Unit 4018: Maintenance Engineering

Unit Code: D/651/0736

Level: 4

Credits: 15

Introduction

Plant and equipment are one of the biggest assets for any business, costing huge sums of money to replace when things go wrong. Without regular maintenance business owners could see an increase in costly breakdowns, often incurring downtime and significant loss of earnings. Inspection and maintenance are therefore vital to detect and prevent any potential equipment issues or faults that would prevent operation at optimum efficiency. Good maintenance proves itself on a day-to-day basis.

This unit introduces students to the importance of equipment maintenance programmes, the benefits that well-maintained equipment brings to an organisation and the risk factors it faces if maintenance programmes and processes are not considered or implemented. Topics included in this unit are: statutory regulations, organisational safety requirements, maintenance strategies, safe working and maintenance techniques.

On successful completion of this unit students will be able to learn about the importance of compliance with statutory regulations associated with asset maintenance, maintenance techniques adopted by the industry, safe working practices whilst performing maintenance tasks in an industrial environment and inspection and maintenance techniques.

Learning Outcomes

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

LO1 Analyse the impact of relevant statutory regulations and organisational safety requirements on the industrial workplace

LO2 Differentiate between the merits and use of different types of maintenance strategies in an industrial workplace

LO3 Illustrate competence in working safely by correctly determining the hazards and risks associated with maintenance techniques

LO4 Apply effective inspection and maintenance techniques relative to a particular specialisation such as mechanical or electrical.

Essential Content

LO1 **Analyse the impact of relevant statutory regulations and organisational safety requirements on the industrial workplace**

Regional and global statutory regulations:

The responsibility of employers and employees with regard to statutory regulations in the workplace, including: HASWA 1974, MHSWR 1999, PUWER 1998, COSHH, LOLER 1998, Working at Height Regulations, Manual Handling Operations Regulations 1992, PPE at Work Regulations 1992, Confined Spaces Regulations 1997, Electricity at Work Regulations 1989, Control of Noise, at Work Regulations 2005, RIDDOR 1995, CDM Regulations 2015, ACoP HSE Guidance Notes and Safety Signs

Case studies: Occupational Safety and Health Administration (OSHA), risk categories, risk assessment and prevention procedures and tools; country/region specific health and safety executive regulations.

Organisational safety requirements:

The responsibility of the employee with regard to organisational safety requirements such as the role of the HSE and the power of inspectors, right of inspection, improvement notices and prohibition notice

Product safety and raw materials safety requirements, Safety Data Sheet (SDS) of materials, PPE in all stages of operations to ensure safety.

LO2 **Differentiate between the merits and use of different types of maintenance strategies in an industrial workplace**

Maintenance strategies:

Definition of, and need for maintenance

Component failure, bathtub curve

Equipment design life and periodic maintenance (e.g. belt adjustment, lubrication etc)

Reactive, preventive, predictive and reliability centred maintenance

Comparison of the presented maintenance programmes – for example, Total Productive Maintenance (TPM), Condition Based Maintenance (CBM), Run-to-Failure Maintenance (RTF), Mean Time Between Failure (MTBF); compare and adapt latest advances in maintenance programmes

Creation and application of Failure Mode and Effects Analysis

Maintenance schedules and illustration diagrams/tools.

LO3 **Illustrate competence in working safely by correctly determining the hazards and risks associated with maintenance techniques**

Working safely:

Life-saving rules for employee safety, such as safety devices and guards, lock out, tag out, electrical work, arc flash, fall protection and permit required confined space working

Understanding plant layouts as part of safety training including emergency exists, workflow chart, stage-wise PPE, and human ergonomics

Development and implementation of safe schemes of work (e.g., daily/weekly/monthly checks about the safety measures such as earth resistance, neutral to earth voltage, lighting illumination, lubrication for bearings, cleaning of Conveyors, input air pressure and its leakage systems, fire alarm etc.)

Lone working

Permit to work (PTW)

Working safely in confined spaces

Emergency procedures and training

Hazard identification and assessment of risk associated with identified hazard

Use of control measures (ERIC SP)

Production of a Risk Assessment & Method Statement for a maintenance procedure.

