based within departments in order to give you access to specialist facilities. Each course has a designated HE Course Leader, who is responsible for the day to day running of your course, and is your first point of contact.

We are proud of our vocational facilities, which are among the best in the north of England, and our staff work hard to ensure you get a valuable experience when using them. You will find your tutors and support staff approachable and available to help you every step of your journey. For us, your time here is ‘all about you’ and we hope that you will work with us to continue to build a vibrant HE community.

1.3 Purpose of this handbook and how to use it

An important aspect of offering high quality courses of study at university level is the provision of information for students which is accurate, comprehensive and reliable for your learning needs.

In support of this objective, this handbook is designed in collaboration with your awarding body, Pearson Edexcel, to meet the expectations of the UK Quality Code.

The handbook provides information about your course team, the course you have chosen to study, assessment, personal academic and pastoral support, learning resources, quality assurance, work-based learning and opportunities for further study. It is a document that you will need to dip into during the course, when you need to look up, for example, what to do if you are ill. It contains the rules by which we all must live; so keep it in a safe place for future reference.

2 Course Team

2.1 Contacting Staff

At the Sheffield College we are proud of the amount of tutor support we provide. We encourage you to contact tutors if you need any help or support with your work, or if you have any queries about their unit. Whilst you can often catch staff in their workrooms during breaks, email is usually the best method of contact at other times, as tutors have busy teaching commitments and may not be readily available by phone. If you do contact by phone, be prepared to leave a message with your phone number; your tutor will always phone you back to arrange a time to meet with you to discuss any concerns you may have.

As well as having tutors for different units of the course, each course has an HE Course Leader, who is responsible for the day to day running of the course. You should contact the HE Course Leader if you have any queries concerning the course and how it operates, or if you are unable to attend class for any reason, for example due to illness.

In addition, your course is managed by a Programme Leader. You are unlikely to need to make contact with the Programme Leader, unless your HE Course Leader is absent from College for any length of time. Contact details for individual tutors will be given to you in class, by the tutors themselves. Contact details for your HE Course Leader and Programme Leader are listed below.

Engineering (Manufacturing) - Pearson BTEC Level 4 HNC

Name	Role	email
Lance Burkitt	*Interim* HE Course Leader	lance.burkitt@sheffcol.ac.uk
Lance Burkitt	Head of School, Construction, Digital, Engineering and Creative Industries	lance.burkitt@sheffcol.ac.uk
TBC	Programme Leader	TBC@sheffcol.ac.uk

2.2 HE@TSC

The College has a dedicated specialist HE Office to service HE students. This is your first point of contact for all administrative queries. The HE Senior Administrator can be contacted via email; HEOffice@sheffcol.ac.uk and will either be able to answer your query or give you the contact details of the appropriate person to help you. The Assistant Principal, Higher Education, is Tina Harrison, tina.harrison@sheffcol.ac.uk

3 The Course

This is the Programme Specification for your proposed course. It gives you information about how you will be taught, assessed, and supported whilst at college.

Who is this qualification for?
The BTEC Higher National qualifications in Engineering are aimed at students wanting to continue their education through applied learning. Higher Nationals provide a wide-ranging study of the engineering sector and are designed for students who wish to pursue a career in engineering. In addition to the skills, knowledge and techniques that underpin the study of the sector, Pearson BTEC Higher Nationals in Engineering give students experience of the breadth and depth of the sector that will prepare them for employment, progression within employment or further study.

What Award Will I Get?
Pearson BTEC Level 4 HNC Diploma in Engineering (Manufacturing Engineering)

Is It Approved By Any Professional Body?
Holders of a BTEC Higher National in Engineering meet the academic requirements for the Engineering Council Engineering Technician Standard (**Eng**Tech).

What could this qualification lead to?
The Level 4 Higher National Certificate provides a solid grounding in engineering, which students can build on should they decide to continue their studies beyond the Certificate stage.

A Level 5 Higher National Diploma allows students to specialise by committing to specific career paths and progression routes to degree-level study.

After completing a BTEC Higher National Certificate or Diploma, students can also progress directly into employment. Typical Job Roles include:

- after HNC Engineering (Manufacturing Engineering) – Manufacturing Systems Technician
- after HND Engineering (Manufacturing Engineering) - Manufacturing Systems Engineer

Aims of the Programme
Graduates successfully completing the Higher National Certificate will be able to demonstrate a sound knowledge of the basic concepts of engineering. They will be able to communicate accurately and appropriately and they will have the qualities of personal responsibility needed for employment. They will have developed a range of transferable skills to ensure effective team working, independent working with growing fault finding and problem-solving strategies, and organisational awareness. They will be adaptable and flexible in their approach to work, showing resilience under pressure and the ability to meet challenging targets within a reasonable, pre-set, timeframe. They will also demonstrate regard for the ethical responsibilities of the engineer, for cost and for the importance of protecting and sustaining the environment.

What will my timetable look like?
The table below shows the basic structure of your Programme.

Pearson BTEC Level 4 Higher National Certificate in Engineering (Manufacturing Engineering)		Unit credit	Level
YEAR 1			
Core Unit	Unit 1 – Engineering Design	15	4
Specialist Mandatory Unit	Unit 14 – Production Engineering for Manufacture	15	4
YEAR 2			
Core Unit	Unit 2 – Engineering Maths	15	4
Core Unit	Unit 3 – Engineering Science	15	4
Specialist Mandatory Unit	Unit 17 – Quality and Process Improvement	15	4
Optional Unit	Unit 19 – Electrical and Electronic Principles	15	4
YEAR 3			
Core Unit	Unit 4 – Managing a Professional Engineering Project *(Pearson-set)*	15	4
Optional Unit	Unit 77 – Industrial Robots	15	4

How will I be taught?

The course is taught over three years, part time.

	Learning Methods
Knowledge and Understanding	• lectures and seminars • directed study of textbooks and journal articles • assignment work • project work
Intellectual Skills	• more active learning processes • assignments or projects • group-learning activity such as a seminar or tutorial
Subject Specialist Skills	• application in context • workbooks or guidance manuals may also be used to support learning
Key Skills	• through naturally arising opportunities within the curriculum e.g. written communication skills through essays or dissertations • oral communication skills through presentations in seminars • team working skills through collaborative projects

How will I be Assessed?

	Assessment Method
Knowledge and Understanding	• Most methods require some demonstration of knowledge and understanding
Intellectual Skills	• Problem-based exercises • Independent project work • Research dissertations
Subject Specialist Skills	• Application in context • Practical demonstration of skill
Key Skills	• Through naturally arising opportunities within the curriculum • E.g. written communication skills through essays or dissertations • Oral communication skills through presentations in seminars • Team working skills through collaborative projects

What are my responsibilities as a student?

It is your responsibility to manage your personal and professional development. You will be mentored and supported in this by your academic course tutor. The amount of support given will be driven by your needs, as determined by you and / or Unit tutors, and is therefore expected to decrease in quantity and nature as you progress through the course and become more independent.

Higher National qualifications are vocational courses which prepare you for working in a professional environment as well as to undertake further study. These courses require you to behave in a professional manner, in much the same way as you would in a working environment. Therefore, we expect your attendance rate to be high and that, if you have to miss a class for some unavoidable reason, you inform your HE Course Leader and make arrangements to catch up the class you miss. Our courses move at a fast pace, and there is a strong relationship between good attendance and success.

Group work is a key component of all courses, and will form part of your assessment. Good attendance enables you to build working relationships with your peers and play your full part in collaborative activities. Being able to work as part of a team is an important employability skill, and is highly valued on our courses.

For all these reasons, your academic course tutor will monitor your attendance and, should an issue arise for any reason, will help you to action plan so that you get back on track. However, it is your personal responsibility to ensure that you **do not take holidays during term time**. To help you with your planning, you will receive a college calendar at induction.

The College reserves the right to withdraw you from your course should your attendance pattern indicate a lack of commitment to your studies with the likelihood that you will not successfully complete the course. If you have a pattern of haphazard attendance, your Course Leader will initiate a Positive Engagement Plan, to help you set targets and arrange support if you require it, in order to get you back on track. However, should your attendance not improve, or you do not attend for 4 consecutive weeks, you will be withdrawn and the student loans company will be informed. This will result in your funding being stopped, and you will owe the college the balance of any unpaid fees.

To learn more, go to https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Positive Engagement and Disciplinary Procedure*.

It is your responsibility to keep a copy of all written coursework submitted.

What support and help can I get?

Every student is allocated an academic course tutor. Full time students meet with their academic course tutor during induction and then on a weekly basis for either group or individual tutorials. Part time students meet for individual tutorials by arrangement.

Your academic course tutor will monitor and keep records of your progress. You will be expected to take an active part in this process and take responsibility for your own learning and progress. Your academic course tutor is there to support and guide you on your learning journey and is your first point of contact if you have any concerns or need to access support, counselling or careers guidance. Your academic course tutor will be responsible for writing your reference when you apply for further courses or employment. You will be given contact details for your academic course tutor during induction.

You will also receive academic support from your unit tutors. This may take the form of face to face academic tutorials, advice surgeries, appointments which may be remote (by telephone or email conversations) and conferences on the college intranet. Never be afraid to ask for help or advice – we are here to support you. Unit tutors will provide you with contact details during the first lesson.

Other sources of support

During induction you will be given details of all the support services which the college provides.

A Student Central base is located at the City and Hillsborough campuses, staffed by the Student Support Team who are there to support you throughout your time at College. This team of staff includes our own Careers Advice Team who can advise you about appropriate courses and give careers advice, and a team of staff offering personal support. We have various initiatives in place to support you, no matter what issues you might be facing either at home or at college. More information can be found here.

The College offers a wide range of assistance to learners with additional needs. We believe that everyone should be enabled to learn effectively and have access to College facilities.

Learners with additional needs include people with:

- physical or mobility difficulties
- visual impairment e.g. blind and partially sighted
- hearing impairment e.g. deaf or hard of hearing
- communication difficulties e.g. Autistic and Asperger syndrome
- learning difficulty e.g. dyslexia, ADHD
- medical condition e.g. epilepsy, diabetes and heart disease
- mental health difficulties e.g. depression and anxiety

In order to access specialist support you need to apply for Disabled Students Allowance. You need to complete an online application form and send the documents requested to Student Finance England, who will assess your claim. If successful, they will fund you to attend an assessment centre where your particular support needs can be assessed. For more information visit Disabled Students' Allowances If you need any help with your application, or have any questions about Disabled Student Allowance, you should contact Charlotte Hope on 0114 260 2969 or by email charlotte.hope@sheffcol.ac.uk

If you have applied for Disabled Students' Allowance and been unsuccessful, ask your HE Course Leader to refer you to Charlotte Hope, who will liaise with them about your case and agree appropriate strategies for your support.

How Can I Find Out More?

