Course: **Certificate in Automotive Maintenance (Engine Repairs)**

Contact Hours: **60 hours**

Pre-requisite: **Basic Knowledge of Mathematics and Science**

Abstract

This unit was designed for persons interested in automotive maintenance and for those seeking to become a qualified, certified mechanic. This unit will focus on the principles of engine theory, operations, diagnosis and repairs with emphasis being placed on the use of equipment and tools to diagnose engine performance and the technical training required to complete repairs in line with the manufacturer specifications.

In order to ensure that the learner fully understands the concepts relating to automotive maintenance, the course content was structured to maximize the contact hours allocated for practical work. Currently 80% of the course involves hands on, practical training.

Upon completion of this engine repairs course, participants can register for the **National Institute for Automotive Service Excellence (ASE) online examination**.

Target Audience

This course is ideally suited for persons interested in automotive maintenance would like to become a qualified, certified mechanic.

Learning outcomes

On completion of this course, learners will be able to:

1. Carry out general engine diagnosis
2. Carry out tests and repairs to the valve train and cylinder head
3. Perform inspection and repairs to the fuel, electrical, ignition and exhaust systems
4. Carry out engine block diagnosis and repairs
5. Carry out tests and repairs to the lubrication and cooling systems
6. Prepare for the National Institute for Automotive Service Excellence (ASE) exam.

Course Content

1. **Carry out general engine diagnosis**

   Engine Diagnosis: Excessive oil consumption, excessive coolant consumption, unusual engine exhaust color and odor, engine noise and vibrations; Hard starting (no-crank, cranks but will not start).

   Tests: Engine vacuum, Cylinder power balance, Cylinder cranking compression, Cylinder leakage.

2. **Carry out tests and repairs to the valve train and cylinder head**

   Cylinder Head: Remove, disassemble, clean and prepare for inspection; Inspect for cracks, warps, corrosion, leakage; Inspect and repair damage threads; Install plugs (core, gallery); Reassemble, install gaskets and replace/torque bolts according to the manufacturer specifications.

   Valves: Check valve springs for squareness, pressure and free height; Inspect spring retainers, rotators, locks/keepers and lock grooves, valve guides, stem-to-guide clearance and stem height; Replace valve stem seals.

   Camshaft: Inspect camshaft (check drive gear wear, backlash, end play, sprocket and chain wear, drive belt, belt tensioner, reluctor ring); Inspect camshaft journals and lobes; Measure camshaft lift.

3. **Perform inspection and repairs to the fuel, electrical, ignition and exhaust systems**

   Systems: Inspect, clean and replace fuel injection system components; Inspect and test ignition system components, verify timing; Inspect and test exhaust system; Test engine cranking system.

4. **Carry out engine block diagnosis and repairs**

   Engine Block Diagnosis: Remove and disassemble engine block; clean and prepare components for inspection and reassembly. Visually inspect block for cracks, warpage, surface finish and corrosion, inspect the condition of the passages, core

and gallery plug hole, piston oil cooling nozzle/jets for damage, improper alignment and restrictions.

Cylinder Walls: Clean and inspect cylinder walls, measure cylinder bore, determine need for further action.

Crankshaft: Inspect crankshaft for end play, journal damage, keyway damage, thrust flange and sealing surface condition. Check oil passage condition, measure journal wear and check crankshaft reluctor ring/tone wheel (where applicable). Inspect main bearing wear patterns and measure main bearing bores and cap alignment. Mark caps for location and direction. Clean and inspect crank girdle. Install main bearings and crankshaft, check bearing clearances and end play, inspect, replace and torque all bolts to manufacturer specifications. Inspect auxiliary shafts (balance, intermediate, idler, counterbalance, and silencer), drives, gears and support bearings for damage and wear. Inspect and reinstall crankshaft vibration damper/harmonic balancer.

Camshaft, pistons and rods: Inspect camshaft bearings for excessive wear and alignment, replace bearings, install timing chain and gear, and check end play. Inspect, measure and service piston rings and piston/wrist pins. Assemble piston and connecting rod, install piston/rod assembly, check bearing clearance and side play, install connecting rod bearings. Inspect, replace and torque fasteners according to manufacturer's specifications.

Engine Assembly: Assemble the engine using gaskets, seals and formed-in-place sealants. Reinstall engine.

5. Carry out tests and repairs to the lubrication and cooling systems

Lubrication Systems: Disassemble and inspect oil pump (including gears, rotors housing and pick-up assembly), measure oil pump clearance, inspect pump drive. Inspect, test and flush or replace internal and external engine oil coolers. Replace oil filter. Perform oil pressure tests.

Cooling Systems: Inspect and test radiator, heater core, pressure cap and coolant recovery systems (Pressure test, coolant dye test). Inspect, replace and adjust drive belts, tensioner and pulleys. Inspect and replace engine cooling systems and heater system hoses, pipes and fittings. Inspect, test and replace thermostat, coolant by-pass and housing. Inspect and replace water pump.

