ICTQual AB

Qualification Specification

Level 3 Diploma in Mechanical Engineering
60 Credits – 6 Months

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Qualification Specifications about

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About ICTQual AB

ICTQual AB UK Ltd. is a distinguished awarding body based in the United Kingdom, dedicated to fostering excellence in education, training, and skills development. Committed to global standards, ICTQual AB provides internationally recognized qualifications that empower individuals and organizations to thrive in an increasingly competitive world. Their offerings span diverse industries, including technical fields, health and safety, management, and more, ensuring relevance and adaptability to modern workforce needs.

The organization prides itself on delivering high-quality educational solutions through a network of Approved Training Centres worldwide. Their robust curriculum and innovative teaching methodologies are designed to equip learners with practical knowledge and skills for personal and professional growth. With a mission to inspire lifelong learning and drive positive change, ICTQual AB continuously evolves its programs to stay ahead of industry trends and technological advancements.

ICTQual AB's vision is to set benchmarks for educational excellence while promoting inclusivity and integrity. Their unwavering focus on quality and accessibility makes them a trusted partner in shaping future-ready professionals and advancing societal progress globally.

Course Overview

The ICTQual Level 3 Diploma in Mechanical Engineering is a highly regarded qualification designed for those pursuing a career in mechanical engineering or related fields. It provides a structured learning path, allowing individuals to gain an in-depth understanding of engineering concepts, design processes, and manufacturing techniques. Learners will be equipped with the essential skills required to thrive in dynamic and demanding work environments, making it an ideal choice for individuals looking to advance their technical expertise in mechanical engineering.

Throughout the course, students will develop their practical and theoretical knowledge in key areas such as fluid mechanics, thermodynamics, and mechanical systems. This qualification prepares learners for various roles in engineering, such as mechanical technician, design engineer, or manufacturing engineer. With flexible delivery options, the ICTQual Level 2 Diploma is suitable for both those who are already employed and individuals looking to enter the engineering sector.

Certification Framework

Qualification title	**Level 3 Diploma in Mechanical Engineering 60 Credits – 6 Months**
Course ID	ME0004
Qualification Credits	60 Credits
Course Duration	Six Months
Grading Type	Pass / Fail
Competency Evaluation	Coursework / Assignments / Verifiable Experience
Assessment	The assessment and verification process for ICTQual qualifications involves two key stages: **Internal Assessment and Verification:** ✓ Conducted by the staff at the Approved Training Centre (ATC). Ensures learners meet the required standards through continuous assessments. ✓ Internal quality assurance (IQA) is carried out by the centre's IQA staff to validate the assessment processes. **External Quality Assurance:** ✓ Managed by ICTQual AB verifiers, who periodically review the centre's assessment and IQA processes. ✓ Verifies that assessments are conducted to the required standards and ensures consistency across centres

Entry Requirements

To enroll in the ICTQual Level 3 Diploma in Mechanical Engineering 60 Credits – 6 Months, candidates must meet the following entry requirements:

- ✓ A minimum of a Level 2 qualification (e.g., GCSEs, NVQ Level 2, or equivalent). A strong foundation in mathematics and science is highly recommended, as these subjects are essential for understanding mechanical engineering concepts.
- ✓ Applicants must typically be 16 years or older.
- ✓ Proficiency in English is essential, as the course involves technical terminology, report writing, and communication.
- ✓ Basic computer literacy is advantageous, as some modules may involve software tools like CAD (Computer-Aided Design) and other engineering-specific programs.
- ✓ While not mandatory, any prior experience in mechanical engineering, manufacturing, or a related field can be beneficial for understanding key principles and practices.

Qualification Structure

This qualification comprises 6 mandatory units, totaling 60 credits. Candidates must successfully complete all mandatory units to achieve the qualification.

Mandatory Units		
Unit Ref#	**Unit Title**	**Credits**
ME0004-1	Engineering Principles	10
ME0004-2	Mechanical Systems and Technology	10
ME0004-3	Materials Science for Engineering	10
ME0004-4	Engineering Drawing and CAD	10
ME0004-5	Mechanical Maintenance and Fault Diagnosis	10
ME0004-6	Health, Safety, and Environmental Practices	10

Centre Requirements

Even if a centre is already registered with ICTQual AB, it must meet specific requirements to deliver the ICTQual Level 3 Diploma in Mechanical Engineering 60 Credits – 6 Months. These standards ensure the quality and consistency of training, assessment, and learner support.

1. Approval to Deliver the Qualification

- ✓ Centres must obtain formal approval from ICTQual AB to deliver this specific qualification, even if they are already registered.
- ✓ The approval process includes a review of resources, staff qualifications, and policies relevant to the program.

2. Qualified Staff

- ✓ **Tutors:** Must have relevant qualifications in mechanical engineering or construction at Level 4 or higher, alongside teaching/training experience.
- ✓ **Assessors:** Must hold a recognized assessor qualification and demonstrate expertise in Mechanical Engineering
- ✓ **Internal Quality Assurers (IQAs):** Must be appropriately qualified and experienced to monitor the quality of assessments.

3. Learning Facilities

Centres must have access to appropriate learning facilities, which include:

- ✓ **Classrooms:** Modern, well-equipped spaces with advanced multimedia tools to deliver engaging theoretical instruction in mechanical engineering concepts and design principles.
- ✓ **Practical Areas**: Hands-on training areas featuring cutting-edge tools, machinery, and equipment such as lathes, milling machines, welding stations, and 3D printers for real-world practice and assessments.
- ✓ **Technology Access:** High-performance computers with industry-standard software (e.g., CAD, CAM, FEA) and reliable internet connectivity to support technical design, analysis, and project work.

4. Health and Safety Compliance

- ✓ Centres must ensure that practical training environments comply with relevant health and safety regulations.

- ✓ Risk assessments must be conducted regularly to maintain a safe learning environment.

