



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">• Grinding machines (portable, bench and surface)• Cutting (drilling machines, power saw, band saw)• Shearing machines (manual and power driven)• Press machines• Joining (arc, gas)• Handling and usage of gas cylinders <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none">• Process layout• Product layout <p>Referring to the OHS Act, analyse the responsibilities of the:</p> <ul style="list-style-type: none">• Employer• Employee <p>Practical: 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		Lathe: <ul style="list-style-type: none"> Safety measures Taper turning (compound slide method – inside and outside tapers) <ul style="list-style-type: none"> ➤ Calculations for setting over of compound slide and tail stock Screw cutting <ul style="list-style-type: none"> ➤ Description of the pitch and leads for single- and multi-start screw threads ➤ Uses of screw thread dial gauge, pitch gauge, centre gauge and graduated collar when screw thread cutting is carried out ➤ Methods to determine the locating positions on the dial gauge ➤ Calculations of depth of V-threads and square threads ➤ Square thread (calculation of helix, leading and following angles for the cutting tools) ➤ Methods of cutting multi-start screw threads (Theory only): Set over of compound slide Change gear 		10		
		Milling machine: <ul style="list-style-type: none"> Safety measures Calculations on: <ul style="list-style-type: none"> ➤ Centring of cutter ➤ Cutting of keyways Identifying and apply the following milling processes and describe the advantages and disadvantages: <ul style="list-style-type: none"> ➤ Gang milling ➤ Straddle milling ➤ Down cut ➤ Up cut 		15		
				20		

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

Fitting and Machining Grade 12: Term 1

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

FITTING AND MACHINING

GRADE 12 – TERM 2

SPECIFIC CONTENT

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 4 16 weeks	FORCES (Specific)	<p>Forces:</p> <p>Basic calculations:</p> <ul style="list-style-type: none"> System of forces (maximum of four forces) Resultant and equilibrant <p>Moments:</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>Stress/Strain:</p> <p>Basic calculations on:</p> <ul style="list-style-type: none"> Stress, Strain (Stress/Strain diagram only for mild steel), Safety factor, Modulus of elasticity and Change in length. <p>Practical:</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>Suitable preventative maintenance in operating systems for:</p> <ul style="list-style-type: none"> Gear, Belt and Chain drives. <p>The use of the following materials for bushes and gears:</p> <ul style="list-style-type: none"> Thermoplastic composites : <ul style="list-style-type: none"> Nylon Teflon Poly Vinyl Composite (PVC) Vesconite Thermo hardened (Thermosetting) composites <ul style="list-style-type: none"> Carbon Fibre Glass Fibre Bakelite <p>Minimum and maximum coefficient of friction for the following different materials:</p> <ul style="list-style-type: none"> Copper, Cast iron, Thermo composites, Stainless steel, White metal, and Rubber <p>Practical: Collect and identify samples of Thermoplastic and Thermo hardened composites</p>		46		
9 - 11	MID-YEAR EXAMINATION	HOD Signature: _____ Date: _____				

GRADE 12 – TERM 3

SPECIFIC CONTENT

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
7 - 8 8 hours	JOINING METHODS (Specific)	<p>Use basic calculations on the size of drills for bolts and nuts (ISO metric):</p> <ul style="list-style-type: none"> • Root diameter • Crest diameter • Effective diameter • Pitch • Lead for multi-start screw threads <p>Use basic calculations on the size of drills for bolts and nuts (Square thread):</p> <ul style="list-style-type: none"> • Crest diameter • Effective diameter • Pitch • Lead for multi-start screw threads • Helix angle • Following angle – cutting tool – support by means of a clear drawing • Leading angle – cutting tool - support by means of a clear drawing • Clearance angle - support by means of a clear drawing <p>Practical:</p> <p>Use basic calculations to determine the dimensions of a square thread</p>		63		
				70		

Fitting and Machining Grade 12: Term 3

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
3 - 6 16 hours	SYSTEMS AND CONTROL Drive systems (Specific)	<p>MECHANICAL COMPONENTS:</p> <p>Uses, functions, advantages and disadvantages of the following drive systems:</p> <ul style="list-style-type: none"> Gears Pulleys Belts (V- and flat) and Chains <p>Basic power and velocity calculations on:</p> <ul style="list-style-type: none"> Gears – Transmission of torque ($T=Fr$) and power ($P=2\pi NT/60$) Gears (compound): Angular velocity and direction of rotation – including idler gears V-belts, chains and pulleys: Linear velocity ($V=\pi DN$), and angular velocity ($N_1D_1=N_2D_2$) <p>HYDRAULICS / PNEUMATICS</p> <p>Applied calculations on:</p> <ul style="list-style-type: none"> Pistons and reservoirs – hydraulic jack (ram and plunger) The force exerted in a closed circuit. <p>Identification and use of hydraulic components indicated by the symbols:</p> <ul style="list-style-type: none"> Motor Pump Filter One-way valve Spring-loaded double-action control valve Pressure gauge Non-return valve Reservoir <p>Practical – hydraulics:</p> <p>Design and illustrate schematically a double-action hydraulic control system</p> <p>Practical – mechanical systems:</p> <p>Use basic calculations to determine the outcome of the abovementioned drive systems</p>		82		
				92		