The College has a dedicated specialist HE Office to service HE students. This is your first point of contact for all administrative queries and can be contacted via the following email address; HEOffice@sheffcol.ac.uk. They will either be able to answer your query or give you the contact details of the appropriate person to help you. The Assistant Principal, Higher Education, is Tina Harrison, tina.harrison@sheffcol.ac.uk

4 Additional Course Specific Information

Course
HNC Manufacturing Engineering
Additional Costs
None
Equipment
None
Printing /Reprographic Costs
None
Residential Trips
None
Please include any other course specific information not given elsewhere
None

5 Assessment

5.1 Assessment Schedule

Deadlines will be given for each unit during the first lesson for that unit, and published in unit guides and the course assessment schedule.

5.2 Assessment Regulations

All HE students are entitled to have access to fair assessment. The College follows QAA and Awarding Body guidance regarding reasonable adjustments and special considerations. Teachers, trainers and assessors will follow the procedures, and design assessment instruments that give all candidates the fairest possible opportunities to show attainment. Internal verifiers will check that assessments give all students equal opportunities to show attainment, and that there is no discrimination or bias in the design or format.

All courses have a Review Board at the end of the first semester and a final Exam Board at the end of the academic year. These boards confirm your results for all completed units, and for the award at the end of the course. Pearson BTEC HNC/D regulations require us to specify a set of rules that all HNC/D programmes adhere to, and which are considered during these Boards. The rules are listed below:

- all students must meet the pass or merit or distinction criteria to achieve each unit
- if there are exceptional circumstances explaining why a student is unable to meet deadline dates, the decision to defer outstanding work must be agreed by an Exceptional Circumstances Panel. It follows that the Exceptional Circumstances Panel must meet prior to the Board.
- if a student does not achieve the pass standard for the first submission of summative assessment of the unit, s/he will be given a refer grade, and will be required to resubmit work by a clearly stated deadline. The grade awarded will be capped at a pass.
- the outcome of the refer work will be discussed at a Resit Board; if still not at the required standard, the student will fail the unit and will need to re-register, subject to the unit's availability
- if it is not possible for a student to retake all re-registered units during the planned 2 years, then a decision to allow a student to continue for a 3rd year of the course may be taken at the discretion of the Resit Board
- all students are to be provided with feedback on their work within 3 weeks of the deadline date
- units that are assessed using group work must also include measurable assessment of the contribution of each individual student

Standards Verifiers consider samples of student work to verify quality and standards. The Review/Exam Board will consider their comments about these samples whether or not it is possible for the Standards Verifier to attend in person. Each Board must also report progress on actions taken in response to any Standards Verifier recommendations.

No discussion of individual results or counselling of students takes place prior to the Review/Exam Board. Discussions that take place during the Board are strictly confidential. Only the Board decisions are reported to you.

Your Standards Verifier is **Rob Blackshaw**. His email address is robert.blackshaw@ntlworld.com

5.3 Extenuating Circumstances

The Sheffield College's Extenuating Circumstances Policy is intended to provide support if you experience unexpected and unanticipated difficulties during your time as a student which adversely impacts on your studies and your ability to complete assessments or complete them to your usual standard.

If you are experiencing such difficulties, please refer to the Sheffield College's HE *Assessment & Extenuating Circumstances Policy* for guidance (which outlines timescales and documentation needed to submit) and speak to a member of the teaching staff about your specific situation. They will be able to advise which procedure you need to follow and who to submit the relevant paperwork to.

The college's Extenuating Circumstances Policy is available here, https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Assessment & Extenuating Circumstances Policy*. You will also find a link on your Google classroom/VLE site.

You should read this information if you are experiencing personal problems, for example, if you are ill, have been in hospital, have experienced an exceptional family emergency or are suffering from exceptional stressful life events, and they are having a significant impact on your ability to study.

Whilst studying with us you may well encounter some of the difficulties of life experienced by most people, such as ill-health or personal issues. Normally you will be able to overcome or manage these without any impact on your ability to study and complete assessment.

Occasionally however you might experience ill-health or personal issues that are exceptional in nature and which have a significant impact on your ability to study and to complete assessment. **We define these as extenuating circumstances**. Generally, such circumstances will occur suddenly, will be unexpected and are beyond your immediate control to overcome or manage due to their severity and/or timing. There are different types of extenuation, dependant on the individual situation. Our policy is to help you where we can to mitigate the impact of your extenuating circumstances on your studies and to consider all requests for help sensitively, fairly and equitably.

It is important you inform us as soon as you are aware that your studies and/or ability to take assessment are being affected by ill-health or personal issues. If you need to apply for Exceptional Circumstances, you should adhere to the timescales outlined and contact your **HE Course Leader** immediately if your circumstances are preventing you from attending classes or are affecting your ability to complete assessment. We understand you might not always feel comfortable doing this particularly when your circumstances are of a personal and sensitive nature. However, we encourage you to do so. Any information you disclose will be handled in confidence.

The appropriate mechanism to help mitigate the impact of your circumstances will depend on the timing and severity of those circumstances.

- Where the circumstances occur close to a coursework submission deadline and are of the type that can quickly be overcome, you can request a short extension to that deadline.
- Where your circumstances will prevent any sustained meaningful engagement with your studies, then you can request a planned break in studies.
- Where your circumstances are having a detrimental impact on your ability to attempt or reach a pass standard in an assessment task, you can request to repeat your attempt at that assessment task.

We will consider any request sensitively, fairly and equitably based on the extent to which you have:

- Submitted the request in a timely manner.
- Clearly stated the nature of your circumstances and the impact they are having on your ability to study and take assessment.
- Provided appropriate documentary evidence where it can be reasonably obtained.

The Sheffield College will support students in completing a Request Extension to Coursework Submission Deadline (RESD), Request Repeat Assessment Attempt (RRAA) or a Break in Study (BIS) form.

In line with the Sheffield College procedure, your Extenuating Circumstances will be reviewed by your Course Leader, and then forwarded for further review by a panel. This process is undertaken so your individual case can be reviewed and either accepted or declined following the Extenuating Circumstances Policy and Procedure process. The Sheffield College will confirm the outcome to students.

*NB: The following list indicates the type of **situations which do not meet** the definition of extenuating circumstances because we believe they can be avoided or that you can act to limit the impact. The list is not exhaustive.*

Medical

- *long-standing medical conditions (as these should be covered by a Learning Contract)*
- *planned health appointments*
- *minor ailments such as a cold*

Personal

- *the break-up of a short-term relationship*
- *financial difficulties*
- *attending or taking part in sporting events*
- *holidays or travel*
- *moving house*
- *normal domestic issues*
- *work commitments for fulltime students reducing time available for study and coursework*
- *voluntary work*
- *weddings*

Study related

- *completing coursework too late and missing deadlines*
- *losing coursework*
- *not following the assessment timetable*
- *transport difficulties which could have reasonably been avoided*
- *withdrawal of IT facilities as a result of being in debt to the College*
- *circumstances that affect another individual in relation to group work*
- *English being a second language*

For full details of the college's Extenuating Circumstances policy, please go to; https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Assessment & Extenuating Circumstances Policy*. You will also find a link on your Google classroom/VLE site.

5.4 Malpractice

Malpractice is any form of cheating, including plagiarism, collusion, impersonation and the use of inadmissible material. It is a breach of the College's Assessment Regulations. If malpractice is suspected, it will be established beyond all reasonable doubt before any formal sanction is imposed. The College views all instances of malpractice, including plagiarism, as a serious offence, and will respond to all allegations of malpractice in accordance with Pearson BTEC HNC/D regulations. This may require the College to report any suspected malpractice to the Awarding Body. It may also require the College to investigate, in which case the Student Disciplinary procedure will be used. Instances of malpractice that are upheld following investigation, will lead to disciplinary action.

For full details of the policy and procedures regarding Academic Misconduct, see https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Assessment Malpractice Policy & Procedure*. You will also find a link on your Google Classroom/VLE site.

Malpractice includes:

Misconduct, for example:

- any form of impersonation
- falsification, fabrication or alteration of results, certificates or assessment evidence
- failure to follow Awarding Body regulations Pearson BTEC HNC/D regulations or the instructions or advice of assessors, supervisors or invigilators
- misuse of assessment or examination material
- taking unauthorised material into assessment rooms
- obtaining, receiving, exchanging or passing on assessment-related information during assessment sessions
- behaviour that disrupts or undermines the integrity of assessment
- any form of cheating to gain an unfair advantage
- deliberate destruction of another person's work
- resubmitting previously graded work

Collusion

- unauthorised co-operation between a learner and another person, in or outside of College, in the preparation and production of work that is eventually submitted by one or both learners as the outcome of his or her individual efforts
- allowing another student to copy your work

You should not be discouraged from teamwork, as this is an essential key skill for many subject areas. However, methods of avoiding collusion, for example, the use of minutes, allocating tasks, agreeing outcomes, etc, are an essential part of team work, and the requirement to use such methods must be made clear to all students.

Plagiarism

Plagiarism is where a student submits someone else's work as if it is their own.

- copying work (artwork, images, artefacts, products, designs, words) from a published source and presenting the copied work as if it were the student's own
- the use of another person's work (artwork, images, artefacts, products, designs, words), with or without permission, without appropriately acknowledging the source

Examples of plagiarism include:

- copying from published text without an acknowledgement of source
- copying images, graphs, tables, art, music etc, without acknowledging the source
- copying small or large sections of assignments from other learners;
- downloading original material from the internet without acknowledging the source
- imitating too closely an existing work of art or music, design idea or concept

5.5 Appeals

Appeals may be made against the decisions e.g. on assessment, the decisions of a Review/Exam Board, Extenuating Circumstances Panel or Academic Conduct Panel, on the grounds stipulated in these regulations, no later than 10 days from receiving the decision against which you wish to appeal.

For full details of the appeals regulations, see https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *HE Academic Appeals*. You will also find a link on your Google classroom/VLE site. You are advised to read these regulations in full.

Grounds for appeal can relate to decisions made about procedures such as:

- exceptional extensions
- extenuating circumstances
- academic misconduct

Grounds for appeal can include:

- that there was an error or irregularity in the process
- that the decision was not in accordance with the relevant regulations
- that the person or panel making the decision did not take sufficient account of the circumstances

Failure to follow College procedures and deadlines does not in itself constitute grounds for an appeal. The appeal process should not be used as an opportunity to simply re-enter the procedure under consideration, and documents etc., originally submitted after the relevant deadlines, that were not considered when the original decision was taken, will not necessarily be taken into account during the appeal.

You cannot appeal against an academic judgement of the marks awarded but you may request confirmation of their validity if you think there has been an error or irregularity. You are therefore strongly advised to discuss the nature of the appeal with appropriate members of staff.