5. Resource Requirements

- ✓ Learning Materials: Approved course manuals, textbooks, and study guides aligned with the curriculum.
- ✓ Assessment Tools: Templates, guidelines, and resources for conducting and recording assessments.
- ✓ E-Learning Systems: If offering online or hybrid learning, centres must provide a robust Learning Management System (LMS) to facilitate remote delivery.

6. Assessment and Quality Assurance

- ✓ Centres must adhere to ICTQual's assessment standards, ensuring that all assessments are fair, valid, and reliable.
- ✓ Internal quality assurance (IQA) processes must be in place to monitor assessments and provide feedback to assessors.
- ✓ External verification visits from ICTQual will ensure compliance with awarding body standards.

7. Learner Support

- ✓ Centres must provide learners with access to guidance and support throughout the program, including:
- ✓ Academic support for coursework.
- ✓ Career guidance for future progression.
- ✓ Additional support for learners with specific needs (e.g., disabilities or language barriers).

8. Policies and Procedures

Centres must maintain and implement the following policies, as required by ICTQual:

- ✓ Equal Opportunities Policy.
- ✓ Health and Safety Policy.
- ✓ Safeguarding Policies and Procedures.
- ✓ Complaints and Appeals Procedure.
- ✓ Data Protection and Confidentiality Policy.

9. Regular Reporting to ICTQual

- ✓ Centres must provide regular updates to ICTQual AB on learner enrollment, progress, and completion rates.
- ✓ Centres are required to maintain records of assessments and learner achievements for external auditing purposes.

Support for Candidates

Centres should ensure that materials developed to support candidates:

- ✓ Facilitate tracking of achievements as candidates progress through the learning outcomes and assessment criteria.
- ✓ Include information on how and where ICTQual's policies and procedures can be accessed.

- ✓ Provide mechanisms for Internal and External Quality Assurance staff to verify and authenticate evidence effectively.

This approach ensures transparency, supports candidates' learning journeys, and upholds quality assurance standards.

Assessment

This qualification is competence-based, requiring candidates to demonstrate proficiency as defined in the qualification units. The assessment evaluates the candidate's skills, knowledge, and understanding against the set standards. Key details include:

1. **Assessment Process:**
    - ✓ Must be conducted by an experienced and qualified assessor.
    - ✓ Candidates compile a portfolio of evidence that satisfies all learning outcomes and assessment criteria for each unit.
2. **Types of Evidence:**
    - ✓ Observation reports by the assessor.
    - ✓ Assignments, projects, or reports.
    - ✓ Professional discussions.
    - ✓ Witness testimonies.
    - ✓ Candidate-produced work.
    - ✓ Worksheets.
    - ✓ Records of oral and written questioning.
    - ✓ Recognition of Prior Learning (RPL).
3. **Learning Outcomes and Assessment Criteria:**
    - ✓ **Learning Outcomes:** Define what candidates should know, understand, or accomplish upon completing the unit.
    - ✓ **Assessment Criteria:** Detail the standards candidates must meet to demonstrate that the learning outcomes have been achieved.

This framework ensures rigorous and consistent evaluation of candidates' competence in line with the qualification's objectives.

Unit Descriptors

ME0004 - 1. Engineering Principles

The aim of this unit is to provide learners with a comprehensive understanding of fundamental mechanical engineering principles, including force, motion, energy, and thermodynamics. It is designed to equip learners with the skills to analyze and solve engineering problems using the concepts of statics and dynamics, material properties, and core equations of mechanics and thermodynamics, enabling them to effectively apply these principles in practical engineering applications. This unit prepares learners for advanced studies and professional practice in mechanical engineering, adhering to international standards of competence and excellence.

Learning Outcome:	Assessment Criteria:
1. Understand and apply fundamental mechanical engineering principles such as force, motion, energy, and thermodynamics.	1.1. Understand the basic concepts of force, including its types (e.g., contact and non-contact forces), units of measurement, and how forces are applied to objects in mechanical systems. 1.2. Apply Newton's Laws of Motion to analyze the relationship between forces and the motion of objects, including concepts like acceleration, velocity, and inertia. 1.3. Recognize the principles of energy, including kinetic energy, potential energy, and mechanical work, and apply the work-energy theorem to solve problems in mechanical systems. 1.4. Understand the laws of thermodynamics, including the first law (energy conservation), second law (entropy), and their relevance to energy transfer and conversion in mechanical systems. 1.5. Apply the principles of heat transfer (conduction, convection, radiation) and thermodynamic cycles (e.g., Rankine and Brayton cycles) to analyze the performance of engines and heat exchangers. 1.6. Calculate the efficiency of mechanical systems by considering energy input, output, and losses, ensuring the optimization of system performance. 1.7. Apply principles of mechanical power, torque, and rotational motion in designing and analyzing machinery, such as engines, turbines, and gear systems. 1.8. Use concepts of static and dynamic

	equilibrium to analyze mechanical systems in both rest and motion, ensuring the stability and functionality of structures and machines. 1.9. Solve engineering problems involving forces, motion, energy, and thermodynamics by applying mathematical models, equations, and analytical techniques.
2. Analyze mechanical systems using concepts of statics and dynamics.	2.1. Apply the principles of statics to analyze forces acting on stationary objects, ensuring the system is in equilibrium by balancing forces and moments. 2.2. Use free-body diagrams to visually represent and calculate forces and moments acting on various components of a mechanical system. 2.3. Apply the conditions of equilibrium ($\sum F = 0$ and $\sum M = 0$) to solve problems related to structures, beams, and supports in static systems. 2.4. Analyze forces in systems involving multiple components, considering both internal and external loads, and calculate reactions at supports or joints. 2.5. Understand and apply the principles of dynamics to analyze objects in motion, including the use of Newton's second law ($F = ma$) to solve problems involving acceleration, velocity, and force. 2.6. Analyze the motion of objects using kinematic equations and dynamics principles, calculating displacement, velocity, and acceleration in linear and rotational systems. 2.7. Use energy and work principles, such as the work-energy theorem and conservation of energy, to analyze dynamic systems, including machines and mechanical devices. 2.8. Apply the concept of impulse and momentum to analyze the effect of forces acting over time, especially in collision and impact problems. 2.9. Solve real-world problems by integrating statics and dynamics concepts to model and predict the behavior of mechanical systems under various load and motion conditions.

