GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

MECHANICAL TECHNOLOGY 2025

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)**	HIV/AIDS Awareness Knowledge of basic First Aid measures Analyse the OHS Act and regulations where applicable to the following machines: • 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 Knowledge and application of basic workshop layouts: • Process layout • Product layout Referring to the OHS Act, analyse the responsibilities of the: • Employer • Employee **Practical:** Compare the process and product layout of 2 different manufacturing or maintenance workshops		5		

Fitting and Machining Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
4 - 5 **8 hours**		**Lathe:** • Safety measures • Taper turning (compound slide method – inside and outside tapers) ➢ Calculations for setting over of compound slide and tail stock • Screw cutting ➢ 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 **Milling machine:** • Safety measures • **Calculations on:** ➢ Centring of cutter ➢ Cutting of keyways • **Identifying and apply the following milling processes and describe the advantages and disadvantages:** ➢ Gang milling ➢ Straddle milling ➢ Down cut ➢ Up cut		10 15 20		

		Practical: • 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				

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
6 - 8 **12 hours**	**TERMINOLOGY Machining (Specific)**	**Indexing:** • Calculations on the indexing for a square, pentagon and hexagon – including the depth of cut • Calculations of the following indexing processes: ➢ Rapid ➢ Simple ➢ Angular ➢ Differential **Dovetail slides:** • 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:** • 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:** • 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: • Involute gear tooth form with a module of no more than 3 • Calculations on: ➢ Number of teeth ➢ Pitch circle diameter ➢ Module ➢ Outside diameter ➢ Addendum ➢ Dedendum ➢ Full depth – cutting depth ➢ Working depth ➢ Clearance ➢ Circular pitch, choral tooth thickness, choral 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:** • Brinell and Rockwell hardness testers • Moments and forces testers • Tensile testers **Simple calculations on:** • Depth micrometre • Screw thread micrometre (included angle) **Practical:** • Do tests by using the above advanced engineering equipment • Use micrometres to take different measurements		36		
10	**REVISION**		**HOD Signature:** _____ **Date:**_____			
11	**CONTROL TEST**		**All theory including practical application and PAT tasks for term 1 have been completed** **Marks entered onto electronic mark sheet**			

FITTING AND MACHINING

GRADE 12 – TERM 2

SPECIFIC CONTENT

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 4 **16 weeks**	**FORCES (Specific)**	**Forces:** Basic calculations: • System of forces (maximum of four forces) • Resultant and equilibrant **Moments:** 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 (only two) **Stress/Strain:** Basic calculations on: • Stress, • Strain (Stress/Strain diagram only for mild steel), • Safety factor, • Modulus of elasticity and • Change in length. **Practical:** Use basic calculations to determine forces, moments and stress		40 44		

Fitting and Machining Grade 12: Term 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
5 - 6 **8 hours**	**MAINTENANCE (Specific)**	**Suitable preventative maintenance in operating systems for:** • Gear, • Belt and • Chain drives. **The use of the following materials for bushes and gears:** • Thermoplastic composites: ➢ Nylon ➢ Teflon ➢ Poly Vinyl Composite (PVC) ➢ Vesconite • Thermo hardened (Thermosetting) composites ➢ Carbon Fibre ➢ Glass Fibre ➢ Bakelite **Minimum and maximum coefficient of friction for the following different materials:** • Copper, • Cast iron, • Thermo composites, • Stainless steel, • White metal, and • Rubber **Practical:** Collect and identify samples of Thermoplastic and Thermo hardened composites		46 52		
9 - 11	**MID-YEAR EXAMINATION**		**HOD Signature:** **_____** **Date:_____** **All theory including practical application and PAT tasks for term 2 have been completed** **Marks entered onto electronic mark sheet**			

GRADE 12 – TERM 3

SPECIFIC CONTENT

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
7 - 8 **8 hours**	**JOINING METHODS (Specific)**	Use basic calculations on the size of drills for bolts and nuts (ISO metric): • Root diameter • Crest diameter • Effective diameter • Pitch • Lead for multi-start screw threads Use basic calculations on the size of drills for bolts and nuts (Square thread): • 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 **Practical:** Use basic calculations to determine the dimensions of a square thread		63 70		

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
3 - 6 **16 hours**	**SYSTEMS AND CONTROL** **Drive systems (Specific)**	**MECHANICAL COMPONENTS:** Uses, functions, advantages and disadvantages of the following drive systems: • Gears • Pulleys • Belts (V- and flat) and • Chains **Basic power and velocity calculations on:** • 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 ($N_1D_1=N_2D_2$) **HYDRAULICS / PNEUMATICS** **Applied calculations on:** • Pistons and reservoirs – hydraulic jack (ram and plunger) • The force exerted in a closed circuit. **Identification and use of hydraulic components indicated by the symbols:** • Motor • Pump • Filter • One-way valve • Spring-loaded double-action control valve • Pressure gauge • Non-return valve • Reservoir **Practical – hydraulics:** Design and illustrate schematically a double-action hydraulic control system **Practical – mechanical systems:** Use basic calculations to determine the outcome of the abovementioned drive systems		82 92		