Assessment Appeal
If you are not happy with your provisional grades, you must discuss your concerns with the subject tutor in the first instance. He or she will then discuss the reason for the decision for awarding the provisional grade. If you are still not happy with the outcome of discussions over provisional grades with your tutor, then discuss your concerns with the Course Leader. He or she will discuss the decision with the subject tutor and/or an internal verifier. If you are still not fully satisfied with your provisional grade, the matter can be pursued in line with the College Appeals Policy.

Stage 1

1. If you disagree with the assessment decision you must explain the reason, in writing, as soon as possible.

2. The tutor must consider this and provide you with a response e.g.:

    - Clear explanation of the assessment decision following re-evaluation of the evidence, or
    - If appropriate, amendment of the assessment record.

If you agree with the decision then the Appeal does not need to progress further but if you remain unhappy with the decision reached, the Appeal must proceed to Stage 2.

Stage 2

The tutor will pass all of the relevant information to an appropriate curriculum specialist via the moderation procedure, which will examine all the issues and evaluate the original decision. If you are still unhappy with this decision you can go to Stage 3.

Stage 3

Within 10 working days of the decision from Stage 2 your work will be passed to an external manager who will consider your Appeal. The decision reached is final.

If necessary, the matter can be referred to the Awarding Organisation Pearson (http://qualifications.pearson.com/en/contact-us/feedback-and-complaints.html#tab-LearnersPearson.com.) and also, the Office of the Independent Adjudicator (OIA) http://www.oiahe.org.uk.

5.6 Complaints

Complaints Procedure

The Sheffield College is committed to providing a high quality, educational experience and aims to provide a supportive environment, responsive to any concerns raised by students. Students should feel able to make a complaint relating to the action, or lack of action, or about the standard of a service or facility provided to students of the College. The procedures are intended to ensure that all complaints are treated fairly and consistently and, wherever possible, to resolve the matter to the complainant's satisfaction. Full details of the Complaints Policy can be seen here, https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Complaints Policy*.

The College complaints procedure has two stages:

1. Informal stage – resolving a concern through informal discussion

2. Formal stage – resolving a concern through the formal complaints procedure, of which there are three possible stages

Full details of the two stages, and who to approach for help and advice, can be seen here https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Complaints Policy*.

Informal Stage

Most concerns are straightforward and can be resolved quickly with staff directly involved without the need to complete and submit a complaint form. Therefore, in the first instance, having considered the responsibilities of both students and the College as detailed within the Student Charter*, any concerns/issues should be discussed, informally, with the person concerned or another member of staff. For example, if your complaint concerns teaching/tutorial matters you may wish to talk to your tutor or other members of teaching staff. If your complaint is about a service, then you should talk to an appropriate member of staff from that service. You could also consider raising your concern via the student forums.

If you are not sure who to speak to, or you do not feel able to approach the person most directly involved, you can seek advice regarding this from your Tutor Mentor, Head of Academy, or from the Students' Union which acts independently of the College.

You can contact the Students' Union by emailing studentsunion@sheffcol.ac.uk or call into one of the reception areas to make an appointment. At this point managers may wish to speak to staff involved and/or obtain further guidance from Human Resources.

If a satisfactory resolution is not found informally, students are entitled to proceed to the College's formal complaints procedure.

Formal Stage

Stage 1

You should complete a Registration of Complaint form, copies of which can be obtained from College reception areas, or you can complete the online form via the College website http://www.sheffcol.ac.uk/complaints. You can ask a member of staff for help to complete the form or ask a friend, parent, carer or a representative of the Students' Union to submit a complaint on your behalf but we would require written agreement from you.

In addition to personal details and other information on the form, you will need to provide:

- details of the complaint
- an explanation of the steps you have already taken to try to resolve the complaint informally and why the responses you have received are not satisfactory
- where applicable, the outcome you would like from your complaint
- any supporting evidence (ie, copies of emails, notes of meetings, references to procedures, handbooks etc).

It is important to keep a copy of the completed form and other documentation submitted for your own records. Completed complaint forms should be submitted to any campus reception area or by email to collegecomplaints@sheffcol.ac.uk.
Within 5 working days of receipt of your complaint form, you will receive an acknowledgement. Your complaint will be considered to determine that the complaints procedure is appropriate and if so, it will be referred to a senior member of staff who will

manage your complaint, ensuring that necessary action is taken and monitoring it through to completion.

After a further 10 working days you will receive a letter informing you of the progress of your complaint. We aim to complete the enquiry and reach a conclusion within 30 working days of receipt of your complaint form. If this is not possible you will be informed of the progress made. Complaints identified as requiring particularly speedy resolution will receive special attention.

You may be invited to attend a meeting to consider your complaint. You may bring a friend or representative to support you and/or for assistance but they cannot be a professional employed to act on your behalf.

Matters raised in a formal complaint will remain confidential to those directly involved in the investigation (which includes any members of staff concerned). All staff and students who become aware of any of the issues involved in a formal complaint are required to keep this information confidential (except as is necessary to progress, investigate or respond to the complaint). Failure to do so may result in formal disciplinary action being taken. However, there may be occasions when it is not possible to maintain confidentiality, for example if another person is at risk. In such cases the situation will be explained to the complainant and/or the representative.

If your complaint is upheld you will be informed how and when any resolution or redress will be implemented. If the complaint is not upheld you can expect to receive clear reasons why this decision has been reached and advice on further action available to you including a review of the process of the complaint by the awarding body where appropriate (see Stage 2 below).

Stage 2

If you are not satisfied with the outcome of Stage 1, you can write to the Chief Executive, within 10 working days of receipt of the letter informing you of the outcome, to apply for a review of the process by the awarding/validating organisation. You should state the reason(s) why you are dissatisfied. Correspondence should be sent to the Chief Executive, c/o PA to the Chief Executive, Sheffield College, Granville Road, Sheffield S2 2RL.

Within 10 working days of receipt of your letter you will be informed of the action to be taken to review your complaint and any action you may need to take directly with the awarding/validating organisation.

Feedback
In accordance with the Student Charter*, at the end of the two formal stages, you will be invited to complete a short evaluation of the process.

Stage 3

Following the action taken at Stage 2 (and not before), if you still feel that the matter has not been resolved to your satisfaction, having exhausted the College's procedures you may wish to contact Pearson, the Awarding Organisation, to refer the matter further.
https://qualifications.pearson.com/en/contact-us/feedback-and-complaints.html
If not resolved to the complainant's satisfaction, Higher Education students can apply for a review of their complaint to The Office of the Independent Adjudicator for Higher Education (OIA) http://www.oiahe.org.uk

The Student Charter is located here; Public Documents || The Sheffield College (sheffcol.ac.uk) under the heading *Applicant, Student and Parent Information

5.7 Marking Arrangements

When you are set coursework, you will be given the deadline by which it is to be submitted. It is vital that you ensure you know the date, time and place for submission of coursework. Failure to meet a deadline counts as non-submission, and has serious repercussions.

It is your responsibility to keep a copy of all written coursework submitted. Your work will be marked by the unit tutor, and a sample will be internally verified by another member of staff. In addition, the Standards Verifier will sample work from all units.

You will receive feedback and marks for your work within 3 working weeks of submission. If for any reason this is not possible, you will be informed of the reason and given a date when work will be returned. The feedback you receive will be both written and oral, and forms a vital part of the learning process. Do make sure that you fully understand the feedback given, so that you can use it to improve your future work. Do not hesitate to ask the tutor if you need further guidance and explanation of your marks.

Please note that any marks you receive as part of the feedback process are provisional until confirmed by the Standards Verifier at an Exam Board.

5.8 Guidance on Referencing

Accurate and consistent referencing is essential in all academic work. Whenever you refer to either the work or ideas of someone, or are influenced by another's work, you must acknowledge this. Similarly, if you make a direct quotation from someone's work this should be referred to accurately.

There are a number of systems of referencing. The system you will use on this course is called the Harvard System. This system is described in the guides which can be found via the link below.
https://librarydevelopment.group.shef.ac.uk/Assets/pdfs/referencing/harvard.pdf

Referencing is a skill which improves with practice. It is a very important part of your academic development. The guides are comprehensive and explain how to reference any information source. Your tutor will give you feedback on your referencing in assignments to help you develop your referencing skills. Senior Learning Facilitators and the HE Tutor Mentor are also available in the learning centres to provide individual help and offer small group workshops by arrangement.

5.9 Notification of Results

At the end of the first semester there will be a Review Board, and the second semester a final Exam Board, both chaired by the Vice Principle of HE and Academic Studies at the College and attended by the HE Course Leader and unit tutors from your course. The Standards Verifier is often, but not always present also. Whether or not the Standards Verifier attends the Board they will have reviewed samples of your assessed work.

The purpose of the Review Board is to review student progress, and the Exam Board will consider your marks and confirm whether or not you have passed each unit, and whether you are awarded the Higher National Certificate at the end of the course. The Sheffield College HE Office sends out results letters at the end of the Academic Year, usually within 2 weeks of the final Exam Board meeting.

Further information regarding Exam Boards can been seen here, https://www.sheffcol.ac.uk/about-us/terms-and-conditions and click on *Exam Board Policy & Procedure*.

5.10 Provision of Certificates

On successful completion of the course, your results are submitted to Pearson, who will issue your Certificate to the college. It is vital that you ensure TSC HE Office always has your current address so that these important documents go to the correct address.

You **must** notify The Sheffield College HE Office by emailing HEOffice@sheffcol.ac.uk if you change either your term time or the permanent addresses given at enrolment, as well as your email address and mobile telephone number.

5.11 Graduation

During the summer following successful completion of your course you will receive an invitation to attend our graduation ceremony. This is a memorable occasion where family and friends join you and your tutors to celebrate your achievements. The ceremony takes place in the autumn following successful completion of your course.

6. Learning Resources

All college campuses provide Wi-Fi access so that you can connect your own devices. There are drop in sessions at all college campuses to help you if you experience difficulties.

6.1 Access to College Resources

Learning Resource Centres (LRCs) provide open access to resources, study space and computing facilities, in a pleasant and welcoming environment. You will find a Learning Resource Centre located at all of the College campuses – Hillsborough, Peaks and Sheffield City College. Opening times can be found on the college website, in our information leaflets, and are displayed in each centre, as well as 24/7 electronic access where available.

It is our aim to make the LRC a flexible service, giving support throughout your time in college. Regular Student Forum meetings are held, where we welcome feedback and suggestions from students in order to improve our service.

LRCs provide you with an extensive range of resources to support your learning, including:

- Books, magazines and newspapers
- DVDs, multimedia, online and electronic resources
- Study support materials and learning packages
- Internet access, including Wi-Fi to connect your own device. Secure access to online resources is provided through an authentication service (currently Shibboleth) more information is available via our Google Classroom page **ibllshj**
- Resources can be produced in alternative formats, please contact your tutor.

You will be able to borrow many of these resources but others are available only for use in the LRC.

