



ILLINOIS VALLEY COMMUNITY COLLEGE

COURSE OUTLINE

DIVISION: Workforce Development

COURSE: ATO 1210; Basic Gas Engines

Date: Fall 2016

Credit Hours: 5

Prerequisite(s): None

Delivery Method: **Lecture** **2 Contact Hours** (1 contact = 1 credit hour)
 Seminar **0 Contact Hours** (1 contact = 1 credit hour)
 Lab **6 Contact Hours** (2-3 contact = 1 credit hour)
 Clinical **0 Contact Hours** (3 contact = 1 credit hour)
 Online
 Blended

Offered: **Fall** **Spring** **Summer**

IAI Equivalent –**Only for Transfer Courses**-go to <http://www.itransfer.org>:

CATALOG DESCRIPTION:

The purpose is to give the student a background in the theory, construction, design, operation and service of gasoline piston engines. Laboratory work will consist of the following requirements on a given engine: disassembly, cleaning, inspecting, measuring, recording, machining and reassembly. Students are encouraged to supply their own engine for this course.

GENERAL EDUCATION GOALS ADDRESSED

[See last page for Course Competency/Assessment Methods Matrix.]

Upon completion of the course, the student will be able:

[Choose up to three goals that will be formally assessed in this course.]

- To apply analytical and problem solving skills to personal, social and professional issues and situations.
- To communicate successfully, both orally and in writing, to a variety of audiences.
- To construct a critical awareness of and appreciate diversity.
- To understand and use technology effectively and to understand its impact on the individual and society.
- To work and study effectively both individually and in collaboration with others.
- To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
- To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
- To appreciate the ongoing values of learning, self-improvement, and career planning.

EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

[Outcomes related to course specific goals. See last page for more information.]

Upon completion of the course, the student will be able to:

I. ENGINE REPAIR (NATEF Tasks)

A. General: Engine Diagnosis; Removal and Reinstallation (R & R)

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.
2. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins.
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Remove and replace timing belt; verify correct camshaft timing.
7. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert.
8. Inspect, remove and replace engine mounts.
9. Identify hybrid vehicle internal combustion engine service precautions.
10. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition.

I. ENGINE REPAIR

B. Cylinder Head and Valve Train Diagnosis and Repair

1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures.

2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.
3. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action.
4. Adjust valves (mechanical or hydraulic lifters).
5. Inspect and replace camshaft and drive belt/chain; 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 valve timing components; verify correct camshaft timing.
6. Establish camshaft position sensor indexing.
7. Inspect valve springs for squareness and free height comparison; determine necessary action.
8. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action.
9. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action.
10. Inspect valves and valve seats; determine necessary action.
11. Check valve spring assembled height and valve stem height; determine necessary action.
12. Inspect valve lifters; determine necessary action.
13. Inspect and/or measure camshaft for runout, journal wear and lobe wear.
14. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action.

I. ENGINE REPAIR

C. Engine Block Assembly Diagnosis and Repair

1. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer).
2. Disassemble engine block; clean and prepare components for inspection and reassembly.
3. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.
4. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action.
5. Deglaze and clean cylinder walls.
6. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.
7. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action.
8. Inspect main and connecting rod bearings for damage and wear; determine necessary action.
9. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; determine necessary action.
10. Inspect and measure piston skirts and ring lands; determine necessary action.
11. Determine piston-to-bore clearance.
12. Inspect, measure, and install piston rings.

13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time.
14. Assemble engine block.

I. ENGINE REPAIR

D. Lubrication and Cooling Systems Diagnosis and Repair

1. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core and galley plugs; determine necessary action.
2. Identify causes of engine overheating.
3. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.
4. Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.
5. Inspect, remove, and replace water pump.
6. Remove and replace radiator.
7. Remove, inspect, and replace thermostat and gasket/seal.
8. Inspect and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.
9. Perform oil pressure tests; determine necessary action.
10. Perform engine oil and filter change.
11. Inspect auxiliary coolers; determine necessary action.
12. Inspect, test, and replace oil temperature and pressure switches and sensors.
13. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.

