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: 2015**

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) Surface finish refers to the texture or smoothness of a machined surface. It is determined by the tool marks left during machining and affects the performance, fit, and appearance of a component.

(b) (i) Tool condition significantly influences surface finish, as a worn-out tool may leave rough or uneven surfaces. Cutting speed also plays a role, where too high or too low speed can result in poor finish. Feed rate impacts the spacing of tool marks, and high feed often leads to rougher surfaces. The material of the workpiece also affects the finish, as harder materials may be harder to machine smoothly.

(ii) Surface finish is crucial for ensuring proper sealing in mating parts, reducing wear and friction, improving aesthetics, and increasing fatigue resistance in mechanical components.

(c) Surface finish is measured using instruments such as a surface roughness tester or profilometer. These tools measure the height and spacing of surface irregularities and provide a numerical value in microns or Ra value.

(d) Common defects that affect surface finish include chatter marks due to vibration, tool marks from dull cutting tools, tearing of soft metals, and built-up edge on the cutting tool which affects the cutting action.

2. (a) A scribing block is a tool used in metal layout work to draw accurate reference lines on the surface of a workpiece. It holds a scribe at a fixed height and is moved across the surface to mark lines.

(b) (i) A typical scribing block consists of a base for stability, a vertical pillar or post for height adjustment, and an adjustable scriber for marking.

(ii) To set a scribing block for marking a line parallel to a surface, adjust the scriber to the required height using a steel rule. Then lock it in position and slide the base along the flat surface while maintaining firm contact, creating a straight line.

(c) Marking out is essential in metalwork as it ensures that cutting, drilling, or machining operations are performed at the correct positions. It helps reduce material waste and errors during fabrication.

(d) Always ensure the scriber is sharp and properly secured. Do not apply excessive pressure which may damage the surface. Keep fingers away from the marking tip. Use safety glasses to prevent metal particles from entering the eyes.

3. (a) Machine maintenance is the process of performing regular checks, cleaning, lubrication, and part replacements to ensure that machines operate efficiently and safely.

(b) (i) Types of maintenance include preventive maintenance, corrective maintenance, predictive maintenance, and routine maintenance.

(ii) Preventive maintenance involves scheduled servicing to avoid breakdowns. Corrective maintenance is carried out after a failure has occurred. Predictive maintenance uses data and monitoring to forecast issues before they happen. Routine maintenance involves daily checks and lubrication tasks.

(c) To perform routine maintenance on a lathe machine, clean the machine to remove swarf and debris. Lubricate moving parts like slides and leadscrews. Check oil levels and refill if necessary. Inspect belts and gears for wear and ensure that guards are secure.

(d) Poor maintenance can lead to unexpected machine breakdowns, reduced accuracy in machining, increased operational costs, and safety hazards for the operator.

4. (a) Clearance fit is a type of engineering fit where there is always space between the mating parts, such as a shaft and a hole, allowing easy assembly and free movement.

(b) (i) Examples include a shaft fitting into a bearing or a pin fitting into a hole in a linkage. These allow for smooth motion and easy removal.

(ii) Clearance fit allows movement, while interference fit involves a tight grip where the shaft is slightly larger than the hole, requiring force or heat to assemble.

(c) Clearance fit is checked using measuring tools like micrometers and plug gauges. The shaft and hole dimensions are compared to ensure they fall within the designed tolerance range.

(d) The type of material, operating temperature, required movement, manufacturing capability, and desired life span of the assembly all affect the selection of fit type.

5. (a) Machine vibration refers to the oscillating motion of machine components caused by imbalanced forces, misalignment, or loose parts during operation.

(b) (i) Causes include unbalanced rotating parts, worn bearings, loose components, and misaligned shafts.

(ii) Vibration can lead to poor surface finish, accelerated tool wear, reduced accuracy, and damage to sensitive components in machining operations.

(c) Vibration can be reduced by regularly balancing rotating parts, using vibration isolators or dampers, tightening loose bolts, and performing regular alignment checks.

(d) Signs of abnormal vibration include increased noise, irregular tool marks on workpieces, visible shaking of machine parts, and operator discomfort during machine operation.

6. (a) A die holder is a tool used to hold a threading die for cutting external threads on cylindrical metal parts. It ensures that the die is held square to the workpiece and guides it during threading.

(b) (i) Types of die holders include the T-handle die holder, adjustable die stock, and round die handle.

(ii) The T-handle die holder is used for small dies in confined spaces. Adjustable die stocks allow for flexibility in die size. Round die handles are used for larger dies needing more torque.

(c) To cut threads, secure the die into the holder. Clamp the workpiece securely and chamfer the end. Align the die with the workpiece and apply pressure while rotating the die holder. Use cutting fluid and back off periodically to break chips. Continue until the desired length is threaded.

(d) Always apply cutting fluid to reduce friction and heat. Ensure the die is properly aligned to avoid angled threads. Do not force the die if it becomes tight. Clean the die after use to remove chips.

7. (a) Lubrication is the application of a substance between moving surfaces to reduce friction, heat, and wear. It is essential in metal cutting to enhance tool life and improve finish.

(b) (i) Types of lubricants include oil-based coolants, synthetic coolants, solid lubricants like graphite, and emulsions.

(ii) Oil-based coolants provide lubrication and cooling. Synthetic coolants offer better heat dissipation. Solid lubricants reduce wear in dry conditions. Emulsions are water-based and suitable for light to medium cutting.

(c) During drilling, lubricant is applied directly to the drill point using a brush or spray. Some machines have a coolant system that delivers fluid continuously through nozzles or through the tool itself.

(d) Lack of lubrication results in overheating, rapid tool wear, poor surface finish, increased cutting force, and possible tool breakage.

8. (a) A tool rest is a flat or adjustable support platform mounted near a grinding wheel. It provides a surface to support the workpiece or tool during grinding.

(b) (i) It ensures that the workpiece is stable during grinding, which increases safety. It also helps in controlling the grinding angle accurately for consistent results.

(ii) To adjust, set the rest close to the wheel (usually within 3 mm), and align it perpendicular to the wheel. Lock it in place before starting the grinder.

(c) An incorrectly set tool rest can cause the workpiece to slip into the wheel gap, resulting in accidents or damage. It also affects the accuracy of grinding and can cause chipping of the wheel edge.

(d) Ensure the tool rest is properly adjusted and tightened before grinding. Wear safety goggles to protect your eyes. Do not apply excessive pressure on the workpiece. Never grind on the side of the wheel unless it is specifically designed for that.