In each LRC we have dedicated staff available to support students' learning needs:

- Senior Learning Facilitators are available during working hours for face to face and remote support, and questions can be sent via email to learningresources@sheffcol.ac.uk or LRCteam@sheffcol.ac.uk they will be answered by the next available assistant.
- Senior Learning Facilitators also offer small group workshops on particular study skills – for example: referencing; researching a subject; effective internet searching, etc. We also have a Study Skills Google Classroom page **kmtfsoe**
- Staff are appropriately trained and keep up to date by attending regular updating sessions.

The LRC staff can help you with your study and research skills, and have specialist knowledge of the resources available in your subject area. The team can provide training in a range of library related information skills to enable you to use resources effectively to support your studies. During induction you will be given a tour of the facilities and have the opportunity to meet the staff.

Your access to the College's IT facilities is by means of a Student Account. Students are given a small starting balance on their printing and photocopying account. When that has been used, further credits can be purchased.

You can pre-book a computer to work on at any of the LRCs, so that you know a PC will be available when you need it.

The library catalogue and details of all the services offered are available from all college LRCs, or online in the LRC sections of the college website.

All students of the Sheffield College can borrow from any campus LRC. In order to borrow resources, students **must** bring their student card to the issue desk. Students are required to show their student card to gain access to College campuses.

Each student can borrow a total of up to 10 items, which may include:

Type of Loan	No. of items	Loan Terms
Ordinary Loan	Up to 10 items	3 Weeks
Short Loan	Up to 5 items	1 Week
Reference	Discretionary	Discretionary

The loan period is designated depending on the nature of resource and likely demand. The loan period may be changed following consultation with colleagues, or in periods of high demand.

Ordinary and short loan items can be renewed twice, either by calling in to the LRC, by email learningresources@sheffcol.ac.uk or by telephone. Reserved and overdue items will not be renewed.

Fines are charged for overdue items. Costs for lost or damaged items are the full cost of replacement, or is negotiable if the advertised price is not available.

Students can reserve items that are on loan to at the issue desk or via the library catalogue. If a resource is not available at their own centre, LRC staff can request it from another centre. This may take up to 5 working days. If your request cannot be satisfied within the college LRCs, we have access to a range of inter-library loan schemes, including links with the British Library.

The Learning Resource Centre Charter

We are here to help you be successful students - this is what we do for you:

Each working day we can give you:

- A welcoming, quiet place to study
- A wide range of books, journals, audio-visual materials and online resources relevant to your subject or course, most of which you are able to borrow
- A range of subject and study guides to support your learning
- Learning Facilitators to help you with your enquiries and information needs
- Senior Learning Facilitators to help with your course work and IT enquiries
- Computers for you to use for your college work
- Wi-fi (eduroam) access for you to connect your own learning devices
- Photocopiers, printers and a range of learning equipment for you to use
- Access to all Sheffield College Learning Resource Centres to use their facilities
- Help in finding resources kept in other Libraries and Information Services

When you are not in college you can access many of our services 24/7:

- You can log in to our online services using your college user name and password
- You can email queries to us, to be answered when we are next working
- Our online catalogue helps you find resources in advance of your next visit
- We have a growing collection of e-books and e-journals for your course
- You can find our useful information guides through your Google classroom

In return, this is what you can do for us:

- Ask us for any help that you need
- Take anything you want to borrow to the LRC desk with your Student ID Card
- Take care of any resources you use or borrow, and return them on time so they are available for other students to use
- Pay for any loss or damage caused to resources or facilities in your care, and the fines due on any items you didn't return on time
- Use the computers for course work only so they can be used by others too
- Respect the needs of other students and staff by keeping noise to a minimum for a pleasant and peaceful working atmosphere
- Use the LRC as a learning place – please don't bring food or drinks in
- Help us contribute to the environment by not wasting resources
- Tell us if you have any ideas on how we can improve our services

We aim to provide an efficient and effective LRC service. Your suggestions and comments are welcome.

7. Opportunities to Engage in Quality Assurance of the Course

7.1 Student Representation

Students are invited to send representatives to attend Course Committees, where issues relating to the running and development of the course are discussed by teaching teams. At these meetings students can raise any concerns they have, so that prompt action can be taken to resolve matters. In addition, your academic course tutor will discuss any concerns which arise during group tutorials, and report back on action taken. Student representatives are also invited to attend the course review at the end of each academic year.

The college employs a Student Involvement Facilitator, who calls termly meetings of the HE Student Forum, to which you are invited to send representatives. The Forum discusses non-course issues which are then raised with the appropriate college manager, who provides feedback to the next meeting. The Student Forum elects a lead Student Representative, who represents the student voice at HE Quality Standards meetings with senior managers and directors. Feedback from the Student Representatives across the country is taken into account by the Office for Students (OfS), alongside data from the annual NSS (National Student Survey). Their website can be found here:
https://www.officeforstudents.org.uk/for-students/what-the-ofs-does-for-students/

Higher Education students elect a representative to sit on the Student Union.

7.2 Student Surveys

The College conducts an annual HE Student Survey, where you are asked to respond to a series of questions about the quality of teaching and learning on your course. In addition, you are asked to complete unit evaluation surveys at the end of each unit in order to help us to continuously improve. The results of these surveys are fed into the Annual Quality Review process, and action plans are devised which take account of student opinion. You will receive feedback on the action arising from these surveys through your representatives on course committees and your academic course tutor during group tutorials.

7.3 Complaints Process

Definition

A complaint is an expression of concern or dissatisfaction with any aspect of the College's provision that requires a response. Complaints concerning assessment and accreditation may sometimes be dealt with through the college Appeals procedures and those set up by awarding/validating organisations.

- For further details of the Appeals procedure, please see paragraph 5.5 of this handbook.
- For further details of the Complaints procedure, please see paragraph 5.6 of this handbook.

8. Opportunities for Further Study

8.1 Opportunities at the Sheffield College

Details of courses suitable for Higher National graduates, including professional courses, can be found in the prospectus online. Located on the college website here, scroll down to *Download our Guides* where you will find the latest *University Level and Professional* prospectus.

If you are uncertain about what you need to study next to progress your career, you can contact the Careers Advice Team via their central email address; CEIAG@sheffcol.ac.uk

You can also keep up to date with careers events, workshops and job opportunities via the Twitter account, @SheffColCareers.

Find out more about our Careers Advice Service on the college website; https://www.sheffcol.ac.uk/careers-advice

8.2 Other Opportunities

You can progress onto the HND qualification, on completion of which, you can apply to 'top up' your Higher National to an honours degree at any university offering the course. You should research their entry requirements via the UCAS and university websites, where you will also find details of the application process; some courses will require you to apply through UCAS, whilst others may ask you to apply direct to the institution. You should check university websites for their current prospectuses.

If you are a full-time student, you may also consider going directly into employment, in which case you should book a careers interview to discuss the opportunities for trainee graduate and internship positions. Careers advisors can also help you with your job search and recommend sources of information such as graduate recruitment fairs.

9. Units of Study

Unit 1: Engineering Design

Unit code: K/615/1475

Level: 4

Credit value: 15

Introduction

The tremendous possibilities of the techniques and processes developed by engineers can only be realised by great design. Design turns an idea into a useful artefact, the problem into a solution, or something ugly and inefficient into an elegant, desirable and cost effective everyday object. Without a sound understanding of the design process the engineer works in isolation without the links between theory and the needs of the end user.

The aim of this unit is to introduce students to the methodical steps that engineers use in creating functional products and processes; from a design brief to the work, and the stages involved in identifying and justifying a solution to a given engineering need.

Among the topics included in this unit are: Gantt charts and critical path analysis, stakeholder requirements, market analysis, design process management, modelling and prototyping, manufacturability, reliability life cycle, safety and risk, management, calculations, drawings and concepts and ergonomics.

On successful completion of this unit students will be able to prepare an engineering design specification that satisfies stakeholders' requirements, implement best practice when analysing and evaluating possible design solutions, prepare a written technical design report, and present their finalised design to a customer or audience.

Learning outcomes

By the end of this unit students will be able to:

1. Plan a design solution and prepare an engineering design specification in response to a stakeholder's design brief and requirements.
2. Formulate possible technical solutions to address the student-prepared design specification.
3. Prepare an industry-standard engineering technical design report.
4. Present to an audience a design solution based on the design report and evaluate the solution/presentation.

Essential content

LO1 **Plan a design solution and prepare an engineering design specification in response to a stakeholder's design brief and requirements**

Planning techniques used to prepare a design specification:
Definition of client's/users objectives, needs and constraints
Definition of design constraints, function, specification, milestones
Planning the design task: Flow charts, Gantt charts, network and critical path analysis necessary in the design process
Use of relevant technical/engineering/industry standards within the design process

Design process:
Process development, steps to consider from start to finish
The cycle from design to manufacture
Three- and five-stage design process
Vocabulary used in engineering design

Stage of the design process which includes:
Analysing the situation, problem statement, define tasks and outputs, create the design concept, research the problem and write a specification Suggest possible solutions, select a preferred solution, prepare working drawings, construct a prototype, test and evaluate the design against objectives, design communication (write a report)

Customer/stakeholder requirements:
Converting customer request to a list of objectives and constraints
Interpretation of design requirements
Market analysis of existing products and competitors
Aspects of innovation and performance management in decision-making

LO2 **Formulate possible technical solutions to address the student-prepared design specification**

Conceptual design and evaluating possible solutions:
Modelling, prototyping and simulation using industry standard software, (e.g. AutoCAD, Catia, SolidWorks, Creo) on high specification computers
Use of evaluation and analytical tools, e.g. cause and effect diagrams, CAD, knowledge-based engineering

LO3 **Prepare an industry-standard engineering technical design report**

Managing the design process:
Recognising limitations including cost, physical processes, availability of material/components and skills, timing and scheduling

Working to specifications and standards, including:
The role of compliance checking, feasibility assessment and commercial viability of product design through testing and validation

Design for testing, including:
Material selection to suit selected processes and technologies
Consideration of manufacturability, reliability, life cycle and environmental issues
The importance of safety, risk management and ergonomics

Conceptual design and effective tools:
Technologies and manufacturing processes used in order to transfer engineering designs into finished products

LO4 **Present to an audience a design solution based on the design report and evaluate the solution/presentation**

Communication and post-presentation review:
Selection of presentation tools
Analysis of presentation feedback
Strategies for improvement based on feedback

