



**GAUTENG PROVINCE**

Department: Education

REPUBLIC OF SOUTH AFRICA

**MECHANICAL TECHNOLOGY 2024**

**ANNUAL TEACHING PLAN**

**Grade 12**

# MECHANICAL TECHNOLOGY

## FITTING AND MACHINING

### GRADE 12

#### GRADE 12: TERM 1 – FITTING AND MACHINING

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 3 12 hours	SAFETY (Generic)	<p>HIV/AIDS Awareness</p> <p>Knowledge of basic First Aid measures</p> <p>Analyse the OHS Act and regulations where applicable to the following machines:</p> <ul style="list-style-type: none"> <li>• Grinding machines (portable, bench and surface)</li> <li>• Cutting (drilling machines, power saw, band saw)</li> <li>• Shearing machines (manual and power driven)</li> <li>• Press machines</li> <li>• Joining (arc, gas)</li> <li>• Handling and usage of gas cylinders</li> </ul> <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none"> <li>• Process layout</li> <li>• Product layout</li> </ul> <p>Referring to the OHS Act, analyse the responsibilities of the:</p> <ul style="list-style-type: none"> <li>• Employer</li> <li>• Employee</li> </ul> <p><b>Practical:</b> Compare the process and product layout of 2 different manufacturing or maintenance workshops</p>		5		

Fitting and Machining Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
4 - 5	8 hours	<p><b>Lathe:</b></p> <ul style="list-style-type: none"> <li>• Safety measures</li> <li>• Taper turning (compound slide method – inside and outside tapers)                             <ul style="list-style-type: none"> <li>➤ Calculations for setting over of compound slide and tail stock</li> </ul> </li> <li>• Screw cutting                             <ul style="list-style-type: none"> <li>➤ Description of the pitch and leads for single- and multi-start screw threads</li> <li>➤ Uses of screw thread dial gauge, pitch gauge, centre gauge and graduated collar when screw thread cutting is carried out</li> <li>➤ Methods to determine the locating positions on the dial gauge</li> <li>➤ Calculations of depth of V-threads and square threads</li> <li>➤ Square thread (calculation of helix, leading and following angles for the cutting tools)</li> <li>➤ Methods of cutting multi-start screw threads (Theory only): Set over of compound slide Change gear</li> </ul> </li> </ul> <p><b>Milling machine:</b></p> <ul style="list-style-type: none"> <li>• Safety measures</li> <li>• <b>Calculations on:</b> <ul style="list-style-type: none"> <li>➤ Centring of cutter</li> <li>➤ Cutting of keyways</li> </ul> </li> <li>• <b>Identifying and apply the following milling processes and describe the advantages and disadvantages:</b> <ul style="list-style-type: none"> <li>➤ Gang milling</li> <li>➤ Straddle milling</li> <li>➤ Down cut</li> <li>➤ Up cut</li> </ul> </li> </ul>		10		
					15	
				20		

		<p><b>Practical:</b></p> <ul style="list-style-type: none"> <li>• Use a lathe to do taper turning</li> <li>• Use a lathe to do multi-start screw cutting</li> <li>• Use a milling machine to show compliance on down cut and up cut milling</li> <li>• Use a milling machine to cut a parallel keyway</li> </ul>				
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WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
6 - 8 12 hours	TERMINOLOGY Machining (Specific)	<p><b>Indexing:</b></p> <ul style="list-style-type: none"> <li>• Calculations on the indexing for a square, pentagon and hexagon – including the depth of cut</li> <li>• Calculations of the following indexing processes: <ul style="list-style-type: none"> <li>➤ Rapid</li> <li>➤ Simple</li> <li>➤ Angular</li> <li>➤ Differential</li> </ul> </li> </ul> <p><b>Dovetail slides:</b></p> <ul style="list-style-type: none"> <li>• Calculation for internal and external dove tail with precision rollers</li> <li>• Calculation of included angle.</li> <li>• Test for accuracy</li> </ul> <p><b>Write a Digital Read Out (DRO) Program to incorporate cutting a recess on a work piece:</b></p> <ul style="list-style-type: none"> <li>• Explain the difference between DRO and CNC systems</li> <li>• Programming on a 3-axis digital readout system (“DRO”) on milling machines</li> <li>• Absolute and incremental reference systems</li> <li>• Tools change position</li> <li>• Allowance for diameter thickness</li> </ul> <p><b>Balancing of irregular work pieces on a lathe:</b></p> <ul style="list-style-type: none"> <li>• Graphical solution to balance an unbalanced work piece on a face plate</li> </ul>		25		
				28		

