THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

789 METAL WORKING AND MECHANICAL PRACTICE

Time: 3 Hour. **ANSWERS** **Year: 2009**

Instructions

1. This paper consists of **eight (8)** questions.
2. Answer any **five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Non-programmable calculators may be used.
5. Communication devices, programmable calculators and any unauthorized materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

1. (a) Thread cutting is the process of creating helical grooves on a cylindrical or conical surface to form screw threads. It is used in mechanical work to produce bolts, screws, nuts, or internal threads in components for fastening and assembly purposes.

   (b) (i) Internal threads are cut inside a hole, typically using taps. External threads are cut around a cylindrical rod, using dies or lathe machines.
   (ii) Tools used for internal thread cutting include taper tap, second tap, and plug tap.

   (c) Factors that affect thread quality include the sharpness of the cutting tool, as a dull tap or die results in rough threads. Proper alignment of the tool ensures concentric and even threads. The use of lubrication prevents tool breakage and improves surface finish. Correct cutting speed and feed also influence the precision and integrity of the threads.

   (d) Wear safety goggles to protect eyes from metal chips. Use the correct size and type of tap or die. Secure the workpiece properly before cutting. Avoid excessive force to prevent tool breakage and ensure clean threads.

2. (a) A lathe bed is the base of a lathe machine that supports all major components including the headstock, tailstock, and carriage. It provides rigidity and alignment for accurate machining operations.

   (b) (i) Lathe beds are commonly made from cast iron or steel.
   (ii) Cast iron has good damping properties to absorb vibration. Steel offers high tensile strength and durability, ensuring long service life and stability under load.

   (c) To align the headstock and tailstock, place a straight bar between centers and rotate it. Use a dial indicator to check for misalignment and adjust the tailstock laterally or vertically as needed until minimal deviation is observed.

   (d) Misalignment can cause tapered cuts on the workpiece. It leads to excessive wear on tools due to uneven contact. Drilling operations may produce off-center holes. It can also damage the tailstock center and workpiece surface.

3. (a) Repetitive production is the continuous or repeated manufacturing of identical components. It allows for standardization and faster production rates in workshop operations.

(b) (i) Jobs suited for repetitive production include bolt manufacturing, washers, and gear blanks.
(ii) Tools that assist in repetitive tasks include jigs for guiding tools and fixtures for holding workpieces consistently.

(c) Jigs ensure that holes or shapes are drilled or cut at the same location on every workpiece. Fixtures hold each part in exactly the same position, reducing setup time and improving consistency across parts.

(d) Challenges include tool wear from continuous use, leading to reduced accuracy. Managing worker fatigue in repetitive environments can affect quality. Space limitations in small workshops hinder batch movement. Tool setup for each batch requires time and care to maintain standard output.

4. (a) The shank is the non-cutting part of a tool that is held by the tool holder or chuck. It transfers torque and ensures the tool is secured during machining.

(b) (i) Common shank configurations include cylindrical and tapered shanks.
(ii) Considerations when selecting a shank type include the compatibility with the tool holder and the rigidity required for the machining operation.

(c) A properly designed shank ensures firm clamping and transmits force efficiently. Poor fit may result in tool slippage or vibration, affecting accuracy and tool life.

(d) Tool breakage at the shank may be caused by poor clamping that leads to shifting. Excessive cutting forces can exceed the shank's strength. Using the wrong tool holder can misalign the shank. Fatigue from repeated loading cycles also weakens the shank over time.

5. (a) A bevel protractor is a precision measuring instrument used to measure and mark angles accurately. It consists of a base with a rotating blade and graduated scale.

(b) (i) A bevel protractor provides accurate angular measurements. It is adjustable for measuring both internal and external angles. It is easy to use and provides visual confirmation of angle settings.
(ii) A bevel protractor measures variable angles with precision, while a try square is limited to checking or marking 90-degree angles only.

(c) To use a bevel protractor, place the base along one surface and adjust the blade to align with the other surface. Read the angle value from the scale where the blade intersects the graduated arc.

(d) Keep the tool clean and free from rust. Store it in its protective case to prevent damage. Avoid dropping or knocking it to preserve calibration. Use gentle pressure to prevent bending the blade.

6. (a) A flatness test is a method used to determine if a metal surface is even and free from warps or distortions. It is important in fitting work to ensure proper assembly, contact, and seal between surfaces.

(b) (i) Tools used include surface plates, straight edges, and feeler gauges.
(ii) To perform the test, place the workpiece on a surface plate. Position a straight edge across the surface and use a feeler gauge to check for any gaps between the workpiece and the straight edge.

(c) Working with warped surfaces results in poor contact between parts. It causes leaks in joints, increases wear due to uneven loading, and reduces overall assembly precision.

(d) Manual testing is cost-effective and requires no electricity. It is easy to perform and useful for quick checks. However, it may not detect microscopic deviations. It is less reliable for large or complex surfaces.

7. (a) Clearance is the intentional space left between two mating parts. It allows for smooth movement or fitting without interference, especially in rotating or sliding components.

(b) (i) Clearance prevents metal-to-metal contact, reducing friction and wear. It allows room for thermal expansion during operation.
(ii) Clearance is checked using feeler gauges, visual inspection with marking paste, and micrometres or calipers for precise measurement.

(c) Proper clearance allows rotating parts like shafts to spin freely without overheating. It ensures lubrication film retention and reduces power losses due to friction.

(d) Too little clearance causes seizing or binding of moving parts. Excessive clearance can result in vibrations, misalignment, or fluid leakage in hydraulic systems. It may also affect accuracy and performance of mechanisms.

8. (a) Vibration is the rapid back-and-forth movement of machine components during operation. It can arise from unbalanced rotating parts, worn components, or loose fixtures.

(b) (i) Causes of vibration include imbalance in rotating components, misalignment of shafts or tools, and loose bolts or mountings.
(ii) Vibration can be reduced by balancing rotating parts properly. Installing vibration dampers or isolators can absorb movement. Regular maintenance helps detect and eliminate sources early.

(c) Continuous vibration increases tool wear, shortens machine life, and degrades surface finish. It may also cause dimensional inaccuracies due to tool deflection.

(d) Always wear hearing protection if noise levels are high. Secure all tools and fixtures before starting the machine. Inspect mounting bolts and rotating parts regularly. Avoid working near unstable or vibrating machinery without supervision.