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Plan a design solution and prepare an engineering design specification in response to a stakeholder's design brief and requirements</td><td rowspan="2">D1 Compare and contrast the completed design specification against the relevant industry standard specification</td></tr>
<tr><td>P1 Produce a design specification from a given design brief
P2 Explain the influence of the stakeholder's design brief and requirements in the preparation of the design specification
P3 Produce a design project schedule with a graphical illustration of the planned activities</td><td>M1 Evaluate potential planning techniques, presenting a case for the method chosen
M2 Demonstrate critical path analysis techniques in design project scheduling/planning and explain its use</td></tr>
<tr><td colspan="2">LO2 Formulate possible technical solutions to address the student-prepared design specification</td><td rowspan="2">D2 Evaluate potential technical solutions, presenting a case for the final choice of solution</td></tr>
<tr><td>P4 Explore industry standard evaluation and analytical tools in formulating possible technical solutions
P5 Use appropriate design techniques to produce possible design solution</td><td>M3 Apply the principles of modelling/simulation/ prototyping, using appropriate software, to develop appropriate design solutions</td></tr>
<tr><td colspan="2">LO3 Prepare an industry-standard engineering technical design report</td><td rowspan="2">D3 Evaluate the effectiveness of the presented industry-standard engineering technical design report for producing a fully compliant finished product</td></tr>
<tr><td>P6 Prepare an industry-standard engineering technical design report
P7 Assess the presented technical design and identify any potential limitations it may have</td><td>M4 Explain the role of design specifications and standards in producing a finished product
M5 Identify any compliance, safety and risk management issues present in the chosen solution</td></tr>
<tr><td colspan="2">LO4 Present to an audience a design solution based on the design report and evaluate the solution/ presentation</td><td rowspan="2">D4 Justify potential improvements to the presented design solution, based on reflection and/or feedback obtained from the presentation</td></tr>
<tr><td>P8 Present the recommended design solution to the identified audience
P9 Explain possible communication strategies and presentation methods that could be used to inform the stakeholders of the recommended solution</td><td>M6 Reflect on effectiveness of communication strategy in presenting the solution</td></tr>
</table>

Recommended Resources

Textbooks

DUL, J. and WEERDMEESTER, B. (2008) *Ergonomics for beginners*. 3rd Ed. Boca Raton: CRC Press.

DYM, C.L., LITTLE, P. and ORWIN, E. (2014) *Engineering Design: a Project Based Introduction*. 4th Ed. Wiley.

GRIFFITHS, B. (2003) *Engineering Drawing for Manufacture*. Kogan Page Science.

REDDY, K.V. (2008) *Textbook of Engineering Drawing*. 2nd Ed. Hyderabad: BS Publications.

Websites

www.epsrc.ac.uk	Engineering and Physical Sciences Research Council (General Reference)
www.imeche.org	Institution of Mechanical Engineers (General Reference)

Links

This unit links to the following related units:

Unit 23: Computer Aided Design and Manufacture (CAD/CAM)

Unit 34: Research Project

Unit 2: Engineering Maths

Unit code: M/615/1476

Level: 4

Credit value: 15

Introduction

The mathematics that is delivered in this unit is that which is directly applicable to the engineering industry, and it will help to increase students' knowledge of the broad underlying principles within this discipline.

The aim of this unit is to develop students' skills in the mathematical principles and theories that underpin the engineering curriculum. Students will be introduced to mathematical methods and statistical techniques in order to analyse and solve problems within an engineering context.

On successful completion of this unit students will be able to employ mathematical methods within a variety of contextualised examples, interpret data using statistical techniques, and use analytical and computational methods to evaluate and solve engineering problems.

Learning outcomes

By the end of this unit students will be able to:

1. Identify the relevance of mathematical methods to a variety of conceptualised engineering examples.
2. Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages.
3. Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering applications.
4. Examine how differential and integral calculus can be used to solve engineering problems.

Essential content

LO1 **Identify the relevance of mathematical methods to a variety of conceptualised engineering examples**

Mathematical concepts:
Dimensional analysis
Arithmetic and geometric progressions

Functions:
Exponential, logarithmic, circular and hyperbolic functions

LO2 **Investigate applications of statistical techniques to interpret, organise and present data, by using appropriate computer software packages**

Summary of data:
Mean and standard deviation of grouped data
Pearson's correlation coefficient
Linear regression

Probability theory:
Binomial and normal distribution

LO3 **Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering application.**

Sinusoidal waves:
Sine waves and their applications
Trigonometric and hyperbolic identities

Vector functions:
Vector notation and properties
Representing quantities in vector form
Vectors in three dimensions

LO4 **Examine how differential and integral calculus can be used to solve engineering problems**

Differential calculus:

Definitions and concepts

Definition of a function and of a derivative, graphical representation of a function, notation of derivatives, limits and continuity, derivatives; rates of change, increasing and decreasing functions and turning points

Differentiation of functions

Differentiation of functions including:
- standard functions/results
- using the chain, product and quotient rules
- second order and higher derivatives

Types of function: polynomial, logarithmic, exponential and trigonometric (sine, cosine and tangent), inverse trigonometric and hyperbolic functions
Integral calculus:

Definite and indefinite integration

Integrating to determine area

Integration of common/standard functions and by substitution and parts

Exponential growth and decay

Types of function: algebraic including partial fractions and trigonometric (sine, cosine and tangent) functions

Engineering problems involving calculus:

Including: stress and strain, torsion, motion, dynamic systems, oscillating systems, force systems, heat energy and thermodynamic systems, fluid flow, AC theory, electrical signals, information systems, transmission systems, electrical machines, electronics

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Identify the relevance of mathematical methods to a variety of conceptualised engineering examples</td><td rowspan="8">LO1 & 2

D1 Present statistical data in a method that can be understood by a non-technical audience

D2 Model the combination of sine waves graphically and analyse the variation in results between graphical and analytical methods

D3 Analyse maxima and minima of increasing and decreasing functions using higher order derivatives</td></tr>
<tr><td>P1 Apply dimensional analysis techniques to solve complex problems
P2 Generate answers from contextualised arithmetic and geometric progressions
P3 Determine solutions of equations using exponential, trigonometric and hyperbolic functions</td><td>M1 Use dimensional analysis to derive equations</td></tr>
<tr><td colspan="2">LO2 Investigate applications of statistical techniques to interpret, organise and present data by using appropriate computer software packages</td></tr>
<tr><td>P4 Summarise data by calculating mean and standard deviation, and simplify data into graphical form
P5 Calculate probabilities within both binomially distributed and normally distributed random variables</td><td>M2 Interpret the results of a statistical hypothesis test conducted from a given scenario</td></tr>
<tr><td colspan="2">LO3 Use analytical and computational methods for solving problems by relating sinusoidal wave and vector functions to their respective engineering application</td></tr>
<tr><td>P6 Solve engineering problems relating to sinusoidal functions
P7 Represent engineering quantities in vector form, and use appropriate methodology to determine engineering parameters</td><td>M3 Use compound angle identities to separate waves into distinct component waves</td></tr>
<tr><td colspan="2">LO4 Examine how differential and integral calculus can be used to solve engineering problems</td></tr>
<tr><td>P8 Determine rates of change for algebraic, logarithmic and circular functions
P9 Use integral calculus to solve practical problems relating to engineering</td><td>M4 Formulate predictions of exponential growth and decay models using integration methods</td></tr>
</table>

Recommended Resources

Textbooks

SINGH, K. (2011) *Engineering Mathematics Through Applications*. 2nd Ed. Basingstoke: Palgrave Macmillan.

STROUD, K.A. and BOOTH, D.J. (2013) *Engineering Mathematics*. 7th Ed. Basingstoke: Palgrave Macmillan.

Websites

http://www.mathcentre.ac.uk/	Maths Centre (Tutorials)
http://www.mathtutor.ac.uk/	Maths Tutor (Tutorials)

Links

This unit links to the following related units:

Unit 39: Further Mathematics

Unit 3: Engineering Science

Unit code: T/615/1477

Level: 4

Credit value: 15

Introduction

Engineering is a discipline that uses scientific theory to design, develop or maintain structures, machines, systems, and processes. Engineers are therefore required to have a broad knowledge of the science that is applicable to the industry around them.

This unit introduces students to the fundamental laws and applications of the physical sciences within engineering and how to apply this knowledge to find solutions to a variety of engineering problems.

Among the topics included in this unit are: international system of units, interpreting data, static and dynamic forces, fluid mechanics and thermodynamics, material properties and failure, and A.C./D.C. circuit theories.

On successful completion of this unit students will be able to interpret and present qualitative and quantitative data using computer software, calculate unknown parameters within mechanical systems, explain a variety of material properties and use electromagnetic theory in an applied context.

Learning outcomes

By the end of this unit students will be able to:

1. Examine scientific data using both quantitative and computational methods.
2. Determine parameters within mechanical engineering systems.
3. Explore the characteristics and properties of engineering materials.
4. Analyse applications of A.C./D.C. circuit theorems, electromagnetic principles and properties.

Essential content

LO1 **Examine scientific data using both quantitative and computational methods**

International system of units:
The basic dimensions in the physical world and the corresponding SI base units
SI derived units with special names and symbols
SI prefixes and their representation with engineering notation

Interpreting data:
Investigation using the scientific method to gather appropriate data
Test procedures for physical (destructive and non-destructive) tests and statistical tests that might be used in gathering information
Summarising quantitative and qualitative data with appropriate graphical representations
Using presentation software to present data to an audience

LO2 **Determine parameters within mechanical engineering systems**

Static and dynamic forces:
Representing loaded components with space and free body diagrams
Calculating support reactions of objects subjected to concentrated and distributed loads
Newton's laws of motion, D'Alembert's principle and the principle of conservation of energy

Fluid mechanics and thermodynamics:
Archimedes' principle and hydrostatics
Continuity of volume and mass flow for an incompressible fluid
Effects of sensible/latent heat of fluid
Heat transfer due to temperature change and the thermodynamic process equations

LO3 **Explore the characteristics and properties of engineering materials**

Material properties:
Atomic structure of materials and the structure of metals, plastics and composites
Mechanical and electromagnetic properties of materials

Material failure:
Destructive and non-destructive testing of materials
The effects of gradual and impact loading on a material.
Degradation of materials and hysteresis

LO4 **Analyse applications of A.C./D.C. circuit theorems, electromagnetic principles and properties**

D.C. circuit theory:
Voltage, current and resistance in D.C. networks
Exploring circuit theorems (Thevenin, Norton, Superposition), Ohm's law and

Kirchhoff’s voltage and current laws
A.C. circuit theory:
Waveform characteristics in a single-phase A.C. circuit
RLC circuits

Magnetism:
Characteristics of magnetic fields and electromagnetic force
The principles and applications of electromagnetic induction

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Examine scientific data using both quantitative and computational methods		**D1** Present an analysis of scientific data using both computational and qualitative methods
P1 Describe SI units and prefix notation **P2** Examine quantitative and qualitative data with appropriate graphical representations	**M1** Explain how the application of scientific method impacts upon different test procedures	
LO2 Determine parameters within mechanical engineering systems		**D2** Critically compare how changes in the thermal efficiency of a heat transfer process can affect the behavioural characteristics of a mechanical systems
P3 Determine the support reactions of a beam carrying a concentrated load and a uniformly distributed load **P4** Use Archimedes' principle in contextual engineering applications **P5** Determine through practical examples the change within a solid material when exposed to temperature variations	**M2** Determine unknown forces by applying d'Alembert's principle to a free body diagram	
LO3 Explore the characteristics and properties of engineering materials		**D3** Compare and contrast theoretical material properties of metal and non-metallic materials compared with values obtained through destructive and non-destructive test methods
P6 Describe the structural properties of metals and non-metals with reference to their material properties **P7** Explain the types of degradation found in metals and non-metals	**M3** Review elastic, electrical and magnetic hysteresis in different materials	
LO4 Analyse applications of A.C./D.C. circuit theorems, electromagnetic principles and properties		**D4** Critically evaluate different techniques used to solve problems on series-parallel R, L, C circuits using A.C. theory.
P8 Calculate currents and voltages in circuits using circuit theorems. **P9** Describe how complex waves are produced from sinusoidal waveforms. **P10** Solve problems on series R, L, C circuits with A.C. theory.	**M4** Explain the principles and applications of electromagnetic induction.	

