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CAMBRIDGE NATIONALS IN ENGINEERING

R104 OPTIMISING PERFORMANCE IN ENGINEERING SYSTEMS AND PRODUCTS

DELIVERY GUIDE

VERSION 1

OCR
Oxford Cambridge and RSA

CONTENTS

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INTRODUCTION

This Delivery Guide has been developed to provide practitioners with a variety of creative and practical ideas to support the delivery of this qualification. The Guide is a collection of lesson ideas with associated activities, which you may find helpful as you plan your lessons.

OCR has collaborated with current practitioners to ensure that the ideas put forward in this Delivery Guide are practical, realistic and dynamic. The Guide is structured by learning objective so you can see how each activity helps you cover the specification.

We appreciate that practitioners are knowledgeable in relation to what works for them and their learners. Therefore, the resources we have produced should not restrict or impact on practitioners' creativity to deliver excellent learning opportunities.

Whether you are an experienced practitioner or new to the sector, we hope you find something in this guide which will help you to deliver excellent learning opportunities.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resourcesfeedback@ocr.org.uk.

PLEASE NOTE

The activities suggested in this Delivery Guide MUST NOT be used for assessment purposes. (This includes the Consolidation suggested activities).

The timings for the suggested activities in this Delivery Guide DO NOT relate to the Guided Learning Hours (GLHs) for each unit.

Assessment guidance can be found within the Unit document available from www.ocr.org.uk.

The latest version of this Delivery Guide can be downloaded from the OCR website

OPPORTUNITIES FOR ENGLISH AND MATHS SKILLS DEVELOPMENT

We believe that being able to make good progress in English and maths is essential to learners in both of these contexts and on a range of learning programmes. To help you enable your learners to progress in these subjects, we have signposted opportunities for English and maths skills practice within this resource. These suggestions are for guidance only. They are not designed to replace your own subject knowledge and expertise in deciding what is most appropriate for your learners.

KEY

English

Maths

UNIT R104 - OPTIMISING PERFORMANCE IN ENGINEERING SYSTEMS AND PRODUCTS

Guided learning hours : 30

PURPOSE OF THE UNIT

This unit develops knowledge and understanding of engineering system operational principles used in the modern world. It takes learners through the modern approaches to maintaining optimum performance and explores how influences on performance impact on product design.

Methods used in engineering sectors such as automotive, aeronautical, production and rail have different approaches to how optimum performance is achieved. This unit considers processes and methods such as predictive and reactive and considers how this impacts on cost to users and businesses.

Learners will have the opportunity to perform basic pre use and maintenance tasks on a range of engineering equipment and systems to appreciate the importance of optimum performance and consequences of poor performance.

Learning Outcome — The learner will:
LO1: Understand why engineering systems and products are designed and maintained for optimum performance
LO2: Know methods used in engineering sectors to maintain optimum performance
LO3: Understand factors that contribute to system/product failure
LO4: Be able to perform simple procedures to optimise product/system performance

LO1 - UNDERSTAND WHY ENGINEERING SYSTEMS AND PRODUCTS ARE DESIGNED AND MAINTAINED FOR OPTIMUM PERFORMANCE

Learning Outcome — The learner will:
LO1: Understand why engineering systems and products are designed and maintained for optimum performance

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Why systems and products are designed for maintenance 	Teachers could introduce learners to concepts of design for maintenance by asking learners to consider examples of engineered products such as vehicles, to set the context for design for maintenance (and repair). Learners could be set an exercise to identify common features of an engineered product where maintenance and repair have been considered in the design. This includes examples of access, removable parts and panels, fixings designed to provide access, and special tools required for maintenance.	1 hour	
	Learners could be asked to identify engineered products (such as a calculator) that are designed not to be repaired or maintained, and features or technology that prevent maintenance or repair.	1 hour	
	Teachers could start a classroom discussion asking learners to consider what happens to parts and consumables once replaced as part of a service or repair, and to identify the environmental and sustainability issues. This could include everyday items such as ink cartridges, waste engine oils, no longer functional cutting tools, rollers and tyres. Learners could watch the video by accessing the following web link: http://youtu.be/NplprEGyFKw and http://youtu.be/ux7bVKXetSI Learners could also be asked to consider the impact of manufacturing and disposal of packaging used for parts and consumables. Learners could be given an exercise to carry out and to report on equipment designed for maintenance. See Lesson Element: Design for Maintenance and Repair.	1 hour	

