basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

MECHANICAL TECHNOLOGY

EXAMINATION GUIDELINES

GRADE 12

2017

These guidelines consist of 12 pages.

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1. INTRODUCTION

The Curriculum and Assessment Policy Statement (CAPS) for Mechanical Technology outlines the nature and purpose of the subject Mechanical Technology. This guides the philosophy underlying the teaching and assessment of the subject in Grade 12.

The purpose of these Examination Guidelines is to:

- Provide clarity on the depth and scope of the content to be assessed in the Grade 12 National Senior Certificate Examination in Mechanical Technology.
- Assist teachers to adequately prepare learners for the examinations.

This document deals with the final Grade 12 external examinations. It does not deal in any depth with the School Based Assessment, Performance Assessment Tasks or final external practical examinations as these are clarified in a separate PAT document which is updated annually.

This guideline should be read in conjunction with:

- *National Curriculum Statement (NCS) Curriculum and Assessment Policy Statement (CAPS)*: Mechanical Technology
- National Protocol of Assessment: *An addendum to the policy document, the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF), regarding the National Protocol for Assessment (Grades R–12)*
- National policy pertaining to the programme and promotion requirements of the National Curriculum Statement, Grades R–12

2. ASSESSMENT IN GRADE 12

2.1 The structure/format of the question paper is as follows:

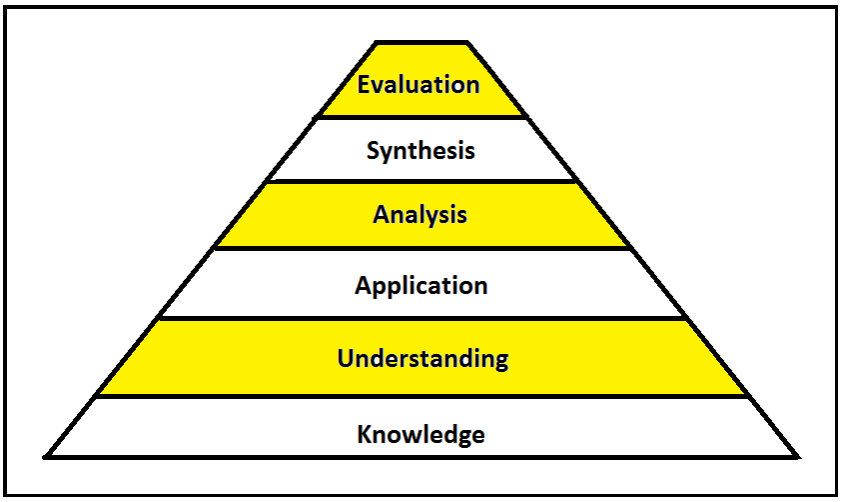
QUESTION NO.	TOPIC	CONTENT	MARKS
ONE	**Multiple Choice**	This question covers all 9 topics for the grade 12 content. Twenty (20) questions will be set with a weighting of 1 mark each. Three questions each on (a) terminology and (b) systems and control. Two questions each on the remaining 7 topics.	20
TWO	**Safety**	Occupational Health and Safety Act and Regulations; Machine specific safety measures; Advanced tools and equipment specific safety measures.	10
THREE	**Tools and equipment**	Identify tools and equipment from drawings; Describe use, care, purpose, functions and principles of specialized tools and equipment; Label tools and equipment from given drawings. Simple calculation: depth micro meter and screw thread micro meter	12
FOUR	**Materials**	Reasons why certain products are made from enhanced materials taking into cognizance the environmental aspects. Description and explanation of the iron-carbon equilibrium diagram. Explanation of the typical characteristics changes at AC_1, AC_2, and AC_3.	13

QUESTION NO.	TOPIC	CONTENT	MARKS
FIVE	**Termino-logy**	Cutting procedures: Lathe: Metric V-thread screw cutting calculation on cutting depth using the compound slide method; Metric V-thread terms (know the entities of a labelled sketch; setting up of lathe and cutting tools). Milling machine i.e. up-cut, down-cut and gang milling; Identification of milling cutters for a milling machine; Calculations: simple indexing (application of gear cutting formula on addendum, cutting depth, etc.), keyways.	30
SIX	**Joining Methods**	Identification of welding defects from drawings; causes and correction methods of weld defects; Labelling of drawings on destructive and non-destructive weld tests; Description, analysis and application of weld tests; Labelling of diagrams/sketches and description of Metal Arc Gas Shielded (MAGS) or Metal Inert Gas Shielded (MIGS) welding.	25
SEVEN	**Forces**	Calculations: System of forces (maximum of four forces), resultant and equilibrant. Moments calculation beam with two vertical point loads and one uniformly distributed load. Calculations Young's' Modulus of Elasticity, Stress and Strain, Type of forces; Change in length; the Stress/strain diagram and interpretation thereof.	30
EIGHT	**Mainte-nance**	Properties of lubricating oil – viscosity, pour point, flash point. Grading of oils: transmission oil, engine oil, differential oil, cutting fluid, grease. Replacement and maintenance of belt and chain drives and clutches.	15