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 8 hours	MATERIALS (Generic)	<p>Identify materials by:</p> <ul style="list-style-type: none"> • Sound test • Bending test • Filing test and • Machining test <p>Methods of enhancing the properties of steel (only heated temperature and cooling apply):</p> <ul style="list-style-type: none"> • Tempering • Case hardening • Hardening • Annealing • Normalising <p>Practical:</p> <p>Test FOUR different types of materials using the:</p> <ul style="list-style-type: none"> • Sound test • Bending test • Filing test • Machining test 		97		
7 - 11	TRIAL EXAMINATION	<p>HOD Signature:</p> <p>_____</p> <p>Date: _____</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>HOD Signature:</p> <p>_____</p> <p>Date: _____</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
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"> Grinding machines (portable, bench and surface) Cutting (drilling machines, power saw, band saw) Shearing machines (manual and power driven) Press machines Joining (arc, gas) Handling and usage of gas cylinders <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none"> Process layout Product layout <p>Referring to the OHS Act analyse the responsibilities of the:</p> <ul style="list-style-type: none"> Employer Employee <p>Practical:</p> <p>Compare the process and product layout of TWO different manufacturing or maintenance workshops</p>		5		

Automotive Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
4 - 6 12 hours	TOOLS (Specific)	Identification and application of diagnostic equipment: <ul style="list-style-type: none"> • Compression tester • Cylinder leakage tester • Gas analyser (all crankcase gases) • Computerised diagnostic scanner • Wheel balancer • Wheel alignment equipment (bubble gauge and turn tables) Practical: Use any 2 of the diagnostic equipment mentioned above to simulate a real-life situation		10 20		
7 - 9 12 hours	ENGINES (Specific)	Crankshafts: <ul style="list-style-type: none"> • Balancing of crankshafts • Vibration damper (function and assembly) • Cylinder layouts • Crank arrangements • Firing orders Describe the operating principles and construction of: <ul style="list-style-type: none"> • Turbochargers • Super chargers Practical: Compare and identify different crankshafts layouts and match to the different cylinder blocks		31 38		
10	REVISION	HOD Signature: _____ Date: _____ All theory including practical application and PAT tasks for term 1 have been completed Marks entered onto electronic mark sheet				
11	CONTROL TEST					

GRADE 12: TERM 2 – AUTOMOTIVE

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 8 hours	MATERIALS (Generic)	Identify materials by: <ul style="list-style-type: none"> • Sound test • Bending test • Filing test • Machining test 		44		
		Methods of enhancing the properties of steel (only heated temperature and cooling apply): <ul style="list-style-type: none"> • Tempering • Case hardening • Hardening • Annealing • Normalising Practical: Test TWO different materials using the: <ul style="list-style-type: none"> • Sound test • Bending test • Filing test • Machining test 		49		
3 - 4 8 hours	FORCES (Specific)	Application of the following automotive calculations: <ul style="list-style-type: none"> • Work, Power, Torque, Compression Ratio • Indicated Power, Brake Power, Mechanical Efficiency Practical: <ul style="list-style-type: none"> • Measure stroke • Measure cylinder bore • Measure combustion chamber volume Use specifications and measurements obtained from a given engine and calculate the Indicated power		60		

Automotive Grade 12: Term 2

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

GRADE 12: TERM 3 – AUTOMOTIVE

WEEK	TOPIC	PREScribed CONTENT	Practical component	%	Date completed	Signature
1 - 6 24 hours	SYSTEM AND CONTROL (Specific)	<p>Steering Geometry:</p> <ul style="list-style-type: none"> Alignment to manufacturers specifications Toe-in and toe-out Castor and camber Kingpin inclination Ackermann principle (toe-out on turns) <p>Practical: Use testing equipment and demonstrate competency to test and adjust various wheel alignment angles to specifications:</p> <ul style="list-style-type: none"> Toe-in and toe-out Castor and camber <p>Application of wheel balancing:</p> <ul style="list-style-type: none"> Static Dynamic <p>Practical: Use a wheel balancer and demonstrate competency to balance a wheel</p> <p>ELECTRICITY: Purpose and operation of engine management:</p> <ul style="list-style-type: none"> Petrol Diesel Catalytic converter Speed Control systems (Theory only) Charging systems (Alternator) <p>Practical: Use a diagnostic scanner on an engine to test various systems</p> <p>Electrical fuel pump (Theory):</p> <ul style="list-style-type: none"> Purpose and operation Pressure control (basic) <p>Practical: Test fuel pump pressure</p>		85		
				90		
				100		
7 - 11	EXAMINATIONS	<p style="text-align: center;">HOD Signature:</p> <p style="text-align: center;">_____</p> <p>Date: _____</p> <p>All theory including practical application and PAT tasks for term 3 have been completed Marks entered onto electronic mark sheet</p>				