Recommended Resources

Textbooks

BIRD, J. (2012) *Science for Engineering*. 4th Ed. London: Routledge.

BOLTON, W. (2006) *Engineering Science*. 5th Ed. London: Routledge.

TOOLEY, M. and DINGLE, L. (2012) *Engineering Science: For Foundation Degree and Higher National*. London: Routledge.

Journals

International Journal of Engineering Science.

International Journal of Engineering Science and Innovative Technology.

Websites

https://www.khanacademy.org/	Khan Academy Physics (Tutorials)

Links

This unit links to the following related units:

Unit 9: Materials, Properties and Testing

Unit 3: Engineering Science

Unit 4: Managing a Professional Engineering Project

Unit code: A/615/1478

Level: 4

Credit value: 15

Introduction

The responsibilities of the engineer go far beyond completing the task in hand. Reflecting on their role in a wider ethical, environmental and sustainability context starts the process of becoming a professional engineer – a vial requirement for career progression.

Engineers seldom work in isolation and most tasks they undertake require a range of expertise, designing, developing, manufacturing, constructing, operating and maintaining the physical infrastructure and content of our world. The bringing together of these skills, expertise and experience is often managed through the creation of a project.

This unit introduces students to the techniques and best practices required to successfully create and manage an engineering project designed to identify a solution to an engineering need. While carrying out this project students will consider the role and function of engineering in our society, the professional duties and responsibilities expected of engineers together with the behaviours that accompany their actions.

Among the topics covered in this unit are: roles, responsibilities and behaviours of a professional engineer, planning a project, project management stages, devising solutions, theories and calculations, management using a Gantt chart, evaluation techniques, communication skills, and the creation and presentation of a project report.

On successful completion of this unit students will be able to conceive, plan, develop and execute a successful engineering project, and produce and present a project report outlining and reflecting on the outcomes of each of the project processes and stages. As a result, they will develop skills such as critical thinking, analysis, reasoning, interpretation, decision-making, information literacy, and information and communication technology, and skills in professional and confident self-presentation.

This unit is assessed by a Pearson-set assignment. The project brief will be set by the centre, based on a theme provided by Pearson (this will change annually). The theme and chosen project within the theme will enable students to explore and examine a relevant and current topical aspect of professional engineering.

Learning outcomes

By the end of this unit students will be able to:

1. Formulate and plan a project that will provide a solution to an identified engineering problem.
2. Conduct planned project activities to generate outcomes which provide a solution to the identified engineering problem.
3. Produce a project report analysing the outcomes of each of the project processes and stages.
4. Present the project report drawing conclusions on the outcomes of the project.

Essential content

LO1 **Formulate and plan a project that will provide a solution to an identified engineering problem**

Examples of realistic engineering based problems:
Crucial considerations for the project
How to identify the nature of the problem through vigorous research
Feasibility study to identify constraints and produce an outline specification

Develop an outline project brief and design specification:
Knowledge theories, calculations and other relevant information that can support the development of a potential solution

Ethical frameworks:
The Engineering Council and Royal Academy of Engineering's Statement of Ethical Principles
The National Society for Professional Engineers' Code of Ethics

Regulatory bodies:
Global, European and national influences on engineering and the role of the engineer, in particular: The Royal Academy of Engineering and the UK Engineering Council
The role and responsibilities of the UK Engineering Council and the Professional Engineering Institutions (PEIs)
The content of the UK Standard for Professional Engineering Competence (UKSPEC)
Chartered Engineer, Incorporated Engineer and Engineering Technician

International regulatory regimes and agreements associated with professional engineering:
European Federation of International Engineering Institutions.
European Engineer (Eur Eng)
European Network for Accreditation of Engineering Education
European Society for Engineering Education
Washington Accord
Dublin Accord
Sydney Accord
International Engineers Alliance
Asia Pacific Economic Cooperation (APEC) Engineers Agreement

LO2 **Conduct planned project activities to generate outcomes which provide a solution to the identified engineering problem**

Project execution phase:

Continually monitoring development against the agreed project plan and adapt the project plan where appropriate

Work plan and time management, using Gantt chart or similar.

Tracking costs and timescales

Maintaining a project diary to monitor progress against milestones and timescales

Engineering professional behaviour sources:

Professional responsibility for health and safety (UK-SPEC)
Professional standards of behaviour (UK-SPEC)

Ethical frameworks:
The Engineering Council and Royal Academy of Engineering's Statement of Ethical Principles
The National Society for Professional Engineers' Code of Ethics

LO3 **Produce a project report analysing the outcomes of each of the project processes and stages**

Convincing arguments:
All findings/outcomes should be convincing and presented logically where the assumption is that the audience has little or no knowledge of the project process

Critical analysis and evaluation techniques:

Most appropriate evaluation techniques to achieve a potential solution

Secondary and primary data should be critiqued and considered with an objective mindset

Objectivity results in more robust evaluations where an analysis justifies a Judgement

LO4 **Present the project report drawing conclusions on the outcomes of the project**

Presentation considerations:

Media selection, what to include in the presentation and what outcomes to expect from it. Audience expectations and contributions

Presentation specifics. Who to invite: project supervisors, fellow students and employers. Time allocation, structure of presentation

Reflection on project outcomes and audience reactions

Conclusion to report, recommendations for future work, lessons learned, changes to own work patterns

Reflection for learning and practice:
The difference between reflecting on performance and evaluating a project – the former considers the research process, information gathering and data collection, the latter the quality of the research argument and use of evidence

The cycle of reflection:

To include reflection in action and reflection on action

How to use reflection to inform future behaviour, particularly directed towards sustainable performance

The importance of Continuing Professional Development (CPD) in refining ongoing professional practice

Reflective writing:
Avoiding generalisation and focusing on personal development and the research journey in a critical and objective way

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Formulate and plan a project that will provide a solution to an identified engineering problem</td><td rowspan="2">D1 Illustrate the effect of legislation and ethics in developing the project plan</td></tr>
<tr><td>P1 Select an appropriate engineering based project, giving reasons for the selection
P2 Create a project plan for the engineering project</td><td>M1 Undertake a feasibility study to justify project selection</td></tr>
<tr><td colspan="2">LO2 Conduct planned project activities to generate outcomes which provide a solution to the identified engineering problem</td><td rowspan="2">D2 Critically evaluate the success of the project plan, making recommendations for improvements</td></tr>
<tr><td>P3 Conduct project activities, recording progress against original project plan</td><td>M2 Explore alternative methods to monitor and meet project milestones, justify selection of chosen method(s)</td></tr>
<tr><td colspan="2">LO3 Produce a project report analysing the outcomes of each of the project processes and stages</td><td rowspan="5">LO3 & LO4

D3 Critically analyse the project outcomes making recommendations for further development</td></tr>
<tr><td>P4 Produce a project report covering each stage of the project and analysing project outcomes</td><td>M3 Use appropriate critical analysis and evaluation techniques to analyse project findings</td></tr>
<tr><td colspan="2">LO4 Present the project report drawing conclusions on the outcomes of the project</td></tr>
<tr><td>P5 Present the project report using appropriate media to an audience</td><td>M4 Analyse own behaviours and performance during the project and suggest areas for improvement</td></tr>
</table>

Recommended Resources

Textbooks

PUGH, P. S. (1990) *Total Design: Integrated Methods for Successful Product Engineering*. Prentice Hall.

STRIEBIG, B., OGUNDIPE, A. and PAPADAKIS, M. (2015) *Engineering Applications in Sustainable Design and Development*. Cengage Learning.

ULRICH, K. and EPPINGER, S. (2011) *Product Design and Development*. 5th Ed. McGraw-Hill Higher Education.

Journals

Journal of Engineering Design.

Links

This unit links to the following related units:

Unit 34: Research Project

Unit 35: Professional Engineering Management

Unit 14: Production Engineering for Manufacture

Unit code: **H/615/1488**

Level: 4

Credit value: 15

Introduction

All of the manufactured products we use in our daily lives, from processed food to clothing and cars, are the result of production engineering. Production engineers need to have a comprehensive knowledge and understanding of all the possible production technologies available, their advantages and disadvantages, the requirements of the production system operation and the interaction between the various components of the production system.

This unit introduces students to the production process for key material types; the various types of machinery used to manufacture products and the different ways of organising production systems to optimise the production process; consideration of how to measure the effectiveness of a production system within the overall context of the manufacturing system; and an examination of how production engineering contributes to ensuring safe and reliable operation of manufacturing.

On successful completion of this unit students will be able to illustrate the role and purpose of production engineering and its relationship with the other elements of a manufacturing system. They will be able to select the most appropriate production processes and associated facility arrangements for manufacturing products of different material types and design a production system incorporating a number of different production processes.

Learning Outcomes

By the end of this unit students will be able to:

1. Illustrate the role and purpose of production engineering and its relationship with the other elements of a manufacturing system.
2. Select the most appropriate production processes and associated facility arrangements, for manufacturing products of different material types.
3. Analyse how a production system can incorporate a number of different production processes for a given product or assembly.
4. Explore the effectiveness of a production system in terms of its operation within the wider manufacturing system.