QUESTION NO.	TOPIC	CONTENT	MARKS
NINE	**Systems and Control**	**Calculations:** Mechanical: Gears (including idler gear) Power transfer (including friction clutches), pulleys belts (v-belts, flat belts) belt speed and lengths for open and crossed belt drives. Hydraulic: Double – acting pistons and reservoir. Application of Pascal's law. **Basic operating principles:** Vehicle management systems/ECU. Anti-lock braking system (label diagram, principle of operation) Traction control Air bag control Central locking	25
TEN	**Turbines**	Types of turbines, their components, functions and operating principles of water, steam and gas turbines and turbochargers and superchargers Terminology related to turbines e.g. boost, blow-through system, draw through system, under/overdriven, adiabatic efficiency, volumetric efficiency, mechanical efficiency, density ratio, pressure ratio;	20

2.2 Cognitive levels

Bloom's taxonomy consists of six levels as shown below.



Bloom's Taxonomy	Bloom's Revised Taxonomy	Description	Degree of Challenge		
Evaluation	Creating	Generating, planning, producing	Easy	Medium	Difficult
Synthesis	Evaluating	Critiquing, judging, justifying, recommending	Easy	Medium	Difficult
Analysis	Analysing	Differentiating, organising, attributing, solving	Easy	Medium	Difficult
Application	Applying	Executing, implementing, preparing, using	Easy	Medium	Difficult
Under-standing	Under-standing	Interpreting, exemplifying, classifying, summarising, inferring, comparing, explaining	Easy	Medium	Difficult
Knowledge	Remember-ing	Recognising, recalling, labelling, naming	Easy	Medium	Difficult

The following cognitive levels and weighting are applicable to Mechanical Technology:

Cognitive Levels		Weighting
Lower order	**Knowledge:** memorise and recall information: arrange, define, label, list, outline, repeat, order	30%
Medium order	**Comprehension:** (understanding) interpret information in one's own words: describe, indicate, restate, review, summarize, classify	50%
	Application: apply knowledge to new situations: apply, calculate, draw, explain, identify, illustrate, prepare, operate, practice, solve, sketch, use	
Higher order	**Analysis:** breakdown knowledge into parts and show relationship among parts: analyses, categorize, compare, distinguish, discuss, examine, investigate, and test	20%
	Synthesis: bring together parts of knowledge to form a whole; build relationships for new situation: arrange, compose, formulate, organize, plan, assemble, construct, problem solving	
	Evaluation: make judgments on basis of criteria: appraise, assess, comment on, critically analyses, evaluate, conclude, interrogate, judge, predict, compare, and score	

3. CONCLUSION

It is envisaged that this Examination Guidelines document will serve as an instrument to strengthen and empower teachers to set valid and reliable assessment items in all their classroom activities.

This Examination Guidelines document is meant to articulate the assessment aspirations espoused in the CAPS document. It is therefore not a substitute for the CAPS document which teachers should teach to.

Qualitative curriculum coverage as enunciated in the CAPS cannot be over-emphasised.

4. Formula Sheet

FORMULA SHEET FOR MECHANICAL TECHNOLOGY – GRADE 12

1. BELT DRIVES

1.1 $$Belt\ speed = \frac{\pi DN}{60}$$

1.2 $$Belt\ speed = \frac{\pi (D + t) \times N}{60} \quad (t = belt\ thickness)$$

1.3 $$Belt\ mass = Area \times length \times density \quad (A = thickness \times width)$$

1.4 $$Speed\ ratio = \frac{Diameter\ of\ driven\ pulley}{Diameter\ of\ driver\ pulley}$$

1.5 $$N_1 D_1 = N_2 D_2$$

1.6 $$Open\text{-}belt\ length = \frac{\pi(D + d)}{2} + \frac{(D - d)^2}{4c} + 2c$$

1.7 $$Crossed\text{-}belt\ length = \frac{\pi(D + d)}{2} + \frac{(D + d)^2}{4c} + 2c$$