GRADE 12: TERM 4 – AUTOMOTIVE

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

WELDING AND METALWORK

GRADE 12

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"> Grinding machines (portable, bench and surface) Cutting (drilling machines, power saw, band saw) Shearing machines (manual and power driven) Press machines Joining (arc, gas) Handling and usage of gas cylinders <p>Knowledge and application of basic workshop layouts:</p> <ul style="list-style-type: none"> Process layout Product layout <p>Referring to the OHS Act analyse the responsibilities of the:</p> <ul style="list-style-type: none"> Employer Employee <p>Practical:</p> <p>Compare the process and product layout of TWO different manufacturing or maintenance workshops</p>		5		

Welding and Metalwork Grade 12: Term 1

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Welding and Metalwork Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
8 - 9 8 hours	MATERIALS (Generic)	<p>Identify materials by:</p> <ul style="list-style-type: none"> • Sound test • Bending test • Filing test and • Machining test <p>Practical: Identify material types by using sound, bending, filing and machining tests.</p> <p>Methods of enhancing the properties of steel (only heated temperature and cooling apply):</p> <ul style="list-style-type: none"> • Tempering • Case hardening • Hardening • Annealing • Normalising <p>Practical: Do enhancement on materials by applying tempering on cutting tools and hardening soft carbon steel.</p>		35		
10	REVISION		<p>HOD Signature:</p> <p>_____</p> <p>Date: _____</p>			
11	CONTROL TEST		<p>All theory including practical application and PAT tasks for term 1 have been completed</p> <p>Marks entered onto electronic mark sheet</p>			

GRADE 12 – TERM 2

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

Welding and Metalwork Grade 12: Term 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
5 - 8 16 hours	JOINING METHODS (Specific)	INSPECTION OF WELDS (Inspection during and after completion of oxy-acetylene and arc welding): <ul style="list-style-type: none"> • Clean bead • Constant width and height of bead • Fusion and penetration • Presence of pits • Undercutting • Distortion • Cracks • Spatter • Slag inclusion • Start and termination of weld • Correct flame • Pressure • Current Application of destructive tests on welded joints: <ul style="list-style-type: none"> • Nick break • Nick bend • Machinability tests Practical: Perform destructive tests on a welded joint using nick break, nick bend and machinability test to identify defects.				
		Describe and compare the following non-destructive tests: <ul style="list-style-type: none"> • Visual inspection • X-rays • Dye penetration • Ultrasonic test Practical: Perform the above non-destructive tests on a welded joint to identify defects.		60		
				70		

Welding and Metalwork Grade 12: Term 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
	JOINING METHODS (Specific)	<p>Stresses and distortion in welding and stress relieving:</p> <ul style="list-style-type: none"> • Shrinkage Of Welded Joint: <ul style="list-style-type: none"> ➤ Definition of shrinkage ➤ Transverse shrinkage causing distortion ➤ Longitudinal shrinkage causing distortion ➤ Thickness shrinkage causing distortion ➤ The effect of the type of electrode with which it is welded ➤ The effect of the size of the welding current ➤ The effect of speed with which it is welded ➤ The effect of the rate of cooling while welding and after welding • Identify the factors affecting distortion and residual stress • Methods to prevent or reduce distortion and stress • Identify and apply <u>stress relieving heat treatment processes</u> • Describe the effect of change in temperature on steel: <ul style="list-style-type: none"> ➤ The effect of cold and hot working on the crystal structure ➤ The application of the iron-carbon equilibrium diagram on steel in respect of heat treatment and welding ➤ The effect of fast cooling on the structure and properties of steel <p>Practical: Identify the factors that lead to distortion and residual stresses within a welded joint.</p>		75		
9 - 11	MID-YEAR EXAMINATION		<p>HOD Signature: _____</p> <p>Date: _____</p> <p>All theory including practical application and PAT tasks for term 2 have been completed Marks entered onto electronic mark sheet</p>			

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"> Lack of lubrication or incorrect lubrication Overloading Friction <p>Practical: Perform periodic maintenance as prescribed by manufacturers on specific machines.</p>		90		
3 - 8 24 hours	TERMINOLOGY DEVELOPMENTS (Specific)	<p>Development of:</p> <p>Marking-off templates, by calculation only, of the following between horizontal parallel planes:</p> <ul style="list-style-type: none"> A cone frustum of slight taper Square to round transformers (on centre only) Hoppers with square or rectangular openings (on and off centre) <p>Practical: Do calculations on cone frustum, square to round transition and hoppers.</p>		100		
9 - 11	TRIAL EXAMINATION	<p style="text-align: center;">HOD Signature:</p> <p style="text-align: center;">_____</p> <p>Date: _____</p> <p>All theory including practical application and PAT tasks for term 3 have been completed Marks entered onto electronic mark sheet</p>				

WELDING AND METALWORK**GRADE 12 – TERM 4**

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