3. Identify and apply material properties in engineering applications.	3.1. Identify key material properties such as strength, elasticity, hardness, toughness, ductility, and fatigue resistance, and understand how these properties influence material performance in engineering applications. 3.2. Apply knowledge of mechanical properties, including yield strength, ultimate tensile strength, and elongation, to select appropriate materials for specific structural and mechanical applications. 3.3. Understand and apply thermal properties, such as thermal conductivity, specific heat, and thermal expansion, to materials used in high-temperature or thermal management systems. 3.4. Recognize the impact of environmental factors, including corrosion resistance, wear resistance, and chemical stability, in selecting materials for harsh or corrosive environments. 3.5. Apply knowledge of material properties to ensure the design of components that meet safety, performance, and durability requirements in various engineering sectors. 3.6. Use hardness testing methods (e.g., Rockwell, Brinell, Vickers) to evaluate materials for wear resistance and suitability for cutting tools, gears, and bearing applications. 3.7. Apply principles of material selection to achieve cost efficiency, manufacturability, and sustainability, considering factors such as material availability, processing methods, and lifecycle impacts. 3.8. Evaluate the impact of material properties on the overall design, ensuring materials are chosen to meet operational, regulatory, and performance standards. 3.9. Use material property data in conjunction with engineering software tools and databases to make informed decisions in the selection of materials for diverse engineering applications.
4. Solve engineering problems using basic	4.1. Apply Newton's laws of motion to solve

equations of mechanics and thermodynamics.	problems involving force, mass, and acceleration in mechanical systems, ensuring correct identification of forces and their directions. 4.2. Use basic equations of kinematics to solve for displacement, velocity, and acceleration in linear and rotational motion problems. 4.3. Apply the work-energy theorem to calculate work, energy, and power in systems, ensuring the correct application of energy conservation principles. 4.4. Solve problems involving mechanical advantage, using equations for levers, pulleys, gears, and other simple machines to determine force and displacement relationships. 4.5. Apply the first law of thermodynamics (conservation of energy) to solve problems related to heat energy, work done, and internal energy in thermodynamic systems. 4.6. Use equations for specific heat, heat transfer, and temperature changes to calculate heat energy requirements in various processes, such as heating, cooling, and insulation. 4.7. Solve problems involving thermodynamic cycles (e.g., Rankine, Brayton), calculating efficiency, work output, and heat transfer in engines and refrigeration systems. 4.8. Apply the second law of thermodynamics to assess the performance limits of machines, such as determining the maximum efficiency of heat engines or refrigerators. 4.9. Solve statics problems involving equilibrium of forces and moments, ensuring correct application of equilibrium equations ($\Sigma F = 0$ and $\Sigma M = 0$) for structures and mechanical components. 4.10. Use material property data in conjunction with basic mechanics and thermodynamics equations to analyze stress, strain, and temperature effects in engineering components.

ME0004 - 2. Mechanical Systems and Technology

The aim of this study unit is to equip learners with comprehensive knowledge and practical skills in mechanical systems and technology. It covers key concepts including mechanical transmission systems, gears, cams, and the principles of automation, robotics, and control systems within mechanical engineering. Learners will develop the ability to evaluate, design, troubleshoot, and repair mechanical systems, ensuring optimal performance, functionality, and efficiency in alignment with international industry standards.

Learning Outcome:	Assessment Criteria:
1. Demonstrate knowledge of various mechanical systems, including mechanical transmission systems, gears, and cams.	1.1. Identify and describe the main components of mechanical systems, such as gears, shafts, bearings, and cams, and their roles in transmitting motion and force. 1.2. Understand the principles behind mechanical transmission systems, including the types of drive systems (e.g., belt, chain, gear, and shaft drive) and their applications in machinery and vehicles. 1.3. Explain the working principles of gears, including gear ratios, types (spur, bevel, helical, worm), and their impact on torque and speed transmission. 1.4. Analyze the function of cams in converting rotary motion into linear motion, understanding the different cam profiles (e.g., radial, axial) and their applications in engines, machinery, and automation. 1.5. Understand the relationship between gear sizes, gear ratios, and mechanical advantage, and calculate the required gear ratios for specific speed and torque conditions. 1.6. Explain the concept of mechanical advantage in transmission systems, demonstrating how different configurations of gears and cams optimize performance in various mechanical systems. 1.7. Apply knowledge of gear and cam systems to solve problems involving motion conversion, force transmission, and mechanical efficiency. 1.8. Identify common faults or inefficiencies in mechanical transmission systems, such as wear, backlash, and misalignment, and suggest appropriate solutions or maintenance procedures. 1.9. Demonstrate the importance of proper