**Fitting and Machining Grade 12: Term 1**

			<b>Practical component</b>	<b>%</b>	<b>Date completed</b>	<b>Signature</b>
		<p><b>Manufacturing of spur gear:</b></p> <ul style="list-style-type: none"> <li>• Involute gear tooth form with a module of no more than 3</li> <li>• Calculations on:               <ul style="list-style-type: none"> <li>➤ Number of teeth</li> <li>➤ Pitch circle diameter</li> <li>➤ Module</li> <li>➤ Outside diameter</li> <li>➤ Addendum</li> <li>➤ Dedendum</li> <li>➤ Full depth – cutting depth</li> <li>➤ Working depth</li> <li>➤ Clearance</li> <li>➤ Circular pitch, chordal tooth thickness, chordal tooth addendum</li> <li>➤ Indexing</li> </ul> </li> </ul> <p><b>Practical:</b> Use a milling machine to cut a spur gear</p>		32		
<b>WEEK</b>	<b>TOPIC</b>	<b>CONTENT</b>	<b>Practical component</b>	<b>%</b>	<b>Date completed</b>	<b>Signature</b>
9 4 hours	<b>TOOLS (Specific)</b>	<p><b>Describe the principles and functions of advanced engineering equipment:</b></p> <ul style="list-style-type: none"> <li>• Brinell and Rockwell hardness testers</li> <li>• Moments and forces testers</li> <li>• Tensile testers</li> </ul> <p><b>Simple calculations on:</b></p> <ul style="list-style-type: none"> <li>• Depth micrometre</li> <li>• Screw thread micrometre (included angle)</li> </ul> <p><b>Practical:</b></p> <ul style="list-style-type: none"> <li>• Do tests by using the above advanced engineering equipment</li> <li>• Use micrometres to take different measurements</li> </ul>		36		
10	<b>REVISION</b>	<b>HOD Signature:</b> _____				
11	<b>CONTROL TEST</b>	<p>Date: _____</p> <p>All theory including practical application and PAT tasks for term 1 have been completed Marks entered onto electronic mark sheet</p>				

**FITTING AND MACHINING**

**GRADE 12 – TERM 2**

**SPECIFIC CONTENT**

<b>WEEK</b>	<b>TOPIC</b>	<b>CONTENT</b>	<b>Practical component</b>	<b>%</b>	<b>Date completed</b>	<b>Signature</b>
1 - 4 16 weeks	<b>FORCES</b> (Specific)	<p><b>Forces:</b></p> <p>Basic calculations:</p> <ul style="list-style-type: none"> <li>• System of forces (maximum of four forces)</li> <li>• Resultant and equilibrant</li> </ul> <p><b>Moments:</b></p> <p>Moments found in engineering components: (By calculation only)</p> <p>A simply supported beam with two vertical point loads and one uniformly distributed load (UDL) acting on the beam including reactions at the supports (only two)</p> <p><b>Stress/Strain:</b></p> <p>Basic calculations on:</p> <ul style="list-style-type: none"> <li>• Stress,</li> <li>• Strain (Stress/Strain diagram only for mild steel),</li> <li>• Safety factor,</li> <li>• Modulus of elasticity and</li> <li>• Change in length.</li> </ul> <p><b>Practical:</b></p> <p>Use basic calculations to determine forces, moments and stress</p>		40		
				44		

