THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

789 METAL WORKING AND MECHANICAL PRACTICE

(SUPPLEMENTARY)

Time: 3 Hours. **Year: 2003**

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) (i) Define the term 'ferrous' metal and give one example.

(ii) Define the term 'non-ferrous' metal and give one example.

(iii) Describe the characteristic properties of a material with high 'ductility'.

(iv) Explain the phenomenon of 'work hardening' and suggest a way to reverse its effects.

(b) State three common workshop applications for cast iron.

(c) Identify two common types of keys used in mechanical power transmission.

2. (a) Briefly explain the purpose and steps of the heat treatment process known as 'normalizing'.

(b) Outline the steps involved in the process of 'tempering' a hardened steel tool.

(c) (i) Explain the term 'quenching' in heat treatment.

(ii) Give two examples of common quenching media.

3. (a) Differentiate between 'hot working' and 'cold working' of metals.

(b) (i) Explain the term 'case hardening' and give one application.

(ii) Outline the main objective of the annealing heat treatment process.

(c) State four desirable properties of a material used for making machine tool beds (e.g., lathe bed).

4. (a) (i) Give two examples of thermoplastic polymers.

(ii) Give two examples of thermosetting polymers.

(b) Describe the main advantage of using 'composites' (like fiber-reinforced plastic) over pure metals in certain applications.

(c) State three different ways that chips (swarf) can be disposed of in a mechanical workshop.

5. (a) Explain the function and main operating principle of a shaper machine.

(b) State three advantages of using a power hacksaw over a hand hacksaw, focusing on efficiency and quality.

(c) Identify the main components of a belt drive system and explain the function of the slack side.

6. (a) Outline the general procedures for safely lifting and moving a heavy machine tool in the workshop.

(b) State four reasons why lubrication is crucial for the efficient and prolonged life of workshop machinery.

(c) Explain the function of the 'clearance hole' in a bolted joint.

7. (a) Explain the term 'draft' in metal casting and explain why it is necessary.

(b) How are anvils and swage blocks used in connection with metal forming?

(c) Describe the process of using a bearing puller to safely dismantle a press-fit assembly.

8. (a) A metal bar is subjected to a tensile force of 150 kN. If the cross-sectional area of the bar is 2500 mm^2, calculate the tensile stress in N/mm^2 (MPa).

(b) A 10 mm wide key is used in a shaft. If the shaft diameter is 40 mm and the allowable shear stress is 50 N/mm^2, calculate the minimum key length required to transmit a torque of 50 N·m.

(c) A force of 10 kN is applied to a 2 m long bar causing it to extend by 0.5 mm. If the cross-sectional area is 100 mm^2, calculate the strain in the bar.