	material selection, lubrication, and design in ensuring the efficient and reliable operation of gears, cams, and mechanical transmission systems.
2. Evaluate and design mechanical systems based on performance requirements.	2.1. Analyze the performance requirements of a mechanical system, including factors such as load capacity, speed, accuracy, durability, and energy efficiency. 2.2. Apply engineering principles to select the appropriate components (e.g., gears, shafts, bearings, actuators) that meet the specified performance criteria. 2.3. Use computational tools and simulation software to model mechanical systems, predict performance, and optimize design parameters. 2.4. Consider material properties and manufacturing processes when designing mechanical systems to ensure they meet performance, cost, and manufacturability standards. 2.5. Design systems with a focus on reliability and maintenance, evaluating the impact of wear, fatigue, and environmental factors on system longevity. 2.6. Apply principles of system dynamics to evaluate how components interact and affect overall system performance under varying loads and operating conditions. 2.7. Use performance analysis techniques, such as stress analysis, heat transfer calculations, and vibration analysis, to assess the design's ability to meet performance requirements. 2.8. Evaluate the trade-offs between design parameters, such as size, weight, and efficiency, to balance performance with cost and environmental impact. 2.9. Incorporate safety standards and regulatory requirements into the design process, ensuring that the system is safe for operation under intended conditions.
3. Understand the principles of automation, robotics, and control systems in mechanical	3.1. Understand the basic principles of automation, including the use of control

engineering.	systems to regulate and optimize mechanical processes in manufacturing, assembly, and other industrial applications. 3.2. Recognize the role of robotics in automating tasks, from simple repetitive motions to complex interactions, and the impact on efficiency, precision, and safety in various industries. 3.3. Identify the different types of robots (e.g., industrial robots, collaborative robots) and their applications in mechanical systems, such as material handling, welding, and assembly. 3.4. Understand the fundamentals of control systems, including open-loop and closed-loop control, feedback mechanisms, and the role of sensors and actuators in system regulation. 3.5. Learn the components of automated systems, such as Programmable Logic Controllers (PLCs), sensors, motors, and drives, and how they work together to achieve desired outcomes. 3.6. Apply knowledge of control theory to design and analyze control systems, including proportional-integral-derivative (PID) controllers and their role in achieving accurate and stable system performance. 3.7. Understand the integration of automation and robotics with advanced manufacturing technologies, such as additive manufacturing (3D printing), CNC machines, and smart factories. 3.8. Recognize the significance of human-machine interfaces (HMIs) in automation systems, ensuring that operators can monitor, control, and troubleshoot automated processes effectively. 3.9. Apply concepts of system diagnostics, fault detection, and troubleshooting to ensure the reliable operation and maintenance of automated and robotic systems in mechanical engineering applications.
4. Troubleshoot and repair mechanical systems, ensuring proper functionality and efficiency.	4.1. Identify common mechanical system issues, such as misalignments, wear, lubrication failures, and mechanical stress, through

	careful inspection and diagnostic procedures. 4.2. Utilize troubleshooting techniques, including visual inspection, sound analysis, vibration monitoring, and temperature checks, to detect faults in mechanical components like gears, bearings, and shafts. 4.3. Interpret system diagrams, manuals, and technical documentation to locate and diagnose faults in mechanical systems effectively. 4.4. Apply knowledge of mechanical principles to isolate the root cause of issues, such as incorrect gear ratios, misalignment, or material failure, and recommend appropriate corrective actions. 4.5. Use diagnostic tools, such as torque wrenches, vibration analyzers, and pressure gauges, to assess the condition and performance of mechanical systems. 4.6. Repair or replace damaged components (e.g., gears, belts, seals) following manufacturer specifications, ensuring that parts are correctly fitted, aligned, and lubricated. 4.7. Recalibrate or adjust system settings (e.g., tension, torque, speed) to restore optimal performance and efficiency in mechanical systems. 4.8. Conduct tests after repairs to verify system functionality, ensuring that the repaired system meets performance standards and safety requirements. 4.9. Maintain accurate records of system faults, repairs, and maintenance activities, ensuring a detailed history for future reference and continuous improvement.

ME0004 - 3. Materials Science for Engineering

The aim of this study unit is to provide a comprehensive understanding of the properties and behaviors of materials commonly used in mechanical engineering, including metals, polymers, and composites. Learners will gain the ability to apply material selection criteria based on performance, cost, and environmental impact, as well as analyze the effects of stress, strain, and temperature on materials in mechanical applications. This unit also emphasizes the critical role of materials science in the design and manufacturing processes, preparing learners to make informed decisions in engineering practice.

Learning Outcome:	Assessment Criteria:
1. Understand the properties and behaviors of materials commonly used in mechanical engineering, such as metals, polymers, and composites.	1.1. Identify and describe the fundamental properties of common engineering materials, including metals, polymers, and composites, such as strength, hardness, elasticity, toughness, and ductility. 1.2. Understand the classification of metals (e.g., ferrous and non-ferrous), and their typical properties, such as corrosion resistance, thermal conductivity, and weldability, which influence their use in mechanical engineering applications. 1.3. Recognize the types of polymers (e.g., thermoplastics, thermosets, elastomers) and their mechanical properties, such as flexibility, chemical resistance, and impact strength, and understand their suitability for specific applications. 1.4. Understand the properties of composite materials, including fiber reinforcement and matrix material, and how these properties contribute to high strength-to-weight ratios, corrosion resistance, and thermal stability. 1.5. Analyze the behavior of materials under different loading conditions, such as tensile, compressive, shear, and torsional forces, and predict their deformation, failure modes, and fracture behavior. 1.6. Evaluate how material properties are affected by temperature, environmental conditions, and manufacturing processes, and understand how these factors influence material selection in engineering designs. 1.7. Apply knowledge of material behavior to select the most appropriate materials for specific mechanical engineering applications,