Fitting and Machining Grade 12: Term 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
5 - 6 8 hours	MAINTENANCE (Specific)	<p><b>Suitable preventative maintenance in operating systems for:</b></p> <ul style="list-style-type: none"> <li>• Gear,</li> <li>• Belt and</li> <li>• Chain drives.</li> </ul> <p><b>The use of the following materials for bushes and gears:</b></p> <ul style="list-style-type: none"> <li>• Thermoplastic composites : <ul style="list-style-type: none"> <li>➤ Nylon</li> <li>➤ Teflon</li> <li>➤ Poly Vinyl Composite (PVC)</li> <li>➤ Vesconite</li> </ul> </li> <li>• Thermo hardened (Thermosetting) composites <ul style="list-style-type: none"> <li>➤ Carbon Fibre</li> <li>➤ Glass Fibre</li> <li>➤ Bakelite</li> </ul> </li> </ul> <p><b>Minimum and maximum coefficient of friction for the following different materials:</b></p> <ul style="list-style-type: none"> <li>• Copper,</li> <li>• Cast iron,</li> <li>• Thermo composites,</li> <li>• Stainless steel,</li> <li>• White metal, and</li> <li>• Rubber</li> </ul> <p><b>Practical:</b> Collect and identify samples of Thermoplastic and Thermo hardened composites</p>		46		
9 - 11	MID-YEAR EXAMINATION	<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p><b>All theory including practical application and PAT tasks for term 2 have been completed</b> <b>Marks entered onto electronic mark sheet</b></p>				





WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 8 hours	MATERIALS (Generic)	<p><b>Identify materials by:</b></p> <ul style="list-style-type: none"> <li>• Sound test</li> <li>• Bending test</li> <li>• Filing test and</li> <li>• Machining test</li> </ul> <p><b>Methods of enhancing the properties of steel (only heated temperature and cooling apply):</b></p> <ul style="list-style-type: none"> <li>• Tempering</li> <li>• Case hardening</li> <li>• Hardening</li> <li>• Annealing</li> <li>• Normalising</li> </ul> <p><b>Practical:</b></p> <p>Test FOUR different types of materials using the:</p> <ul style="list-style-type: none"> <li>• Sound test</li> <li>• Bending test</li> <li>• Filing test</li> <li>• Machining test</li> </ul>		97		
7 - 11	TRIAL EXAMINATION		<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p>All theory including practical application and PAT tasks for term 3 have been completed Marks entered onto electronic mark sheet</p>			

## FITTING AND MACHINING

### GRADE 12 – TERM 4

WEEK	TOPIC	CONTENT	
1 - 3	REVISION		<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p>All theory including practical application and PAT tasks for term 4 have been completed Marks entered onto electronic mark sheet</p>
4 - 9	EXAMINATION		

# MECHANICAL TECHNOLOGY – AUTOMOTIVE

## GRADE 12 – TERM 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
<b>1 - 3</b> 12 hours	<b>SAFETY</b> (Generic)	<p>HIV/AIDS Awareness</p> <p>Knowledge of basic First Aid measures</p> <p>Analyse the OHS Act and regulations where applicable to the following machines:</p> <ul style="list-style-type: none"> <li>• Grinding machines (portable, bench and surface)</li> <li>• Cutting (drilling machines, power saw, band saw)</li> <li>• Shearing machines (manual and power driven)</li> <li>• Press machines</li> <li>• Joining (arc, gas)</li> <li>• Handling and usage of gas cylinders</li> </ul> <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none"> <li>• Process layout</li> <li>• Product layout</li> </ul> <p>Referring to the OHS Act analyse the responsibilities of the:</p> <ul style="list-style-type: none"> <li>• Employer</li> <li>• Employee</li> </ul> <p><b>Practical:</b></p> <p>Compare the process and product layout of TWO different manufacturing or maintenance workshops</p>		5		



