# COURSE OUTLINE: AST812 - ENGINE SYSTEMS

Prepared: Stephen Kent
Approved: Corey Meunier, Dean, Technology, Trades, and Apprenticeship

| | |
|---|---|
| **Course Code: Title** | AST812: ENGINE SYSTEMS |
| **Program Number: Name** | 6069: AUTO SERV TN LEVEL 3 |
| **Department:** | MOTIVE POWER APPRENTICESHIP |
| **Academic Year:** | 2024-2025 |
| **Course Description:** | Upon successful completion the apprentice will have the ability to explain the operating principles of cooling systems, belt pulley systems, and lubrication systems, and perform maintenance, diagnose and service on these systems, the ability to explain and perform the recommended engine diagnostic and testing procedures, and the ability to explain recommended engine replacement and start-up procedures - all according to manufacturers` recommendations and trade practices. |
| **Total Credits:** | 4 |
| **Hours/Week:** | 0 |
| **Total Hours:** | 36 |
| **Prerequisites:** | There are no pre-requisites for this course. |
| **Corequisites:** | There are no co-requisites for this course. |
| **Essential Employability Skills (EES) addressed in this course:** | EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.<br>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.<br>EES 3 Execute mathematical operations accurately.<br>EES 4 Apply a systematic approach to solve problems.<br>EES 5 Use a variety of thinking skills to anticipate and solve problems.<br>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.<br>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.<br>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.<br>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.<br>EES 10 Manage the use of time and other resources to complete projects.<br>EES 11 Take responsibility for ones own actions, decisions, and consequences. |
| **Course Evaluation:** | Passing Grade: 50%, D<br><br>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation. |

**Other Course Evaluation & Assessment Requirements:**

V. EVALUATION PROCESS/GRADING SYSTEM:

The final grade for this course will be based on the results of classroom, assignments and shop evaluations weighed as indicated:
Classroom 70% of the final grade is comprised of term tests
Shop 30% of the final grade is comprised of attendance, punctuality, preparedness, student ability, work organization and general attitude
(Student will be given notice of test and assignment dates in advance)

The following semester grades will be assigned to students:

Grade
Definition Grade Point Equivalent
A+ 90 - 100% 4.00
A 80 - 89%
B 70 - 79% 3.00
C 60 - 69% 2.00
D 50 - 59% 1.00
F (Fail)49% and below 0.00

CR (Credit) Credit for diploma requirements has been awarded.
S Satisfactory achievement in field /clinical placement or non-graded subject area.
U Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR Grade not reported to Registrar`s office.
W Student has withdrawn from the course without academic penalty.

**Books and Required Resources:**

Automotive Technology: A Systems Approach by Erjavec
Publisher: Cengage Learning Canada Edition: 4th Canadian Edition

**Course Outcomes and Learning Objectives:**

| Course Outcome 1 | Learning Objectives for Course Outcome 1 |
|---|---|
| explain the operating principles of cooling systems, perform maintenance, diagnose and service according to manufacturers` recommendations. | LEARNING OUTCOMES AND CONTENT<br>1 Define the fundamentals of engine cooling systems.<br>• fundamentals of coolant:<br>convection, conduction and radiation<br>temperature effects<br>heat measurement<br>the effects of pressure on boiling points / ratio<br>2 Identify engine cooling system components.<br>• liquid-cooled systems:<br>• full circulation |

| | |
|---|---|
| | thermostat<br>radiators and heater cores<br>pressure caps<br>coolant pumps<br>• fans<br>electrical, viscous, mechanical<br>shrouds and deflectors<br>• oil coolers<br>• coolant level sensors<br><br>3 Explain the operation and effect of engine cooling systems.<br><br>• liquid cooled systems<br>4 Perform inspection and testing for an engines cooling system.<br><br>• visual inspection<br>• PH testing / quality of water<br>• pressure test liquid cooling system<br>• test coolant freeze protection, condition and compatibility<br>• test for both internal and external leakage<br>visual<br>fluorescent dye<br>pressure tester<br>temperature / leak relationship<br>cylinder leakage tester<br>combustion gas tester<br>• check for presence of transfer between systems<br>• test for system flow restrictions<br>• test engine temperature control operation<br><br>5 Research recommended cooling system service and maintenance procedures.<br><br>• external cooling system cleaning<br>• system flushing and anti-freeze replacement<br>• describe procedures for replacement of<br>thermostats<br>fan or fan drives or belts<br>radiators<br>water pump<br>heater cores<br>core plugs<br>flushing of oil coolers |
| **Course Outcome 2** | **Learning Objectives for Course Outcome 2** |
| explain the operating principles of belt and pulley systems, perform maintenance, diagnose and service according the manufacturers` recommendation. | 1 Identify the types and applications of belt and pulley systems.<br><br>• double edged serpentine and V-belts<br>• pulleys<br>• manual adjusters<br>• idlers / tensioners<br>• routing diagrams |