	considering factors like cost, performance, and durability. 1.8. Understand the concept of material fatigue and wear, and apply this knowledge to design mechanical systems that minimize the effects of cyclic loading and wear.
2. Apply material selection criteria based on performance, cost, and environmental impact.	2.1. Evaluate materials based on their mechanical properties (e.g., strength, durability, hardness, and fatigue resistance) to ensure they meet the specific performance requirements of the engineering application. 2.2. Consider the cost of materials, including initial purchase price, processing costs, and long-term maintenance or replacement costs, to optimize the overall budget for the project. 2.3. Assess the environmental impact of materials, including factors such as resource extraction, energy consumption during manufacturing, recyclability, and waste generation, to ensure sustainability and compliance with environmental standards. 2.4. Analyze the material's lifespan and resistance to wear, corrosion, and environmental degradation, ensuring that selected materials provide long-term reliability and reduce the need for frequent replacements. 2.5. Incorporate life cycle analysis (LCA) to assess the environmental footprint of materials from extraction through to disposal, comparing options to reduce ecological impact. 2.6. Prioritize the selection of sustainable and recyclable materials, such as bio-based polymers or low-impact metals, to promote eco-friendly engineering practices. 2.7. Consider material availability and supply chain reliability to avoid delays or cost increases due to shortages or production limitations. 2.8. Understand regulatory and industry standards that govern material selection, ensuring that materials meet all safety, quality, and environmental compliance requirements. 2.9. Apply the principles of material efficiency to reduce waste during the manufacturing process, selecting materials that minimize

	energy use and material consumption without sacrificing performance.
3. Analyze the effects of stress, strain, and temperature on materials in mechanical applications.	3.1. Understand the relationship between stress and strain, and how materials deform under various loading conditions, including tension, compression, shear, and torsion. 3.2. Analyze stress-strain curves for materials, identifying key points such as elastic limit, yield strength, ultimate tensile strength, and fracture point, to assess material behavior under different loads. 3.3. Apply Hooke's Law for linear elastic materials to calculate the stress-strain relationship in the elastic region, ensuring accurate predictions of material deformation. 3.4. Evaluate the effects of different types of stresses (e.g., normal stress, shear stress, bending stress) on materials, understanding how these forces contribute to deformation and failure in mechanical components. 3.5. Investigate the impact of strain rate on material behavior, including the differences between static and dynamic loading conditions, and how materials respond to high-speed or shock loading. 3.6. Analyze the effects of temperature on material properties, such as changes in tensile strength, hardness, and ductility at high or low temperatures, and how thermal expansion or contraction can affect system performance. 3.7. Examine the behavior of materials under thermal stress, considering the impact of temperature gradients and differential expansion on material integrity, particularly in applications involving heating, cooling, or thermal cycling. 3.8. Assess the influence of cyclic loading (fatigue) and thermal cycling on materials, identifying how repeated stresses or temperature variations lead to fatigue failure and how materials can be selected or treated to resist this effect. 3.9. Understand the role of temperature in

	material phase changes, such as the melting or softening of polymers, or the effects on metals in heat treatment processes (e.g., annealing, quenching, tempering).
4. Recognize the role of materials science in the design and manufacturing process.	4.1. Understand how materials science influences the selection and application of materials in the design process, ensuring that materials meet the performance, cost, and environmental requirements of the product. 4.2. Recognize the role of material properties, such as strength, ductility, hardness, and corrosion resistance, in determining the suitability of materials for specific engineering applications. 4.3. Apply knowledge of materials science to choose appropriate materials that align with manufacturing methods (e.g., casting, machining, welding) and optimize the efficiency of the production process. 4.4. Evaluate the impact of material behavior on product durability, safety, and functionality, ensuring that materials are selected to withstand the operating conditions and stress levels they will encounter. 4.5. Understand the significance of material processing techniques, such as heat treatment, alloying, and surface coatings, in enhancing material properties and improving the performance of finished products. 4.6. Recognize the importance of material testing and characterization, including tensile tests, fatigue testing, and microscopic analysis, in verifying material selection and ensuring the product meets design specifications. 4.7. Apply the principles of material science to develop innovative solutions for complex engineering challenges, such as lightweight structures, high-temperature applications, or advanced electronic components. 4.8. Consider the lifecycle of materials, including their environmental impact, recyclability, and sustainability, to ensure responsible and efficient use of resources throughout the design and manufacturing stages.

ME0004 - 4. Engineering Drawing and CAD

This study unit aims to equip learners with the essential skills and knowledge required to create, interpret, and modify engineering drawings in alignment with industry-standard conventions. Through the application of Computer-Aided Design (CAD) software, learners will develop proficiency in designing mechanical components and systems, producing detailed technical drawings, and generating 3D models for manufacturing and assembly processes. Additionally, the unit will provide learners with the expertise to utilize CAD tools for simulating and analyzing designs in virtual environments, thereby enhancing their ability to contribute effectively to the engineering design and production process.

Learning Outcome:	Assessment Criteria:
1. Create and interpret engineering drawings using industry-standard conventions.	1.1. Understand and apply industry-standard conventions for creating and interpreting engineering drawings, including ISO, ANSI, and other relevant standards, to ensure clarity and consistency. 1.2. Utilize proper line types and weights to represent different features, such as solid lines for visible edges, dashed lines for hidden details, and centerlines for symmetry, in accordance with drawing standards. 1.3. Accurately represent geometric features, dimensions, tolerances, and surface finishes on drawings to communicate the necessary information for manufacturing and assembly. 1.4. Use correct scaling techniques to ensure that the drawing's size and proportions are consistent with the actual dimensions of the object being designed. 1.5. Apply standard symbols and abbreviations for materials, welding, threading, and other mechanical features to ensure universal understanding across teams and industries. 1.6. Interpret orthographic projections, including front, top, and side views, to visualize complex 3D objects in 2D format and understand spatial relationships between components. 1.7. Incorporate section views, detail views, and auxiliary views when necessary to clarify complex geometries and hidden features. 1.8. Ensure that appropriate dimensions and tolerances are applied to critical features to control the manufacturing process and ensure