VIII. ENGINE PERFORMANCE (NATEF Tasks)

A. General: Engine Diagnosis

1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins.
2. Diagnose abnormal engine noises or vibration concerns; determine necessary action.
3. Diagnose the cause of excessive oil consumption, coolant consumption, unusual exhaust color, odor, and sound; determine necessary action.
4. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.
5. Perform cylinder cranking and running compression tests; determine necessary action.
6. Perform cylinder leakage test; determine necessary action.
7. Verify engine operating temperature; determine necessary action.
8. Verify correct camshaft timing.

VII. HEATING AND AIR CONDITIONING (NATEF Tasks)

C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair

1. Inspect engine cooling and heater systems hoses; perform necessary action.

REQUIRED SUPPLEMENTAL TASKS (NATEF)

Shop and Personal Safety

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Locate and demonstrate knowledge of material safety data sheets (MSDS).

Tools and Equipment

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (i.e. micrometer, dial-indicator, dial-caliper).

Note: NATEF Tasks are completed by students either individually or with a partner.

COURSE TOPICS AND CONTENT REQUIREMENTS:

- I Basic Engine Operation
 - A. Four stroke cycle.
 - B. Construction
 - C. Major components
 - D. Work, energy, heat
 - E. Thermal efficiency
- II The Cylinder Block
 - A. Purpose of block
 - B. Stresses in block
 - C. Parts of the block
 - D. Manufacture of blocks
 - E. Block designs
 - F. Block service
 - 1. Cleaning
 - 2. Crack detection
 - 3. Cylinder measurement
 - 4. Cylinder coring, honing, deglazing
 - 5. Cylinder sleeves
 - 6. Align-boring
 - 7. Deck inspection, resurfacing
 - 8. Ridge reaming
- III The Crankshaft
 - A. Nomenclature
 - B. Function
 - C. Design and construction
 - D. Forces to be balanced
 - 1. Static
 - 2. Dynamic
 - E. Firing order
 - F. Cylinder angle
 - 1. Even
 - 2. Odd
 - G. Flywheels, vibration dampener
 - H. Crankshaft service
 - 1. Cleaning
 - 2. Grinding and polishing
 - 3. Inspection and measurement
 - 4. Balancing
 - 5. Removal and installation
- IV Engine Bearings
 - A. Bearing Function
 - 1. Support
 - 2. Reduction of friction
 - B. Bearing characteristics
 - 1. Fatigue strength
 - 2. Conformability
 - 3. Embedability
 - 4. Surface action

- 5. Resist corrosion
- 6. Temperature strength
- 7. Thermal conductivity
- C. Bearing materials
- D. Bearing designs
 - 1. Full circle
 - 2. Split
 - 3. Spread
 - 4. Crush
 - 5. Locating devices
- E. Oil clearance
 - 1. Plastigage
 - 2. Rule of thumb
- F. Bearing replacement
- V Engine Lubricating Systems
 - A. Purpose and theory
 - B. Properties of oil
 - C. Oil ratings
 - D. Oil pumps
 - E. Oil filtering systems
 - F. Service and diagnosis
- VI Pistons and Connecting Rods
 - A. Nomenclature
 - B. Characteristics of piston
 - 1. Heat resistance
 - 2. Strength
 - 3. Weight
 - 4. Tightness
 - C. Types of Pistons
 - 1. Cast
 - 2. Forged
 - 3. Hypereutectic
 - D. Thrust faces
 - E. Piston markings
 - F. Piston design
 - 1. Cam grinding
 - 2. Piston head
 - 3. Shirt types
 - 4. Expansion control
 - 5. Surface finish
 - G. Piston rings
 - 1. Design and function
 - 2. Ring materials
 - a. Cast iron
 - b. Chrome
 - c. Moly
 - d. Steel
 - e. Oil control
 - 3. Choosing rings

- H. Piston pins
 - 1. Methods of attachment
 - 2. Methods of lubricating
- I. Connecting rods
 - 1. Design function
 - 2. Types of rods
 - 3. Rod manufacture
 - 4. Lubrication of walls
- J. Piston-connecting rod services
 - 1. Ring groove cleaning – measuring
 - 2. Knurling of pistons
 - 3. Rod reconditioning – measuring
 - 4. Piston inspection – measuring
 - 5. Piston installation
 - 6. Rings – remove – replace
 - 7. Balancing of assembly
 - 8. Pin fitting
 - 9. Piston to wall clearance
 - 10. Piston cleaning
- VII The Cylinder Heads
 - A. Construction
 - 1. Cast iron
 - 2. Aluminum
 - 3. Machine operations
 - B. Design
 - 1. Method of cooling
 - a. Liquid
 - b. Air
 - 2. Combustion chamber
 - a. Wedge
 - b. Hemispheric
 - c. Semi-hemi
 - d. Stratified charge
 - 3. Valve operating mechanism
 - a. L-head
 - b. F-head
 - c. I-head
 - d. Overhead cam
 - e. Dual overhead cam
 - 4. Valve ports
 - a. Seamed
 - b. Cross-flow
 - c. Pre-combustion chamber
 - C. Service
 - 1. Measure valve stem & guide clearance
 - 2. Knurl valve guides
 - 3. Measure cylinder head warpage
 - 4. Grind valves & seats
 - 5. Measure spring tension