Essential Content

LO1 **Illustrate the role and purpose of production engineering and its relationship with the other elements of a manufacturing system**

Production engineering activities:
Common practices for manufacturing

Research and develop tools, processes, machines, and equipment

Integrate facilities and systems for producing quality products

Design, implement and refine products, services, processes and systems

Combination of manufacturing technology and management science

LO2 **Select the most appropriate production processes and associated facility arrangements, for manufacturing products of different material types**

Production processes:
Common ceramics, composite, metals manufacturing processes

Bonding and jointing technologies, including welding, adhesives, snap fits, interference fits and mechanical assemblies

LO3 **Analyse how a production system can incorporate a number of different production processes for a given product or assembly**

Function of the range of production facilities within a manufacturing plant:
Production design for manufacture and assembly

Cellular and flexible manufacturing systems

Component production using CNC machining centres and automated production processes

Automated materials handling equipment, conveyor systems, automatic guided vehicle servicing, product assembly and production lines

Heat treatment facilities, paint and coating plants

Warehouse, stock storage equipment

The purpose, operation and effects of incorporating concepts such as lean manufacturing and just-in-time (JIT) supply to the production process

LO4 **Explore the effectiveness of a production system in terms of its operation within the wider manufacturing system**

Production systems:
Production performance criteria, through-put rates, yield rates, cost effectiveness, sustainability, flexibility and reliability

Optimising supply chain performance and management

Essential collaboration between manufacturer, supplier and retailer

Production errors and rectification:
Cost in terms of time, material waste, product recall, reputation and litigation

Production data collection, critical evaluation and analysis

The human component:
Cultural openness to new ideas and continuous improvement

Collaboration and information sharing

Performance management and rewards

Engineer training and development practices

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Illustrate the role and purpose of production engineering and its relationship with the other elements of a manufacturing system</td><td rowspan="3">D1 Analyse how the production engineer supports the development of operational strategies to achieve production and financial objectives

D2 Evaluate how the choice of bonding and jointing processes influence both the product design and the selection of the most effective production process</td></tr>
<tr><td>P1 Describe the multiple elements of a modern manufacturing system
P2 Explain the role of the production engineer within a manufacturing system</td><td>M1 Investigate how the production engineer can influence the design process and refine products, services and systems</td></tr>
<tr><td colspan="2">LO2 Select the most appropriate production processes and associated facility arrangements for manufacturing products of different material types</td></tr>
<tr><td>P3 Examine the properties and applications of ceramic products manufactured using the sintering, hot pressing, chemical vapour deposition (CVD) and reaction bonding processes
P4 Describe the properties and applications of composite products manufactured using manual and automated layup, filament winding, pultrusion and resin transfer moulding processes</td><td>M2 Discuss the benefits associated with polymer manufacturing process</td><td></td></tr>
<tr><td colspan="2">LO3 Analyse how a production system can incorporate a number of different production processes for a given product or assembly</td><td rowspan="2">D3 Analyse the relationship of just-in-time (JIT) and lean manufacturing to total quality and world-class manufacturing and their effects on production processes for a given product or assembly</td></tr>
<tr><td>P5 Review the type and sequence of production processes a product or component would follow from initial design through to manufacture and distribution
P6 Describe the function of the various production facilities within a modern manufacturing plant</td><td>M3 Explain how materials, components and sub-assembly handling and conveyance can impact on the effectiveness and efficiency of a modern manufacturing plan</td></tr>
<tr><td colspan="2">LO4 Explore the effectiveness of a production system in terms of its operation within the wider manufacturing system</td><td rowspan="2">D4 Analyse the criteria by which production performance can be measured within the wider manufacturing system</td></tr>
<tr><td>P7 Review the type of data that would be collected and analysed to measure production performance
P8 Describe the measures that can improve production performance criteria</td><td>M4 Explain the immediate and long-term effects that production errors and rectification can have on a manufacturing company</td></tr>
</table>

Recommended Resources

Textbooks

KALPAKJIAN, S. and SCHMID, S. (2009) *Manufacturing Engineering and Technology*. 6th Ed. Prentice Hall.

Websites

https://www.khanacademy.org/	Khan Academy (Tutorials)

Links

This unit links to the following related units:

Unit 23: Computer Aided Design and Manufacture (CAD/CAM)
Unit 48: Manufacturing Systems Engineering

Unit 17: Quality and Process Improvement

Unit code: **H/615/1491**

Level: 4

Credit value: 15

Introduction

Quality has always been the key to business success and survivability, but it requires organisations to allocate a lot of effort and resources to achieve it. The key to providing quality services and designing top quality products lies in the strength and effectiveness of the processes used in their development; processes which must be constantly reviewed to ensure they operate as efficiently, economically and as safely as possible.

This unit introduces students to the importance of quality assurance processes in a manufacturing or service environment and the principles and theories that underpin them. Topics included in this unit are: tools and techniques used to support quality control, attributes and variables, testing processes, costing modules, the importance of qualifying the costs related to quality, international standards for management (ISO 9000, 14000, 18000), European Foundation for Quality Management (EFQM), principles, tools and techniques of Total Quality Management (TQM) and implementation of Six Sigma.

On successful completion of this unit students will be able to illustrate the processes and applications of statistical process, explain the quality control tools used to apply costing techniques, identify the standards expected in the engineering environment to improve efficiency and examine how the concept of Total Quality Management and continuous improvement underpins modern manufacturing and service environments.

Learning Outcomes

By the end of this unit students will be able to:

1. Illustrate the applications of statistical process control when applied in an industrial environment to improve efficiency.
2. Analyse cost effective quality control tools.
3. Determine the role of standards in improving efficiency, meeting customer requirements and opening up new opportunities for trade.
4. Analyse the importance of Total Quality Management and continuous improvement in manufacturing environments.

Essential Content

LO1 **Illustrate the applications of statistical process control when applied in an industrial environment to improve efficiency**

Quality control:

The tools and techniques used to support quality control

Attributes and variables

Testing processes

Quality tools and techniques, including statistical process control (SPC)

Designing quality into new products and processes using Quality Function Deployment (QFD)

LO2 **Analyse cost effective quality control tools**

Quality costing:

Costing modules

The importance of qualifying the costs related to quality

How costs can be used to improve business performance

LO3 **Determine the role of standards in improving efficiency, meeting customer requirements and opening up new opportunities for trade**

Standards for efficiency:

The history of standards

The role of standards and their importance in enabling and supporting trade, business and industry

Standards for measurement

International Standards for management (ISO 9000, 14000, 18000)

European Foundation for Quality Management (EFQM) as an aid to developing strategic competitive advantage

LO4 **Analyse the importance of Total Quality Management and continuous improvement in manufacturing environments**

Overview and function of quality:

The importance of quality to industry: how it underpins the ability to improve efficiency, meet customer requirements and improve competitiveness

Principles, tools and techniques of Total Quality Management (TQM)

Understanding and implementation of Six Sigma

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Illustrate the applications of statistical process control when applied in an industrial environment to improve efficiency		**D1** Suggest justified recommendations for the application of statistical process control in an industrial environment to improve efficiency
P1 Review the tools and techniques used to support quality control **P2** Describe the processes and applications of statistical process control in industrial environments	**M1** Explain the role and effectiveness of the quality tools and techniques used within an industrial environment	
LO2 Analyse cost effective quality control tools		**D2** Develop a process for the application of an extensive range of quality control tools and techniques with emphasis on costing
P3 Analyse the effective use of quality control tools and techniques **P4** Analyse costing techniques used within industry	**M2** Determine with justification the quality control tools and techniques that could be used to improve business performance	
LO3 Determine the role of standards in improving efficiency, meeting customer requirements and opening up new opportunities for trade		**D3** Illustrate a plan for the application of international standards that would improve efficiency, meet customer requirements and open up new opportunities for trade
P5 Determine required standards to improve efficiency, meet customer requirements and open up new opportunities for trade	**M3** Discuss the importance of standards applied in the engineering environment	
LO4 Analyse the importance of Total Quality Management and continuous improvement in manufacturing and service environments		**D4** Analyse how the appropriate application of Total Quality Management and Continuous improvement in tools and techniques affect quality performance in the manufacturing and service environments
P6 Analyse the principles, tools and techniques of Total Quality Management and continuous improvement **P7** Analyse how the concept of Total Quality Management and continuous improvement could help in delivering high quality performance within businesses	**M4** Discuss how the appropriate application of Total Quality Management and continuous improvement in tools and techniques affect quality performance in the manufacturing and service environments	

Recommended Resources

Textbooks

OAKLAND, J.S. (2003) *Total Quality Management: Text with Cases*. 3rd Ed. Butterworth-Heinemann.

SLACK, N., CHAMBERS, S. and JOHNSTON, R. (2016) *Operations Management*. 8th Ed. Essex: Pearson Education Limited.

Links

This unit links to the following related units:

Unit 49: Lean Manufacturing

Unit 19: Electrical and Electronic Principles

Unit code: M/615/1493

Level: 4

Credit value: 15

Introduction

Electrical engineering is mainly concerned with the movement of energy and power in electrical form, and its generation and consumption. Electronics is mainly concerned with the manipulation of information, which may be acquired, stored, processed or transmitted in electrical form. Both depend on the same set of physical principles, though their applications differ widely. A study of electrical or electronic engineering depends very much on these underlying principles; these form the foundation for any qualification in the field, and are the basis of this unit.

The physical principles themselves build initially from our understanding of the atom, the concept of electrical charge, electric fields, and the behaviour of the electron in different types of material. This understanding is readily applied to electric circuits of different types, and the basic circuit laws and electrical components emerge. Another set of principles is built around semiconductor devices, which become the basis of modern electronics. An introduction to semiconductor theory leads to a survey of the key electronic components, primarily different types of diodes and transistors.

Electronics is very broadly divided into analogue and digital applications. The final section of the unit introduces the fundamentals of these, using simple applications. Thus, under analogue electronics, the amplifier and its characteristics are introduced. Under digital electronics, voltages are applied as logic values, and simple circuits made from logic gates are considered.

On successful completion of this unit students will have a good and wide-ranging grasp of the underlying principles of electrical and electronic circuits and devices, and will be able to proceed with confidence to further study.

Learning Outcomes

By the end of this unit students will be able to:

1. Apply an understanding of fundamental electrical quantities to evaluate simple circuits with constant voltages and currents.
2. Evaluate simple circuits with sinusoidal voltages and currents.
3. Describe the basis of semiconductor action, and its application to simple electronic devices.
4. Explain the difference between digital and analogue electronics, describing simple applications of each.