LO4 **Apply effective inspection and maintenance techniques relative to a particular specialisation such as mechanical or electrical**

Maintenance techniques:

Importance of isolation and making safe before undertaking maintenance

Adherence to PTW process and shift changeover procedures

In-service (live) preventative maintenance e.g. thermographic survey, partial discharge inspection

Standard Operating Procedure (SOP) − application, and documentation recording systems, and the potential implications on safety, quality, and delivery if they are not adhered to

Compliance with manufacturer's recommended inspection and maintenance procedures, using manufacturer's data as case studies

Look, listen and feel philosophy. Visual inspections

Measurements: electrical and mechanical. Mechanical operations test

Functional tests e.g. exercise switching mechanisms

Application of non-destructive examination (NDE) and non-destructive investigation (NDI) techniques for maintenance e.g. acoustic emission, eddy current, liquid penetrant, ultrasonics, thermography

Recording data and maintenance records.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Analyse the impact of relevant statutory regulations and organisational safety requirements on the industrial workplace		
P1 Describe the key features of health and safety regulations in the workplace. **P2** Analyse the role of the Health and Safety Executive in health and safety in the workplace.	**M1** Assess the consequences of employers not abiding by health and safety legislation and regulations, and risk assessment in the workplace.	**D1** Evaluate the likely consequences of non-adherence to relevant health and safety legislation, and risk prevention measures by employers and employees. **D2** Critically appraise the potential impact of a workplace inspection by a Health and Safety Executive inspector including the role of Safety Data Sheet (SDS).
LO2 Differentiate between the merits and use of different types of maintenance strategies in an industrial workplace		
P3 Differentiate methods used to complete engineering maintenance in an industrial workplace. **P4** Discuss the advantages and disadvantages of different strategies to complete maintenance in an industrial workplace.	**M2** Explain the importance of selecting relevant maintenance methods and carrying out engineering maintenance in an industrial workplace.	**D3** Illustrate the most appropriate maintenance system in an industrial workplace. **D4** Assess the likely consequences of not completing a maintenance regime in an industrial workplace.

Pass	Merit	Distinction
LO3 Illustrate competence in working safely by correctly determining the hazards and risks associated with maintenance techniques		
P5 Illustrate various methods used to identify risks and their associated hazards. **P6** Carry out a risk assessment on a typical maintenance technique.	**M3** Discuss the importance of completing risk assessments. **M4** Explain how control measures are used to prevent accidents. **M5** Complete a method statement for a typical maintenance technique.	**D5** Analyse, using actual workplace procedures, the methods used such as SOP to deal with identified hazards in accordance with statutory legal requirements and workplace policies and recommend improvements.
LO4 Apply effective inspection and maintenance techniques relative to a particular specialisation such as mechanical or electrical		
P7 Apply effective inspection and maintenance techniques in an industrial or simulated environment, recording the appropriate sequence of procedures.	**M6** Analyse the effectiveness of these inspection and maintenance techniques in plant asset management.	**D6** Justify appropriate inspection and maintenance techniques across industrial plant assets.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

Affleck E. (2022) *Maintenance Engineering.* New York: Larsen and Keller Education.

Baptista J. (2020) *Industrial Maintenance: Techniques, Stories, and Cases.* Boca Raton, Florida: CRC Press.

Dhillon B.S. (2023) *System Safety, Maintainability, and Maintenance for Engineers.* Boca Raton, Florida: CRC Press.

Hellier C.J. (2020) *Handbook of nondestructive evaluation*. 3rd Ed. New York: McGraw-Hill Education.

Mobley R.K. (2014) *Maintenance Engineering Handbook*. 8th Ed. New York: McGraw-Hill Education.

Peng K. (2021) *Equipment Management in the Post-Maintenance Era: Advancing in the Era of Smart Machines.* 2nd Ed. Boca Raton, Florida: Productivity Press.

Richardson D.C. (2013) *Plant Equipment & Maintenance Engineering Handbook*. New York: McGraw-Hill Education.

The Institution of Engineering and Technology (IET) (2022) *Guide to Electrical Maintenance (IET Codes and Guidance*. London: IET.

Journals

Note: Example journals listed below provide a broad range of articles related to unit content and those relevant for the qualification. Staff and students are encouraged to explore these journals and any other suitable journals to support the development of academic study skills, and subject specific knowledge and skills as part of unit level delivery.

Journal of Nondestructive Evaluation

Journal of Quality in Maintenance Engineering

Non-Destructive Testing

Nondestructive Testing and Evaluation

Links

This unit links to the following related units:

Unit 4004: Managing a Professional Engineering Project

Unit 4025: Operations and Plant Management.