	the final product meets functional requirements. 1.9. Use Computer-Aided Design (CAD) software tools to create, modify, and analyze engineering drawings, ensuring precision and ease of communication with stakeholders.
2. Develop skills in using CAD software to design mechanical components and systems.	2.1. Gain proficiency in using CAD software (e.g., AutoCAD, SolidWorks, CATIA, or Fusion 360) to create 2D and 3D models of mechanical components and systems. 2.2. Understand the basic features and tools of CAD software, such as sketching, extruding, revolving, and cutting, to create accurate representations of mechanical parts. 2.3. Develop skills in creating and modifying parametric designs, allowing the easy adjustment of dimensions and features for iterative design processes. 2.4. Use advanced CAD features like assemblies, constraints, and joints to design and analyze mechanical systems, ensuring proper fit and function of interacting components. 2.5. Learn to apply geometric dimensioning and tolerancing (GD&T) within CAD software to define precise measurement standards and tolerances for manufacturing and assembly. 2.6. Utilize simulation and analysis tools within CAD software to conduct stress, strain, thermal, and motion analyses, ensuring that mechanical components meet performance and safety criteria. 2.7. Create detailed technical drawings from 3D models, including appropriate views, sections, dimensions, and annotations, in compliance with engineering drawing standards. 2.8. Implement CAD tools for sheet metal design, molding, or casting to design components that are optimized for specific manufacturing processes. 2.9. Learn how to use CAD software to generate Bill of Materials (BOM) and other supporting documentation for manufacturing, procurement, and assembly.
3. Produce detailed technical drawings and 3D	3.1. Create precise 2D technical drawings with

models for manufacturing and assembly processes.	correct views (e.g., orthographic, isometric, and sectional views) to clearly communicate the design of mechanical components and assemblies. 3.2. Use dimensioning standards (e.g., ISO, ANSI, or ASME) to accurately represent the size, geometry, and tolerances of parts, ensuring they meet functional and manufacturing requirements. 3.3. Apply geometric dimensioning and tolerancing (GD&T) to specify exact shapes, sizes, and allowable deviations in critical features, ensuring part compatibility and quality during manufacturing and assembly. 3.4. Generate 3D models using CAD software (e.g., SolidWorks, AutoCAD, or CATIA), representing parts and assemblies with accurate dimensions and realistic features to visualize design intent. 3.5. Utilize CAD tools for modeling complex geometries, such as surfaces, meshes, and solid bodies, to create parts that are manufacturable and meet design specifications. 3.6. Develop assemblies within CAD software, accurately positioning and constraining components to reflect real-world interactions and assembly processes. 3.7. Include necessary annotations, such as material specifications, surface finishes, and welding or joining details, on both 2D drawings and 3D models to ensure clear communication of manufacturing requirements. 3.8. Produce detailed Bill of Materials (BOM) and other associated documentation directly from the 3D model, ensuring that all parts and components are accounted for and available for procurement. 3.9. Implement CAD tools for analysis (e.g., stress, thermal, and motion simulations) to validate designs for manufacturability, performance, and safety before production.
4. Apply knowledge of CAD tools to simulate and	4.1. Use CAD software's simulation tools (e.g.,

analyze designs in virtual environments.	stress, thermal, fluid dynamics, and motion analysis) to evaluate the performance of mechanical components and systems under various conditions before physical prototyping. 4.2. Conduct finite element analysis (FEA) to identify stress concentrations, strain, and potential failure points in parts, allowing for design improvements to enhance durability and safety. 4.3. Apply computational fluid dynamics (CFD) tools within CAD software to simulate fluid flow, heat transfer, and pressure distribution in mechanical systems, optimizing designs for efficiency and performance. 4.4. Use motion analysis tools to simulate the movement of parts within an assembly, analyzing kinematics and dynamics to ensure proper function and identify potential interferences or misalignments. 4.5. Assess thermal effects on components by simulating temperature distribution, expansion, and thermal stress in designs subjected to heat cycles, ensuring thermal performance under operational conditions. 4.6. Optimize material usage and part geometry by simulating real-world conditions such as vibration, impact, or load cycles to ensure the design meets both performance and cost objectives. 4.7. Conduct modal analysis to evaluate the natural frequencies and resonance of mechanical systems, avoiding design configurations that could lead to vibration-related issues. 4.8. Utilize CAD tools to perform multi-body dynamics simulations for complex assemblies, analyzing the interaction between moving parts and ensuring system integrity and efficiency. 4.9. Run fatigue analysis within CAD tools to predict the life cycle of parts subjected to cyclic loading, helping to improve reliability and reduce the risk of premature failure.

ME0004 - 5. Mechanical Maintenance and Fault Diagnosis

This unit aims to equip learners with the essential knowledge and skills required to perform effective maintenance and fault diagnosis on mechanical systems and equipment. It focuses on developing the ability to apply diagnostic techniques, implement preventive maintenance strategies, and understand the impact of lubrication, wear, and system components in ensuring the long-term reliability and performance of mechanical systems. Through this unit, learners will gain practical expertise in diagnosing faults and recommending appropriate solutions, thus enhancing system functionality and reducing operational downtime.

Learning Outcome:	Assessment Criteria:
1. Perform maintenance and repairs on mechanical systems and equipment.	1.1. Diagnose mechanical system issues by conducting thorough inspections, using tools such as pressure gauges, thermometers, vibration analyzers, and diagnostic software to identify faults and performance deficiencies. 1.2. Use mechanical drawings, schematics, and manuals to understand the design and operation of systems, ensuring accurate troubleshooting and maintenance. 1.3. Perform routine preventive maintenance on mechanical equipment, including lubricating moving parts, checking fluid levels, and replacing worn components to extend the lifespan of machinery. 1.4. Disassemble, repair, and reassemble mechanical components, such as motors, pumps, gears, and bearings, following manufacturer guidelines and safety protocols to restore equipment functionality. 1.5. Replace or repair defective parts, ensuring that replacements meet the required specifications and standards for performance and safety. 1.6. Test repaired or maintained systems to verify proper function, checking for any residual issues that may require further attention. 1.7. Calibrate mechanical systems and equipment to ensure they operate within the specified parameters, adjusting settings as needed to optimize performance. 1.8. Perform safety checks after maintenance to ensure that all systems are functioning properly and that safety features (e.g., emergency shut-offs, safety interlocks) are operational. 1.9. Maintain accurate maintenance logs and reports,