**GRADE 12: TERM 2 – AUTOMOTIVE**

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 8 hours	MATERIALS (Generic)	<p><b>Identify materials by:</b></p> <ul style="list-style-type: none"> <li>• Sound test</li> <li>• Bending test</li> <li>• Filing test</li> <li>• Machining test</li> </ul> <p><b>Methods of enhancing the properties of steel (only heated temperature and cooling apply):</b></p> <ul style="list-style-type: none"> <li>• Tempering</li> <li>• Case hardening</li> <li>• Hardening</li> <li>• Annealing</li> <li>• Normalising</li> </ul> <p><b>Practical:</b> Test TWO different materials using the:</p> <ul style="list-style-type: none"> <li>• Sound test</li> <li>• Bending test</li> <li>• Filing test</li> <li>• Machining test</li> </ul>		44		
3 - 4 8 hours	FORCES (Specific)	<p><b>Application of the following automotive calculations:</b></p> <ul style="list-style-type: none"> <li>• Work, Power, Torque, Compression Ratio</li> <li>• Indicated Power, Brake Power, Mechanical Efficiency</li> </ul> <p><b>Practical:</b></p> <ul style="list-style-type: none"> <li>• Measure stroke</li> <li>• Measure cylinder bore</li> <li>• Measure combustion chamber volume</li> </ul> <p>Use specifications and measurements obtained from a given engine and calculate the Indicated power</p>		60		

Automotive Grade 12: Term 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
5 - 6 8 hours	MAINTENANCE (Specific)	<p><b>Diagnose faults by using and reading test equipment:</b></p> <ul style="list-style-type: none"> <li>• Gas analysing</li> <li>• Compression test</li> <li>• Cylinder leakage</li> <li>• Pressure test</li> </ul> <p><b>Practical:</b> Use abovementioned equipment to diagnose faults on an engine</p>		68		
7 - 8 8 hours	SYSTEMS AND CONTROL (Specific) (DRIVE TRAINS)	<p><b>Describe the operational purpose and functions of the automatic gearbox:</b></p> <ul style="list-style-type: none"> <li>• Torque converters</li> <li>• Epicyclical gear trains</li> <li>• Brake bands/locking devices</li> <li>• Control body (purpose only)</li> <li>• Gear Ratios</li> </ul> <p><b>Practical:</b></p> <ul style="list-style-type: none"> <li>▪ Explain the power flow through the torque convertor</li> <li>▪ Identify various main components of the automatic gearbox</li> </ul>		75		
9 - 11	EXAMINATION	<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p><b>All theory including practical application and PAT tasks for term 2 have been completed</b> <b>Marks entered onto electronic mark sheet</b></p>				

**GRADE 12: TERM 3 – AUTOMOTIVE**

WEEK	TOPIC	PRESCRIBED CONTENT	Practical component	%	Date completed	Signature
1 - 6 24 hours	SYSTEM AND CONTROL (Specific)	<p><b>Steering Geometry:</b></p> <ul style="list-style-type: none"> <li>Alignment to manufacturers specifications</li> <li>Toe-in and toe-out</li> <li>Castor and camber</li> <li>Kingpin inclination</li> <li>Ackermann principle (toe-out on turns)</li> </ul> <p><b>Practical:</b> Use testing equipment and demonstrate competency to test and adjust various wheel alignment angles to specifications:</p> <ul style="list-style-type: none"> <li>Toe-in and toe-out</li> <li>Castor and camber</li> </ul> <p><b>Application of wheel balancing:</b></p> <ul style="list-style-type: none"> <li>Static</li> <li>Dynamic</li> </ul> <p><b>Practical:</b> Use a wheel balancer and demonstrate competency to balance a wheel</p> <p><b>ELECTRICITY:</b> Purpose and operation of engine management:</p> <ul style="list-style-type: none"> <li>Petrol</li> <li>Diesel</li> <li>Catalytic converter</li> <li>Speed Control systems (Theory only)</li> <li>Charging systems (Alternator)</li> </ul> <p><b>Practical:</b> Use a diagnostic scanner on an engine to test various systems</p> <p><b>Electrical fuel pump (Theory):</b></p> <ul style="list-style-type: none"> <li>Purpose and operation</li> <li>Pressure control (basic)</li> </ul> <p><b>Practical:</b> Test fuel pump pressure</p>		85		
7 - 11	EXAMINATIONS	<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p><b>All theory including practical application and PAT tasks for term 3 have been completed</b> <b>Marks entered onto electronic mark sheet</b></p>				