| | |
|---|---|
| | • ratios<br><br>2 Perform recommended inspection and service procedures for belts and pulleys.<br><br>• identification<br>• dimensions<br>• cracks<br>• wear<br>• deterioration<br>• alignment<br>• tension<br>• temperature<br>• pulley wear<br>• bearings<br>remove, replace and adjust<br>belts<br>pulleys<br>idlers<br><br>3 Diagnose and repair belt and pulley systems.<br><br>• check for vibration<br>• check for noise<br>• verify system condition |
| **Course Outcome 3** | **Learning Objectives for Course Outcome 3** |
| explain the operating principles of lubrication systems, perform maintenance, diagnose and service according to manufacturers` recommendations. | 1 Define the fundamentals of engine lubrication systems.<br><br>• friction<br>• hydrodynamic lubrication<br>• engine lubrication components<br>• oil characteristics, properties, additives and classification<br>• lubrication system cooling<br><br>2 Describe the characteristics and application of engine lubrication system components.<br><br>• types oil pumps<br>• oil coolers and heat exchangers<br>• oil filters and protection valve<br>• oil pressure sending unit and pressure relief valve<br><br>3 Explain the operating principles of engine lubrication systems.<br><br>• oil pumps<br>• oil filtering methods and characteristics<br>• engine oils<br>• heat exchangers<br>• protection and pressure relief devices<br>• oil life monitoring<br>4 Perform recommended inspection, testing and service procedures on lubrication systems. |

| | |
|---|---|
| | • visual inspection for oil leaks<br>- engine running<br>- engine off<br>• perform engine oil pressure test<br>• inspect engine oil condition and level<br>• perform oil life monitor reset<br>• identify the sources and detrimental effects of engine oil contamination<br>- worn bearings<br>- leaking gaskets and seals<br>- auxiliary cooler defects<br>- filters<br>- fuel dilution<br>- engine temperatures<br>- oxidation<br>- sludge<br>- chemical reaction of oil and contaminants<br>- oil additives<br>- engine oil sampling<br>• describe engine oil and filter replacement procedures<br>• identify the significance of<br>- selecting the correct engine oil<br>- priming oil pumps and filters<br>- oil and filter change intervals for all driving conditions<br><br>5 Research manufacturers` recommendations for lubrication system service and maintenance.<br><br>• prepare summary of oil pump overhaul and replacement procedures<br>• oil pressure sending units and regulators<br>• cleaning procedures |
| **Course Outcome 4** | **Learning Objectives for Course Outcome 4** |
| explain and perform the recommended engine diagnostic and testing procedures following manufacturers` recommendations. | 1 Explain the fundamentals of engine component failure analysis and diagnosis.<br><br>• define diagnosis as applied to internal combustion engine failures<br>• identify diagnostic procedures for primary and secondary causes of component failure<br>• explain diagnostic procedures for:<br>- lubricating systems<br>- cooling systems<br>- power loss<br>- oil consumption<br>- engine-related noises<br>- vibrations<br>- mechanical failure<br>- normal wear<br><br>2 Perform recommended inspection and testing procedures to |

| | |
|---|---|
| | determine causes of engine failures.<br><br>• perform engine component assessment for failure analysis on:<br>- valve timing mechanism<br>- effect of wear on gears, chains and belts<br>- valve timing<br>- valve lash<br>- balance shafts<br>- camshafts<br>- blocks and crankshafts<br>- cylinders, pistons and rings<br>- connecting rods and pins<br>- bearings and seals<br>- mechanical failure<br>- normal wear<br>3 Explain the principles of operation of engine testing and diagnostic equipment.<br><br>• vacuum testers<br>• compression<br>• cylinder leakage<br><br>4 Perform assigned operations using vacuum, compression and cylinder leakage equipment.<br><br>• vacuum testing<br>• compression testing<br>• cylinder leakage<br>• valve adjustment<br>• identify and verify valve marks and correct valve timing |
| **Course Outcome 5** | **Learning Objectives for Course Outcome 5** |
| explain recommended engine replacement and start-up procedures according manufacturers` recommendation and | 1 Research manufacturers` recommendations for engine removal and installation.<br>• sequence<br>• lifting techniques<br>• storing and supporting components<br>• explain the procedures to remove and replace an engine<br>• draining of fluids and recovery of refrigerants<br>• replacement precautions<br><br>2 Describe the principles and procedures used in the initial start-up of an overhauled engine assembly.<br><br>• oil circuit priming<br>• oil levels<br>• basic timing adjustments<br>• supercharger and turbocharger precautions |

**Evaluation Process and Grading System:**

| Evaluation Type | Evaluation Weight |
|---|---|
| shop | 40% |

| | | |
|---|---|---|
| | Theory Tests | 60% |
| **Date:** | November 12, 2024 | |
| **Addendum:** | Please refer to the course outline addendum on the Learning Management System for further information. | |