1.8 $$Power\ (P) = \frac{2\pi NT}{60}$$

1.9 $$Ratio\ of\ tight\ side\ to\ slack\ side = \frac{T_1}{T_2}$$

1.10 $$Power = \frac{(T_1 - T_2)\,\pi\, D\, N}{60} \quad where\ T_1 = force\ in\ the\ tight\ side$$

$$T_2 = force\ in\ slack\ side$$

$$T_1 - T_2 = effective\ force\ (T_e)$$

1.11 $$Width = \frac{T_1}{permissible\ tensile\ force}$$

2. FRICTION CLUTCHES

2.1 $Torque\ (T) = \mu WnR$

$where: \mu = coefficient\ of\ friction$

$W = total\ force$

$n = number\ of\ friction\ surfaces$

$R = effective\ radius$

2.2 $Power\ (P) = \frac{2\pi NT}{60}$

3. STRESS AND STRAIN

3.1 $Stress = \frac{Force}{Area} \quad or \quad (\sigma = \frac{F}{A})$

3.2 $Strain\ (\varepsilon) = \frac{change\ in\ length\ (\Delta L)}{original\ length\ (L)}$

3.3 $Young's\ modulus\ (E) = \frac{stress}{strain} \quad or \quad (\frac{\sigma}{\varepsilon})$

3.4 $A_{shaft} = \frac{\pi d^2}{4}$

3.5 $A_{pipe} = \frac{\pi(D^2 - d^2)}{4}$

4. HYDRAULICS

4.1 $Pressure\ (P) = \frac{Force\ (F)}{Area\ (A)}$

4.2 $Volume = Cross\text{-}sectional\ area \times stroke\ length\ (l\ or\ s)$

4.3 $Work\ done = force \times distance$

5. KEYWAYS

5.1 $Width\ of\ key = \frac{Diameter\ of\ shaft}{4}$

5.2 $Thickness\ of\ key = \frac{Diameter\ of\ shaft}{6}$

5.3 $Length\ of\ key = 1,5 \times Diameter\ of\ shaft$

5.4 *Standard taper for taper key: 1 in 100 or 1:100*

6. LEVERS

6.1 $$Mechanical\ advantage\ (MA) = \frac{Load\ (W)}{Effort\ (F)}$$

6.2 $$Input\ movement\ (IM) = Effort \times distance\ moved\ by\ effort$$

6.3 $$Output\ movement\ (OM) = Load \times distance\ moved\ by\ load$$

6.4 $$Velocity\ ratio\ (VR) = \frac{Input\ movement}{Output\ movement}$$

7. GEAR DRIVES

7.1 $$Power\ (P) = \frac{2\pi NT}{60}$$

7.2 $$Gear\ ratio = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{Product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$$

7.3 $$\frac{N_{input}}{N_{output}} = \frac{Product\ of\ the\ number\ of\ teeth\ on\ driven\ gears}{Product\ of\ the\ number\ of\ teeth\ on\ driving\ gears}$$

7.4 $$Torque = force \times radius$$

7.5 $$Torque\ transmitted = gear\ ratio \times input\ torque$$

7.6 $$Module\ (m) = \frac{Pitch\text{-}circle\ diameter\ (PCD)}{Number\ of\ teeth\ (T)}$$

7.7 $$N_1T_1 = N_2T_2$$

7.8 $$Pitch\text{-}circle\ diameter\ (PCD) = \frac{circular\ pitch\ (CP) \times number\ of\ teeth\ (T)}{\pi}$$

7.9 $$Outside\ diameter\ (OD) = PCD + 2\ module$$

7.10 $$Addendum\ (a) = module\ (m)$$

7.11 $$Dedendum\ (b) = 1{,}157\ m \quad or \quad Dedendum\ (b) = 1{,}25\ m$$

7.12 $$Cutting\ depth\ (h) = 2{,}157\ m \quad or \quad Cutting\ depth\ (h) = 2{,}25\ m$$

7.13 $$Clearance\ (c) = 0{,}157\ m \quad or \quad Clearance\ (c) = 0{,}25\ m$$

7.14 $$Circular\ pitch\ (CP) = m \times \pi$$

8. SCREW THREADS

8.1 $Pitch\ diameter = Outside\ diamter - ½pitch$

8.2 $Pitch\ circumference = \pi \times pitch\ diameter$

8.3 $Lead = pitch \times number\ of\ starts$

8.4 $Height\ of\ screw\ thread = 0{,}866 \times P \quad where\ p = pitch\ of\ the\ screw\ thread$

8.5 $Depth\ of\ screw\ thread = 0{,}613 \times P \quad where\ P = pitch\ of\ the\ screw\ thread$

8.6 $Number\ of\ turns = \frac{height}{lead}$

9. CINCINNATI DIVIDING HEAD TABLE FOR THE MILLING MACHINE

Hole circles											
Side 1	*24*	*25*	*28*	*30*	*34*	*37*	*38*	*39*	*41*	*42*	*43*
Side 2	*46*	*47*	*49*	*51*	*53*	*54*	*57*	*58*	*59*	*62*	*66*

$Simple\ indexing = \frac{40}{n} \quad (where\ n = number\ of\ divisions)$

THIS IS A GUIDELINE AND NOT A WORK SCHEDULE.