LO1 - UNDERSTAND WHY ENGINEERING SYSTEMS AND PRODUCTS ARE DESIGNED AND MAINTAINED FOR OPTIMUM PERFORMANCE

Learning Outcome — The learner will:
LO1: Understand why engineering systems and products are designed and maintained for optimum performance

Suggested content	Suggested activities	Suggested timings	Possible relevance to
2 Reasons for maintenance and repair of systems and products 	Teachers could start a discussion with learners about the reasons for maintenance and repair, asking learners to work in pairs (or small groups) to list the reasons why engineered products need to maintained, with learners providing feedback to the wider class. Learners could select an engineered product of thier choice to consider as an example.	1 hour 1 hour	
	Learners should consider; safety, maintaining performance and the implications of not carrying out maintenance and repairs. As part of this exercise, learners could be asked to identify the features or operation of the product that need to be maintained for quality and performance, and reducing downtime. One example could be the braking system of a moped. Learners could watch a video on this topic by accessing the following web link: http://www.youtube.com/watch?v=xDtUltIx9tY	1 hour	
3 Implications of not maintaining systems and products 	Teachers could ask learners to consider the implications for the product and the business of not maintaining the product of system. Working in pairs (or small groups) learners could list the effects (with examples) of not maintaining the product.	1 hour	
	The teacher could give the learners a scenario of a business choosing to delay having the air conditioning system serviced. Learners could be asked to consider and research the implications for the company legally, financially and how this may affect the operation of the system performance. Datasheets, manufacturer catalogues and supplier websites might be used for learners to research technical data about air conditioning systems. One such can be accessed at the following web link: http://www.airconco.com/air_conditioning_service_and_maintenance/	1 hour	

LO2 - KNOW METHODS USED IN ENGINEERING SECTORS TO MAINTAIN OPTIMUM PERFORMANCE

Learning Outcome — The learner will:
LO2: Know methods used in engineering sectors to maintain optimum performance

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Methods used to maintain optimum performance	Teachers could introduce the concepts of different methods to maintaining optimum performance by asking learners to consider the different ways a business could approach the need keep equipment in service with minimum disruption to the product or service. For example, a business that leases out commercial photocopiers. Learners could be asked to list the advantages and disadvantages of either scheduling a service every 3 months or waiting until the business using the copier reports a fault.	1 hour	
	Learners could research condition based monitoring to inform operation, servicing and repairs. Learners could access a video t o demonstrate this at the following web links: http://www.youtube.com/watch?v=GV6JasEuGn4 and http://www.youtube.com/watch?v=Iq401qW-BRE	1 hour	R115 (LO2, LO3)
	Teachers could explain with examples, methods used to maintain optimum performance of systems and products including predictive, preventative, corrective, improvement, and run to failure. Learners could be asked to consider examples of where a run to failure approach is sometimes used. Learners could carry out research on differing maintenance strategies with examples such as the following web link: http://www.reliasoft.com/newsletter/v6i2/maintenance_strategies.htm	1 hour 1 hour	
	Teachers could explain different types of preventive maintenance and ask learners to list examples of planned, scheduled and periodic maintenance and serving applications. Teachers might start a class discussion about regulatory maintenance and testing such as compressors, on certain vehicles or lifting equipment, cranes.	1 hour	
	Teachers could get learners to carry out an exercise to devise a maintenance schedule on a piece of equipment.	1 hour	

LO3 - UNDERSTAND FACTORS THAT CONTRIBUTE TO SYSTEM/PRODUCT FAILURE

Learning Outcome — The learner will:
LO3: Understand factors that contribute to system/product failure