	documenting the procedures performed, parts replaced, and any issues discovered during maintenance to support future troubleshooting and audits.
2. Apply diagnostic techniques to identify faults in mechanical systems and suggest appropriate solutions.	2.1. Use systematic diagnostic procedures, including visual inspections, listening for unusual sounds, and monitoring system behavior, to identify potential faults in mechanical systems. 2.2. Utilize diagnostic tools, such as vibration analysis equipment, pressure gauges, thermometers, and multimeters, to collect data on system performance and pinpoint issues. 2.3. Analyze performance data and compare it to standard operating conditions to detect anomalies, such as temperature fluctuations, irregular vibrations, or pressure deviations, which may indicate faults. 2.4. Review mechanical system schematics, technical manuals, and previous maintenance logs to understand system layout and historical issues, aiding in identifying recurring problems or weak points. 2.5. Apply knowledge of mechanical principles (e.g., thermodynamics, fluid dynamics, and kinematics) to interpret symptoms and narrow down potential causes of system malfunctions. 2.6. Use fault isolation techniques, such as isolating components or sections of a system, to test individual parts and determine the specific source of the problem. 2.7. Identify the severity and impact of the fault, determining whether it requires immediate attention or can be addressed during scheduled maintenance. 2.8. t appropriate corrective actions, including part replacement, system reconfiguration, lubrication, or calibration, based on the identified fault and its potential consequences on system performance. 2.9. Recommend preventive maintenance strategies or design modifications to reduce the likelihood of future faults and improve the reliability of the mechanical system.
3. Implement preventive maintenance schedules to improve system reliability.	3.1. Develop a preventive maintenance (PM) schedule based on manufacturer recommendations,

	industry standards, and equipment usage data, ensuring that maintenance tasks are performed at appropriate intervals. 3.2. Identify key components and systems that require regular inspection and servicing, such as motors, pumps, compressors, bearings, and lubrication systems, to ensure optimal performance and minimize the risk of unexpected failures. 3.3. Monitor and track system performance data (e.g., operating hours, temperature, vibrations) to determine the optimal timing for preventive maintenance tasks and adjust schedules as needed. 3.4. Perform routine maintenance tasks, such as cleaning, lubrication, tightening fasteners, replacing filters, and checking fluid levels, to prevent wear and tear on mechanical systems. 3.5. Implement condition-based monitoring techniques (e.g., oil analysis, vibration monitoring, or thermal imaging) to assess equipment health and schedule maintenance before failures occur. 3.6. Train maintenance personnel to follow established preventive maintenance procedures, ensuring tasks are completed accurately and on time, and that safety protocols are followed. 3.7. Document all preventive maintenance activities, including dates, tasks performed, and parts replaced, to build a comprehensive maintenance history and ensure compliance with regulatory or industry standards. 3.8. Evaluate and update the preventive maintenance schedule periodically based on system performance, feedback from operators, and new technologies, ensuring continuous improvement in system reliability. 3.9. Integrate feedback from maintenance technicians and operators to identify areas for improvement in the preventive maintenance process and make necessary adjustments to the schedule.
4. Understand the role of lubrication, wear and tear, and system components in maintaining mechanical equipment.	4.1. Recognize the importance of lubrication in reducing friction, preventing overheating, and minimizing wear between moving parts, thereby extending the life of mechanical components. 4.2. Understand the different types of lubricants (e.g.,

	oils, greases, and synthetic lubricants) and their properties, such as viscosity, thermal stability, and load-carrying capacity, for use in various mechanical systems. 4.3. Apply proper lubrication techniques, including the selection of appropriate lubricants, ensuring that lubrication points are correctly applied and maintained according to equipment specifications. 4.4. Identify the causes and effects of wear and tear on mechanical components, such as abrasion, corrosion, and fatigue, and understand how they lead to decreased efficiency, increased downtime, and the need for repairs. 4.5. Recognize common signs of wear, including noise, vibration, overheating, and visual damage to parts, and interpret these as early indicators of potential mechanical issues. 4.6. Monitor system performance and lubrication conditions using diagnostic tools, such as oil analysis, vibration analysis, and temperature sensors, to detect early signs of wear or lubrication failure. 4.7. Understand the role of system components, including seals, bearings, gears, and shafts, in maintaining smooth operation and preventing excessive wear. Ensure these components are regularly inspected and replaced as necessary. 4.8. Develop and implement a preventive maintenance strategy that focuses on proper lubrication and timely replacement of worn parts to prevent major system failures and improve overall equipment reliability. 4.9. Maintain accurate records of lubrication schedules, wear patterns, and parts replacements, ensuring compliance with maintenance protocols and enabling informed decision-making for future maintenance actions.

ME0004 - 6. Health, Safety, and Environmental Practices

The aim of this unit is to equip learners with the essential knowledge and skills to identify, assess, and manage health, safety, and environmental risks within mechanical engineering environments. Learners will gain an understanding of key health and safety regulations, develop competencies in conducting risk assessments, and apply safe working practices. Additionally, the unit emphasizes the importance of environmental regulations and sustainability, enabling learners to implement measures that minimize environmental impact and promote sustainable practices in engineering processes. This unit ensures adherence to international standards for health, safety, and environmental management in the field of mechanical engineering.