6. National Institute for Automotive Service Excellence (ASE) examination preparation

Examination Preparation: Tutorials, sample questions, mock tests.

Assessment Criteria

In order to achieve Learning Outcome…	The Learner must…
1 Carry out general engine diagnosis	1.1 Inspect engine assembly for fuel, oil, coolant, and other leaks and determine the necessary action. 1.2 Isolate engine noises and vibrations and determine necessary action. 1.3 Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color, and odor and determine necessary action. 1.4 Perform engine vacuum tests and determine necessary action. 1.5 Perform cylinder power balance tests; determine necessary action. 1.6 Perform cylinder cranking compression tests; determine necessary action. 1.7 Perform cylinder leakage tests; determine necessary action.
2 Carry out tests and repairs to the valve train and cylinder head	2.1 Visually inspect cylinder heads for cracks, warps, corrosion, leakage, and the condition of passages; determine needed repairs. 2.2 Be able remove cylinder heads, disassemble, clean, and prepare for inspection. 2.3 Inspect and repair damaged threads where allowed; install core and gallery plugs. 2.4 Inspect, test, and verify valve springs for squareness, pressure, and free height comparison; replace as necessary. 2.5 Be able to replace valve stem seals. 2.6 Inspect valve guides for wear; check valve stem-to-guide clearance; determine needed repairs. 2.7 Inspect valves and valve seats; determine needed repairs.

	2.8 Be able to check valve spring installed (assembled) height and valve stem height; determine needed repairs. 2.9 Inspect pushrods, rocker arms, rocker arm pivots, and shafts for wear, bending, cracks, looseness, and blocked oil passages; repair or replace as required. 2.10 Inspect and replace hydraulic or mechanical lifters/lash adjusters. 2.11 Adjust valves on engines with mechanical or hydraulic lifters. 2.12 Inspect camshaft(s) (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components); replace as necessary. 2.13 Inspect and measure camshaft journals and lobes; measure camshaft lift. 2.14 Inspect and measure camshaft bore for wear, damage, out-of-round, and alignment; determine needed repairs. 2.15 Inspect valve timing; time camshaft(s) to crankshaft. 2.16 Inspect cylinder head mating surface condition and finish, reassemble and install gasket(s) and cylinder head(s); replace/torque bolts according to manufacturers' procedures.
3 Perform inspection and repairs to the fuel, electrical, ignition and exhaust systems	3.1 Inspect, clean or replace fuel injection system components, intake manifold, and gaskets. 3.2 Inspect, service or replace air filters, filter housings, and intake ductwork. 3.3 Inspect turbocharger/supercharger systems; determine necessary action. 3.4 Test engine cranking system; determine needed repairs. 3.5 Inspect and test crankcase ventilation system components; replace as necessary.

		3.6 Inspect and test ignition system components; replace as necessary; verify timing. 3.7 Inspect and diagnose exhaust system; determine needed repairs.

4	Carry out engine block diagnosis and repairs	4.1 Inspect engine block for cracks, warpage and corrosion and determine necessary action. 4.2 Inspect piston oil cooling nozzles/jets for damage, improper alignment and restriction and determine necessary action. 4.3 Clean and inspect cylinder walls, measure cylinder bore and determine necessary action. 4.4 Inspect crankshaft for end play, journal damage and keyway damage. 4.5 Install main bearings and crankshaft. 4.6 Inspect auxiliary shafts, gears and bearings for damage and wear. 4.7 Inspect and reinstall crankshaft vibration damper/harmonic balancer. 4.8 Inspect camshaft bearings for excessive wear and alignment. 4.9 Install timing chain and gear. 4.10 Inspect, measure and service piston rings/wrist pins. 4.11 Assemble piston and connecting rod. 4.12 Re-assemble engine.
5	Carry out tests and repairs to the lubrication and cooling systems	5.1 Disassemble and inspect oil pump 5.2 Measure oil pump clearance 5.3 Perform oil pressure tests 5.4 Inspect, test and flush oil coolers 5.5 Inspect and test the radiator, heater core, pressure cap and coolant recovery systems 5.6 Inspect, replace and adjust drive belts, tensioner and pulleys 5.7 Inspect, test and replace thermostat, coolant by-pass and housing 5.8 Inspect and replace water pump

	5.9	Inspect and replace cooling and heating system hoses, pipes and fittings

Essential Learning Resources:

Learners will have access to a fully equipped automotive workshop to carry out the various maintenance tasks. It should be noted that the following dress code will be in effect for all practical work.

Dress Code:

1. Flip flops or opened toed shoes are not allowed in the automotive workshop. Proper foot attire should be worn to protect your feet, leather safety work boots are recommended.
2. Coveralls must be worn for all practical activities.
3. Safety glasses must be worn at all times in the automotive workshop.

Note: If a student fails to comply with the above dress code, he or she will not be able to participate in the practical session.

Textbooks and Manuals

1. Owner's manuals (various vehicle models)