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Types of system/component failure 	The teacher might begin with a class discussion of factors that contribute to failure of engineered products and systems.	1 hour	
	The teacher could get learners to disassemble an accessible engineered product that would lend it self to show types and signs of component failure, such as a drill or other power tool, engine block, cylinder head or electric motor. Learners could be asked to identify signs of fatigue, seizure, vibration, corrosion on moving parts and static parts. Learners could apply their knowledge of inspecting engineered products for wear and signs of failure by completing Lesson Element: Analysing Component Failure.	1 hour 1 hour	
	Learners could develop their understanding of different types of bearings and bearing surfaces by watching a video accessed at the web link: http://youtu.be/KGgIvDNDuYc	1 hour	
	Learners could research different signs of wear, seizure and corrosion in engineered applications such as in engines and compressors. One example can be accessed by following the web link: http://www.gregsengine.com/engine-bearing-failure-chart.html	1 hour	

LO3 - UNDERSTAND FACTORS THAT CONTRIBUTE TO SYSTEM/PRODUCT FAILURE

Learning Outcome — The learner will:
LO3: Understand factors that contribute to system/product failure

Suggested content	Suggested activities	Suggested timings	Possible relevance to
2 Reasons for system/component failure 	Teachers could introduce learners to the impact of poor adjustment of components such as belt tensions, tensioners, bearing adjustment and end float. Teachers could discuss the consequences of over tightening belts and bearings with examples of each.	1 hour	
	Learners could be given equipment and manufacturer's data to practice using torque wrenches to gain an understanding of the importance of applying manufacture's settings for tightening nuts and bolts/fixings to avoid damaged and failure, premature wear.	1 hour	
	Learners could research the use of dampers, bushes and other methods to reduce vibration.	1 hour	
	Learners could list examples of where fluid levels are required to be checked at regular intervals to avoid damage and failure.	1 hour	
	Teachers could explain how businesses calculate the need for repairs and failure of products and systems through Mean Time To Repair (MTTR), Mean Time Between Failure (MTBF) and Mean Time To Failure (MTTF). Learners could carry out calculations for MTTF to help understand the links between maintenance and causes of failure.	1 hour	

LO4 - BE ABLE TO PERFORM SIMPLE PROCEDURES TO OPTIMISE PRODUCT/SYSTEM PERFORMANCE

Learning Outcome — The learner will:
LO4: Be able to perform simple procedures to optimise product/system performance

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 How to use manufacturers/ /system information 	The teacher could get learners to perform a system check using manufacturer's instructions such as a security, ventilation or fire alarm system. Teachers could demonstrate diagnostic systems to test the system. Learners could learn more about diagnostic systems in a video about diagnostic equipment by accessing the web link: http://www.youtube.com/watch?v=Mhf78hhqxZw	1 hour	
2 How to use tools and equipment safely when performing maintenance tasks 	Through workshop practices, teachers could introduce learners to the range of tools used to carry out maintenance operations such as filter wrenches, torque wrenches, spanners ratchets and sockets, different types of screw heads and drivers and torx tools, specialist tools, measuring instruments.	2 hours	
3 Methods to perform simple replacement tasks 	Learners could carry out a disassembly of an engineered item such as an industrial sized motor using manufacturer's instructions. Learners inspect measure and replace worn parts, such as a worn timing belt, clean and or lubricate necessary parts before reassembly and then evaluate against manufacturer's specifications. Learners could record their findings on work sheets with recommendations for future service and repair requirements.	2 hours	R109 (LO2)
4 Methods to perform simple performance checks and adjustment tasks	The teacher could get learners to assess an item of workshop equipment for safety and installation. Learners could complete an inspection worksheet to include assessment and security of cables and plugs, belts and chain tensions, operation of safety features and fluid levels. Learners could report on their findings and make recommendations for use/repair.	2 hours	R112 (LO2)
	Learners could complete Lesson Element: Inspecting Workshop Equipment.	2 hours	R109 (LO2)

Contact us

Staff at the OCR Customer Contact Centre are available to take your call between 8am and 5.30pm, Monday to Friday.

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