**GRADE 12: TERM 4 – AUTOMOTIVE**

<b>WEEK</b>	<b>TOPIC</b>	<b>PRESCRIBED CONTENT</b>				
<b>1 - 3</b>	<b>REVISION</b>		<b>HOD Signature:</b>  _____ <b>Date:</b> _____  <b>All theory including practical application and PAT tasks for term 4 have been completed</b> <b>Marks entered onto electronic mark sheet</b>			
<b>4 - 9</b>	<b>EXAMINATIONS</b>					

# WELDING AND METALWORK

## GRADE 12

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 3 12 hours	<b>SAFETY (Generic)</b>	<p>HIV/AIDS Awareness</p> <p>Knowledge of basic First Aid measures</p> <p>Analyse the OHS Act and regulations where applicable to the following machines:</p> <ul style="list-style-type: none"> <li>• Grinding machines (portable, bench and surface)</li> <li>• Cutting (drilling machines, power saw, band saw)</li> <li>• Shearing machines (manual and power driven)</li> <li>• Press machines</li> <li>• Joining (arc, gas)</li> <li>• Handling and usage of gas cylinders</li> </ul> <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none"> <li>• Process layout</li> <li>• Product layout</li> </ul> <p>Referring to the OHS Act analyse the responsibilities of the:</p> <ul style="list-style-type: none"> <li>• Employer</li> <li>• Employee</li> </ul> <p><b>Practical:</b></p> <p>Compare the process and product layout of TWO different manufacturing or maintenance workshops</p>		5		

**Welding and Metalwork Grade 12: Term 1**

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
<b>3 - 5</b> 12 hours	<b>TERMINOLOGY</b> (Specific)	<p><b>Templates:</b></p> <ul style="list-style-type: none"> <li>• Marking off templates, full or part</li> <li>• Sets of roof trusses, beams, lattice girders and plate girders</li> <li>• Method of obtaining and transferring dimensions</li> </ul> <p><b>Calculations of sheet metal for rolling and bending:</b></p> <ul style="list-style-type: none"> <li>• Rolled plate</li> <li>• Rectangular and square plate</li> </ul> <p><b>Practical:</b></p> <p>Do calculations on rolling and bending plates.</p> <p><b>Application of WELDING SYMBOLS:</b></p> <p>All the welding symbols according to the Code of Practice for welding – SANS</p> <p><b>Practical:</b></p> <p>Apply the welding symbols as indicated on a given sketch according to SANS to produce a project from a template.</p>		15		
<b>6 - 7</b> 8 hours	<b>TOOLS</b> (Specific)	<p>The principles and functions of the following purpose-made tooling and equipment:</p> <ul style="list-style-type: none"> <li>• Stocks and dies (characteristics and drill sizes)</li> <li>• Grinding machines (portable, bench)</li> <li>• Cutting machines (drilling machines, power saw, horizontal band saw)</li> <li>• Guillotine machine (manual and power driven)</li> <li>• Press machines</li> <li>• Joining equipment (arc, spot, gas)</li> <li>• Rolling machine</li> <li>• Punch and cropper machine</li> <li>• Plasma cutter</li> <li>• Brinell and Rockwell hardness testers</li> <li>• Moments and forces testers</li> <li>• Tensile testers</li> <li>• MIG/MAG welders</li> </ul> <p><b>Practical:</b></p> <p>Display an understanding of the use and care of purpose-made tooling and equipment when producing a product and doing maintenance.</p>		20		