6. Measure spring installed height
 7. Cylinder head assembly
 8. Cylinder head installation
 9. Torque cylinder head
- VIII Valves and Valve Trains
- A. Poppet valve
 1. History (instant valve jobs)
 2. Head
 3. Stem
 4. Fillet
 5. Margin
 6. Face
 7. Retainers
 - B. Valve train design
 1. Breathing efficiency
 - a. Diameter of intake
 - b. Exhaust valve (85% as large)
 - c. Lift equal 25% of head diameter
 2. Durability
 3. Cost efficiency
 - C. Types of valves
 1. Flathead
 2. Tulip
 3. SAE valve head
 - D. Valve construction
 1. Steel alloy
 2. Stainless (austenitic)
 3. Bi- and tri- metal
 4. Aluminized
 5. Sodium cooled
 - E. Valve guides
 1. Integral
 2. Replaceable
 3. Function
 4. Wear patterns
 5. Measurements
 - F. Valve seats
 1. Integral
 2. Seat inserts
 3. Induction hardened
 4. Valve face
 5. Seat dimensions
 6. Seat width
 7. Interference angle
 - G. Valve springs
 1. Harmonics
 2. Retainers and keepers
 3. Rotators
 4. Testing

- a. Installed height
 - b. Tension
 - c. Shims
- H. Camshaft
 - 1. Duration
 - 2. Overlap
 - 3. Lift
 - 4. Cam contour
 - 5. Construction
 - 6. Roller cam design
- I. Valve operating mechanisms
 - 1. L-head
 - 2. I-head
 - 3. Rocker arm ratio
 - 4. Types of rockers
 - 5. Hydraulic lifters
 - 6. Lifter operation
 - 7. Cam to lifter contact
 - 8. Valve stem seals
 - 9. Roller lifters
 - 10. Valve lash adjustments
- J. Overhead camshaft
 - 1. SOHC
 - a. With rockers
 - b. Without rockers
 - 2. DOHC
- K. Cam drive systems
 - 1. Gear – driven
 - 2. Chain – driven
 - 3. Chain – drive (OHC engines)
 - 4. Cogged timing belt

INSTRUCTIONAL METHODS:

- 1. Lecture
- 2. Power Point Presentations
- 3. Transparencies
- 4. Videos
- 5. Demonstrations
- 6. Hands-on experience
- 7. ATO 1210 Lab Manual
- 8. Written exams and quizzes

INSTRUCTIONAL MATERIALS:

- 1. ATO 1210 Lab Manual
- 2. Argo Software

STUDENT REQUIREMENTS AND METHODS OF EVALUATION:

- 1. Complete all lab objectives (NATEF Tasks)
- 2. Satisfactorily perform complete engine over-haul according to manufacturer's

- specifications and procedures
- 3. Pass written exams and quizzes
- 4. Attitude
- 5. Work habits
- 6. Attendance
- 7. Safety practices

OTHER REFERENCES

1. "On-Demand" CD-ROM Information System – Mitchell (Both shops)
2. "All Data" Information System (Both Shops)
3. Engine Service – Lewis (Auto office)
4. Automotive Machine Shop – J.F. Reynolds
5. Automotive Engine Rebuilding – James G. Hughes

Course Competency/Assessment Methods Matrix

(Dept/# Course Name)	Assessment Options																																	
For each competency/outcome place an "X" below the method of assessment to be used.	Assessment of Student Learning	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment		
	Direct/ Indirect	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.																																		
I.A.1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.				X										X																				
I.A.2. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins.				X										X																				X
I.A.3. Verify operation of the instrument panel engine warning indicators.				X										X																				