Essential content

LO1 **Apply an understanding of fundamental electrical quantities to analyse simple circuits with constant voltages and currents**

Fundamental electrical quantities and concepts:
Charge, current, electric field, energy in an electrical context, potential, potential difference, resistance, electromotive force, conductors and insulators

Circuit laws:
Voltage sources, Ohm's law, resistors in series and parallel, the potential divider Kirchhoff's and Thevenin's laws; superposition

Energy and power:
Transfer into the circuit through, for example, battery, solar panel or generator, and out of the circuit as heat or mechanical. Maximum power transfer

LO2 **Analyse simple circuits with sinusoidal voltages and currents**

Fundamental quantities of periodic waveforms:
Frequency, period, peak value, phase angle, waveforms, the importance of sinusoids

Mathematical techniques:
Trigonometric representation of a sinusoid. Rotating phasors and the phasor diagram. Complex notation applied to represent magnitude and phase

Reactive components:
Principles of the inductor and capacitor. Basic equations, emphasising understanding of rates of change (of voltage with capacitor, current with inductor). Current and voltage phase relationships with steady sinusoidal quantities, representation on phasor diagram

Circuits with sinusoidal sources:
Current and voltage in series and parallel RL, RC and RLC circuits. Frequency response and resonance
Mains voltage single-phase systems. Power, root-mean-square power quantities, power factor

Ideal transformer and rectification:
The ideal transformer, half-wave and full-wave rectification. Use of smoothing capacitor, ripple voltage

LO3 **Describe the basis of semiconductor action, and its application to simple electronic devices**

Semiconductor material:
Characteristics of semiconductors; impact of doping, p-type and n-type semiconductor materials, the p-n junction in forward and reverse bias

Simple semiconductor devices:
Characteristics and simple operation of junction diode, Zener diode, light emitting diode, bipolar transistor, Junction Field Effect Transistor (FET) and Metal Oxide Semiconductor FET (MOSFET). The bipolar transistor as switch and amplifier

LO4 **Explain the difference between digital and analogue electronics, describing simple applications of each**

Analogue concepts:

Analogue quantities, examples of electrical representation of, for example, audio, temperature, speed, or acceleration

The voltage amplifier; gain, frequency response, input and output resistance, effect of source and load resistance (with source and amplifier output modelled as Thevenin equivalent)

Digital concepts:

Logic circuits implemented with switches or relays

Use of voltages to represent logic 0 and 1, binary counting

Logic Gates (AND, OR, NAND, NOR) to create simple combinational logic functions

Truth Tables

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Apply an understanding of fundamental electrical quantities to analyse simple circuits with constant voltages and currents</td><td rowspan="2">D1 Apply the principles of circuit theory to complex circuits, with constant sources, explaining and evaluating the operation of that circuit</td></tr>
<tr><td>P1 Apply the principles of circuit theory to simple circuits with constant sources, to explain the operation of that circuit</td><td>M1 Apply the principles of circuit theory to a range of circuits with constant sources, to explain the operation of that circuit</td></tr>
<tr><td colspan="2">LO2 Analyse simple circuits with sinusoidal voltages and currents</td><td rowspan="2">D2 Critically analyse the principles of circuit theory as applied to complex circuits, with sinusoidal sources, explaining and evaluating the operation of that circuit</td></tr>
<tr><td>P2 Analyse the principles of circuit theory as applied to simple circuits with sinusoidal sources, to explain the operation of that circuit</td><td>M2 Analyse the principles of circuit theory to a range of more complex circuits with sinusoidal sources, to explain the operation of that circuit</td></tr>
<tr><td colspan="2">LO3 Describe the basis of semiconductor action, and its application to simple electronic devices</td><td rowspan="2">D3 Critically evaluate the performance of a range of discrete semiconductor devices in terms of simple semiconductor theory, and suggesting appropriate applications for each</td></tr>
<tr><td>P3 Describe the behaviour of a p-n junction in terms of semiconductor behaviour
P4 Demonstrate the action of a range of semiconductor devices</td><td>M3 Describe and evaluate a range of discrete semiconductor devices in terms of simple semiconductor theory</td></tr>
<tr><td colspan="2">LO4 Explain the difference between digital and analogue electronics, describing simple applications of each</td><td rowspan="2">D4 Critically evaluate the applications of analogue and digital electronics, in terms of their relative advantages, explaining with examples where each might be applied</td></tr>
<tr><td>P5 Explain the difference between digital and analogue electronics
P6 Explain amplifier characteristics
P7 Explain the operation of a simple circuit made of logic gates</td><td>M4 Describe the relative applications and benefits of analogue and digital electronics, explaining with example where each might be applied</td></tr>
</table>

Recommended Resources

Textbooks

BIRD, J. (2013) *Electrical Circuit Theory and Technology*. Routledge.

HUGHES, E., HILEY, J., BROWN, K. and MCKENZIE-SMITH, I. (2012) *Electrical and Electronic Technology*. Pearson.

SINGH, K. (2011) *Engineering Mathematics through Applications*. Palgrave.

BTEC Higher Nationals Study Guide (2011) Custom Publishing. Pearson.

Links

This unit links to the following related units:

Unit 20: Digital Principles
Unit 22: Electronic Circuits and Devices
Unit 52: Further Electrical, Electronic and Digital Principles

Unit 77: Industrial Robots

Unit code: **L/617/3940**

Level: 4

Credit value: 15

Introduction

Industrial robotics is the present and future of automated manufacturing and is an unstoppable reality. With the emergence of lighter, smarter and safer industrial robot models that are increasingly easy to interface, the demand has never been so high and is expected to grow year on year. Popular applications for industrial robots include welding, painting, assembly and materials handling. Modern industrial robots are now an integral part of cyber-physical mechatronic systems contributing to Industry 4.0 manufacturing.

The aim of this unit is for students to investigate the range, operation and benefits of industrial robots within manufacturing applications. Among the topics included are industrial robot selection, and programming and safety protocols that anticipate future developments in industrial robot technology.

On successful completion of this unit students will have an understanding of the electrical, mechanical, hydraulic and pneumatic operation of common industrial robots, how to select and program an industrial robot for a given requirement, taking account of safety considerations, and how to assess the economic future of robot technologies in manufacturing.

Learning Outcomes

By the end of this unit students will be able to:

1. Describe the operational characteristics, selection criteria and applications of industrial robots within manufacturing industries

2. Explain the safety standards associated with industrial robots

3. Program an industrial robot for automated process application

4. Investigate the global economic scope of industrial robots and integration into smart factories.

Essential content

LO1 **Describe the operational characteristics, selection criteria and applications of industrial robots within manufacturing industries**

Types and selection:

Operational characteristics: Cartesian, cylindrical, spherical, toroidal, SCARA

Selection: number of axes; load, orientation, speed, travel, precision, environment and duty cycle parameters (LOSTPED); anthropomorphic robots

Common Brands: e.g. Fanuc, Yaskawa and ABB.

Applications:

Welding, painting, material handling, packaging, assembly, inspection, dangerous and robust working environments, repetitive tasks.

Operation and characteristics of 6-axis industrial robots:

Controller: motion controller, motor drives, power supplies, human−machine interface (HMI)

Manipulator: sensing, brakes, axis motor, effector motor, environment sensing

Tooling: grippers, types, interfaces
Axis operation: purpose of each axis, work area, reach, wrist roll, pitch and yaw motion, rotation, home position and calibration

End effectors: types of gripper tools and hands, two-jaw, vacuum and magnetic.

LO2 **Explain the safety standards associated with industrial robots**

Safety standards:

Functional Safety: IEC61508, Hazard and Risk Assessment

Robot and robot system safety: ANSI/RIA R15.06-2012, BS EN ISO 10218:2011

Cell safety features: operating envelope, space restrictions; operating safeguards, emergency stops, guarding, barriers, interlocks, light curtains, laser, two-hand controls, scanners, floor mats; barrier sizing – around, under, through, over (AUTO)

Operational modes, user interfaces.

LO3 **Program an industrial robot for automated process application**

Software:

E.g. data objects, instruction lists, BASIC, MATALB, Python, Yaskawa, MotoSim Enhanced Graphic Virtual Robot Control, ABB, RobotStudio, Fanuc Roboguide, Denso Wincaps III.

Robot application programming:

Types: joint-level, robot-level and high-level programming

Command and control: graphical user interfaces, point-n-click, scheduling software

Tasking software: drag-n-drop, specific application deployment, scripted language, lead by the nose

Online: joysticks, pendants, jogging, modifying existing positions

Computer simulation offline programming.

Controlling robots with programmable logic controllers (PLCs; see Unit 18)

Robot commands: motion, interlock and sensor

Manufacturers' languages: ABB Rapid, Kuka KRL, Yaskawa Inform.

LO4 **Investigate the global economic scope of industrial robots and integration into smart factories**

Economic scope:

Major markets: Japan, USA, China, South Korea, Germany

Application demand: automotive, electrical and electronics, metal

Robot density; impact on workforce; training of workforce.

Advances in robot technology:

Machine vision, artificial intelligence (AI), collaborative robots (cobots), edge computing, simplified integration, networked robots, cloud robotics, virtual reality robots; training of robots; role of robotics in Industry 4.0.

Learning Outcomes and Assessment Criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">LO1 Describe the operational characteristics, selection criteria and applications of industrial robots within manufacturing industries</td><td rowspan="5">LO1 and LO2

D1 Evaluate the selection of a safetycompliant industrial robot system for a given manufacturing application</td></tr>
<tr><td>P1 Review the types of industrial robots and their applications within manufacturing industries
P2 Describe selection criteria for industrial robot applications</td><td>M1 Analyse the features and operation of six axis robots within manufacturing applications</td></tr>
<tr><td colspan="2">LO2 Explain the safety standards associated with industrial robots</td></tr>
<tr><td>P3 Outline the principles and methods of functional safety analysis within automated manufacturing
P4 Explain the safety criteria for robot cells within manufacturing applications</td><td>M2 Develop hazard and risk assessment for an industrial robot manufacturing system</td></tr>
<tr><td colspan="2">LO3 Program an industrial robot for automated process application</td><td rowspan="2">D2 Design, develop and test a robot program for a series of automated industrial tasks</td></tr>
<tr><td>P5 Investigate the range of programming languages and methods available for industrial robots
P6 Program an industrial robot to perform a simple task</td><td>M3 Analyse offline and online programming methods for industrial robots</td></tr>
<tr><td colspan="2">LO4 Investigate the global economic scope of industrial robots and integration into smart factories.</td><td rowspan="2">D3 Evaluate the global economics of increased robot density in smart factories and the impact on the human workforce</td></tr>
<tr><td>P7 Assess the advantages and scope of collaborative robots over traditional methods
P8 Investigate advances in industrial robot technology</td><td>M4 Analyse the benefits of artificial intelligence within industrial robotics and contribution to Industry 4.0</td></tr>
</table>

Recommended Resources

Textbooks

ENGELBERGER J.F. (2012) *Robotics in Practice: Management and Applications of Industrial Robots*. Berlin: Springer.

NAGAT F. and WATANABE, K. (2013) *Controller Design for Industrial Robots and Machine Tools: Applications to Manufacturing Processes*. Cambridge: Woodhead Publishing in Mechanical Engineering.

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Links

This unit links to the following related units:

Unit 15: Automation, Robotics and Programmable Logic Controllers (PLCs)
Unit 16: Instrumentation and Control Systems
Unit 42: Further Programmable Logic Controllers (PLCs)
Unit 54: Further Control Systems Engineering
Unit 75: Industry 4.0
Unit 78: Programmable Logic Controllers (PLCs)