**GRADE 12 – TERM 2**

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 4 16 hours	FORCES (Specific)	<p><b>FORCES AND MOMENTS:</b> Effects of forces and moments on engineering components applying design principles:</p> <p><b>STEEL FRAMEWORKS:</b> Determine graphically the magnitude and nature of forces on the members of frameworks with a maximum of 11 (eleven) parts. (Only parallel and vertical loads.) Calculate the reactions.</p> <p><b>Basic calculations on:</b></p> <ul style="list-style-type: none"> <li>• Moments found in engineering components: (By calculation only)</li> <li>• A simply supported beam with two vertical point loads and one uniformly distributed load (UDL) acting on the beam (including reactions at the supports)</li> <li>• A simply supported beam with THREE vertical point loads and without uniformly distributed load (UDL) acting on the beam</li> <li>• Calculate the reactions at the supports</li> <li>• Calculate the bending moments at each and shear forces between points</li> </ul> <p><b>Draw the following diagrams to scale:</b></p> <ul style="list-style-type: none"> <li>• Space diagram</li> <li>• Bending moment diagram</li> <li>• Shear force diagram</li> </ul> <p><b>Practical:</b> Do calculations of moments and, using a bending moment tester, perform a bending moment test on a beam.</p> <p><b>STRESS AND STRAIN (Calculation of):</b></p> <ul style="list-style-type: none"> <li>• Stress and strain (Hooke's law)</li> <li>• Compressive/tensile stresses</li> <li>• Young's modulus of elasticity (<i>include the factor of safety</i>)</li> <li>• Determine change in length (<math>\Delta l</math>)</li> <li>• Stress/strain diagram</li> </ul> <p><b>Practical:</b> Do calculations on stress and strain whilst taking into consideration Young's modulus for each material.</p>		45		
				50		





**GRADE 12 – TERM 3**

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 8 hours	MAINTENANCE (Specific)	<p>Refer to manufacturers' manual.</p> <p>Suitable preventative maintenance in operating systems for guillotine, pedestal drill, power saw, roller, punch and shearing machine and pedestal grinder.</p> <p>Identify causes of malfunction of:</p> <ul style="list-style-type: none"> <li>Lack of lubrication or incorrect lubrication</li> <li>Overloading</li> <li>Friction</li> </ul> <p><b>Practical:</b> Perform periodic maintenance as prescribed by manufacturers on specific machines.</p>		90		
3 - 8 24 hours	TERMINOLOGY DEVELOPMENTS (Specific)	<p><b>Development of:</b></p> <p>Marking-off templates, by calculation only, of the following between horizontal parallel planes:</p> <ul style="list-style-type: none"> <li>A cone frustum of slight taper</li> <li>Square to round transformers (on centre only)</li> <li>Hoppers with square or rectangular openings (on and off centre)</li> </ul> <p><b>Practical:</b> Do calculations on cone frustum, square to round transition and hoppers.</p>		100		
9 - 11	TRIAL EXAMINATION	<p><b>HOD Signature:</b></p> <p>_____</p> <p><b>Date:</b> _____</p> <p><b>All theory including practical application and PAT tasks for term 3 have been completed</b> <b>Marks entered onto electronic mark sheet</b></p>				

**WELDING AND METALWORK**

**GRADE 12 – TERM 4**

<b>WEEK</b>	<b>TOPIC</b>	<b>CONTENT</b>				
<b>1 - 3</b>	<b>REVISION</b>		<b>HOD Signature:</b>  _____			
<b>4 - 9</b>	<b>EXAMINATION</b>					