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature

1 - 2 **8 hours**	**MATERIALS (Generic)**	**Identify materials by:** • Sound test • Bending test • Filing test and • Machining test **Methods of enhancing the properties of steel (only heated temperature and cooling apply):** • Tempering • Case hardening • Hardening • Annealing • Normalising **Practical:** Test FOUR different types of materials using the: • Sound test • Bending test • Filing test • Machining test		97 100		
7 - 11	**TRIAL EXAMINATION**		**HOD Signature:** **_____** **Date:_____** **All theory including practical application and PAT tasks for term 3 have been completed** **Marks entered onto electronic mark sheet**			

FITTING AND MACHINING

GRADE 12 – TERM 4

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

MECHANICAL TECHNOLOGY – AUTOMOTIVE

GRADE 12 – TERM 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 3 **12 hours**	**SAFETY (Generic)**	HIV/AIDS Awareness Knowledge of basic First Aid measures Analyse the OHS Act and regulations where applicable to the following machines: • 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 Knowledge and application of basic workshop layouts: • Process layout • Product layout Referring to the OHS Act analyse the responsibilities of the: • Employer • Employee **Practical:** Compare the process and product layout of TWO different manufacturing or maintenance workshops		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:** • 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:** • Balancing of crankshafts • Vibration damper (function and assembly) • Cylinder layouts • Crank arrangements • Firing orders **Describe the operating principles and construction of:** • 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**					

Automotive Grade 12: Term 2

GRADE 12: TERM 2 – AUTOMOTIVE

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 **8 hours**	**MATERIALS (Generic)**	**Identify materials by:** • Sound test • Bending test • Filing test • Machining test **Methods of enhancing the properties of steel (only heated temperature and cooling apply):** • Tempering • Case hardening • Hardening • Annealing • Normalising **Practical:** Test TWO different materials using the: • Sound test • Bending test • Filing test • Machining test		44 49		
3 - 4 **8 hours**	**FORCES (Specific)**	**Application of the following automotive calculations:** • Work, Power, Torque, Compression Ratio • Indicated Power, Brake Power, Mechanical Efficiency **Practical:** • 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)**	**Diagnose faults by using and reading test equipment:** • Gas analysing • Compression test • Cylinder leakage • Pressure test **Practical:** Use abovementioned equipment to diagnose faults on an engine		68		
7 - 8 **8 hours**	**SYSTEMS AND CONTROL (Specific) (DRIVE TRAINS)**	**Describe the operational purpose and functions of the automatic gearbox:** • Torque converters • Epicyclical gear trains • Brake bands/locking devices • Control body (purpose only) • Gear Ratios **Practical:** ▪ Explain the power flow through the torque convertor ▪ Identify various main components of the automatic gearbox		**75**		
9 - 11	**EXAMINATION**		**HOD Signature:** **_____** **Date:_____** **All theory including practical application and PAT tasks for term 2 have been completed** **Marks entered onto electronic mark sheet**			

Automotive Grade 12: Term 3

GRADE 12: TERM 3 – AUTOMOTIVE

WEEK	TOPIC	PRESCRIBED CONTENT	Practical component	%	Date completed	Signature
1 - 6 **24 hours**	**SYSTEM AND CONTROL (Specific)**	**Steering Geometry:** • Alignment to manufacturers specifications • Toe-in and toe-out • Castor and camber • Kingpin inclination • Ackermann principle (toe-out on turns) **Practical:** Use testing equipment and demonstrate competency to test and adjust various wheel alignment angles to specifications: • Toe-in and toe-out • Castor and camber **Application of wheel balancing:** • Static • Dynamic **Practical:** Use a wheel balancer and demonstrate competency to balance a wheel **ELECTRICITY:** Purpose and operation of engine management: • Petrol • Diesel • Catalytic converter • Speed Control systems (Theory only) • Charging systems (Alternator) **Practical:** Use a diagnostic scanner on an engine to test various systems **Electrical fuel pump (Theory):** • Purpose and operation • Pressure control (basic) **Practical:** Test fuel pump pressure		85 90 100		
7 - 11	**EXAMINATIONS**		**HOD Signature:** _____ **Date:**_____ **All theory including practical application and PAT tasks for term 3 have been completed** **Marks entered onto electronic mark sheet**			

GRADE 12: TERM 4 – AUTOMOTIVE

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

WELDING AND METALWORK

GRADE 12

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 3 **12 hours**	**SAFETY (Generic)**	HIV/AIDS Awareness Knowledge of basic First Aid measures Analyse the OHS Act and regulations where applicable to the following machines: • 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 Knowledge and application of basic workshop layouts: • Process layout • Product layout Referring to the OHS Act analyse the responsibilities of the: • Employer • Employee **Practical:** Compare the process and product layout of TWO different manufacturing or maintenance workshops		5		