Learning Outcome:	Assessment Criteria:
1. Recognize and manage potential hazards in mechanical engineering environments.	1.1. Identify common hazards in mechanical engineering environments, including mechanical, electrical, thermal, chemical, and environmental risks, that could lead to accidents, injuries, or equipment damage. 1.2. Conduct thorough risk assessments for mechanical systems and work environments, evaluating potential hazards related to equipment design, operation, maintenance, and environmental factors. 1.3. Implement safety protocols and procedures, such as lockout/tagout (LOTO), to ensure that machinery and equipment are properly de-energized before maintenance or repair work is conducted, preventing accidental startup. 1.4. Ensure compliance with local, national, and international safety standards, including OSHA, ISO, and ANSI, to create a safe work environment and reduce the likelihood of accidents. 1.5. Use personal protective equipment (PPE) appropriately, including safety goggles, gloves, ear protection, and flame-resistant clothing, to minimize exposure to mechanical and environmental hazards. 1.6. Establish and maintain clear signage, warnings, and barriers around hazardous areas to alert workers and visitors to potential risks such as moving machinery, high-voltage areas, or confined spaces. 1.7. Provide training to staff on recognizing, reporting, and mitigating hazards, ensuring

	they are aware of emergency procedures, safe work practices, and the correct use of tools and equipment. 1.8. Monitor the workplace continuously for emerging hazards, ensuring that any changes in operations, equipment, or environment are addressed with updated safety measures and risk management strategies. 1.9. Develop and implement a proactive maintenance program that includes regular inspections, safety checks, and hazard assessments to identify and address potential mechanical failures before they lead to hazardous conditions.
2. Conduct risk assessments and apply safe working practices in line with health and safety regulations.	2.1. Conduct comprehensive risk assessments for mechanical engineering activities, identifying potential hazards, assessing the likelihood and severity of risks, and implementing control measures to minimize those risks. 2.2. Ensure compliance with relevant health and safety regulations, such as OSHA, ISO standards, and local safety guidelines, while carrying out all engineering tasks and maintaining a safe working environment. 2.3. Evaluate mechanical systems, equipment, and work environments to identify risks associated with noise, vibration, chemicals, machinery malfunctions, and manual handling, implementing strategies to reduce exposure. 2.4. Apply hierarchy of controls (elimination, substitution, engineering controls, administrative controls, and PPE) to minimize identified risks, focusing on prevention at the source and providing effective solutions. 2.5. Implement and promote safe working practices, including proper training on equipment use, correct handling of materials, and safe operation procedures to protect workers from mechanical hazards. 2.6. Regularly inspect and maintain equipment

	and machinery to ensure that they are functioning safely, identifying and addressing potential faults or safety issues before they lead to accidents. 2.7. Provide workers with personal protective equipment (PPE) suitable for the tasks at hand, ensuring that employees use it correctly and consistently while on the job. 2.8. Monitor and enforce safety procedures, conducting routine checks to ensure that all safety practices are being followed and that safety equipment is used as intended. 2.9. Keep accurate records of risk assessments, safety inspections, and corrective actions taken, ensuring proper documentation to comply with regulatory requirements and facilitate audits.
3. Understand environmental regulations and sustainability practices within the mechanical engineering field.	3.1. Understand and stay updated on key environmental regulations, such as waste management, emissions control, energy consumption, and material disposal, to ensure compliance with local, national, and international standards in mechanical engineering projects. 3.2. Familiarize with sustainability practices, including energy-efficient design, the use of renewable energy sources, and eco-friendly materials, to minimize the environmental impact of mechanical systems and manufacturing processes. 3.3. Implement practices that reduce resource consumption, such as optimizing manufacturing processes to reduce waste, improving product life cycles, and using materials that can be recycled or reused. 3.4. Evaluate the environmental impact of mechanical systems throughout their lifecycle, from design and production to operation and disposal, ensuring that sustainable methods are prioritized in every phase. 3.5. Apply principles of green engineering to design and develop mechanical systems that minimize environmental damage, such

	as energy-efficient motors, low-emission engines, and sustainable manufacturing techniques. 3.6. Ensure compliance with environmental laws and standards (e.g., ISO 14001, REACH, and RoHS) by integrating environmental management systems (EMS) into engineering practices and regularly auditing processes for compliance. 3.7. Advocate for waste reduction practices, such as recycling scrap materials, reusing components, and reducing harmful emissions during the production and maintenance of mechanical systems. 3.8. Promote the use of life cycle assessments (LCA) to evaluate the environmental impact of products, encouraging decisions that enhance sustainability and reduce overall ecological footprints. 3.9. Foster awareness and training among engineering teams about environmental issues, ensuring they understand the importance of sustainable design and the role of engineering in environmental protection.
4. Implement measures to reduce the environmental impact of engineering processes and promote sustainability.	4.1. Identify key environmental impacts of engineering processes, such as energy consumption, waste generation, resource depletion, and emissions, and assess opportunities for improvement in design, manufacturing, and operation stages. 4.2. Integrate energy-efficient technologies and practices into engineering designs, including the use of renewable energy sources, energy recovery systems, and energy-efficient machinery to reduce overall energy consumption. 4.3. Apply sustainable material selection practices, choosing materials that are renewable, recyclable, or have lower environmental footprints, and designing products for easier disassembly and recycling. 4.4. Optimize manufacturing processes to

	minimize waste by implementing lean production techniques, reusing scrap materials, and reducing defects, which reduces the need for raw materials and minimizes environmental impact. 4.5. Implement water and resource conservation measures in engineering operations, including closed-loop systems for water recycling and reducing consumption of non-renewable resources. 4.6. Adopt waste management strategies such as reducing, reusing, and recycling, ensuring that hazardous waste is disposed of responsibly and non-hazardous waste is diverted from landfills. 4.7. Promote the use of environmentally friendly coatings, solvents, and chemicals in manufacturing processes, reducing harmful emissions and minimizing the environmental impact of toxic substances. 4.8. Evaluate and implement technologies for reducing emissions and pollutants, such as low-emission engines, cleaner production methods, and emissions control systems to mitigate the environmental impact of operations. 4.9. Foster a culture of sustainability by incorporating green design principles into engineering education and practice, ensuring that sustainability considerations are part of every project from the outset.

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