Welding and Metalwork Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
3 - 5 **12 hours**	**TERMINOLOGY (Specific)**	**Templates:** • Marking off templates, full or part • Sets of roof trusses, beams, lattice girders and plate girders • Method of obtaining and transferring dimensions **Calculations of sheet metal for rolling and bending:** • Rolled plate • Rectangular and square plate **Practical:** Do calculations on rolling and bending plates. **Application of WELDING SYMBOLS:** All the welding symbols according to the Code of Practice for welding – SANS **Practical:** Apply the welding symbols as indicated on a given sketch according to SANS to produce a project from a template.		15		
6 - 7 **8 hours**	**TOOLS (Specific)**	The principles and functions of the following purpose-made tooling and equipment: • Stocks and dies (characteristics and drill sizes) • Grinding machines (portable, bench) • Cutting machines (drilling machines, power saw, horizontal band saw) • Guillotine machine (manual and power driven) • Press machines • Joining equipment (arc, spot, gas) • Rolling machine • Punch and cropper machine • Plasma cutter • Brinell and Rockwell hardness testers • Moments and forces testers • Tensile testers • MIG/MAG welders **Practical:** Display an understanding of the use and care of purpose-made tooling and equipment when producing a product and doing maintenance.		20 30		

Welding and Metalwork Grade 12: Term 1

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
8 - 9 **8 hours**	**MATERIALS (Generic)**	**Identify materials by:** • Sound test • Bending test • Filing test and • Machining test **Practical:** Identify material types by using sound, bending, filing and machining tests. **Methods of enhancing the properties of steel (only heated temperature and cooling apply):** • Tempering • Case hardening • Hardening • Annealing • Normalising **Practical:** Do enhancement on materials by applying tempering on cutting tools and hardening soft carbon steel.		35 40		
10	**REVISION**		**HOD Signature:** **_____** **Date:_____**			
11	**CONTROL TEST**		**All theory including practical application and PAT tasks for term 1 have been completed** **Marks entered onto electronic mark sheet**			

WELDING AND METALWORK

GRADE 12 – TERM 2

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 4 16 hours	FORCES (Specific)	**FORCES AND MOMENTS:** Effects of forces and moments on engineering components applying design principles: **STEEL FRAMEWORKS:** 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. **Basic calculations on:** • 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 **Draw the following diagrams to scale:** • Space diagram • Bending moment diagram • Shear force diagram **Practical:** Do calculations of moments and, using a bending moment tester, perform a bending moment test on a beam. **STRESS AND STRAIN (Calculation of):** • Stress and strain (Hooke's law) • Compressive/tensile stresses • Young's modulus of elasticity (*include the factor of safety*) • Determine change in length (Δl) • Stress/strain diagram **Practical:** Do calculations on stress and strain whilst taking into consideration Young's modulus for each material.		45 50		

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):** • 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:** • 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:** • 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)	**Stresses and distortion in welding and stress relieving:** • **Shrinkage Of Welded Joint:** ➢ 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 *stress relieving heat treatment processes*** • **Describe the effect of change in temperature on steel:** ➢ 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 **Practical:** Identify the factors that lead to distortion and residual stresses within a welded joint.		75 80		
9 - 11	**MID-YEAR EXAMINATION**		**HOD Signature:** _____ **Date:**_____ **All theory including practical application and PAT tasks for term 2 have been completed** **Marks entered onto electronic mark sheet**			

Welding and Metalwork Grade 12: Term 3

GRADE 12 – TERM 3

WEEK	TOPIC	CONTENT	Practical component	%	Date completed	Signature
1 - 2 **8 hours**	**MAINTENANCE (Specific)**	Refer to manufacturers' manual. Suitable preventative maintenance in operating systems for guillotine, pedestal drill, power saw, roller, punch and shearing machine and pedestal grinder. Identify causes of malfunction of: • Lack of lubrication or incorrect lubrication • Overloading • Friction **Practical:** Perform periodic maintenance as prescribed by manufacturers on specific machines.		90		
3 - 8 **24 hours**	**TERMINOLOGY DEVELOPMENTS (Specific)**	**Development of:** Marking-off templates, by calculation only, of the following between horizontal parallel planes: • A cone frustum of slight taper • Square to round transformers (on centre only) • Hoppers with square or rectangular openings (on and off centre) **Practical:** Do calculations on cone frustum, square to round transition and hoppers.		100		
9 - 11	**TRIAL EXAMINATION**		**HOD Signature:** **_____** **Date:_____** **All theory including practical application and PAT tasks for term 3 have been completed** **Marks entered onto electronic mark sheet**			

WELDING AND METALWORK

GRADE 12 – TERM 4

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