AUTO 151 Course Outline as of Spring 2021

CATALOG INFORMATION

Dept and Nbr: AUTO 151 Title: AUTOMOTIVE ENGINES
Full Title: Automotive Engines
Last Reviewed: 2/24/2020

Units		Course Hours per Week		Nbr of Weeks	Course Hours Total	
Maximum	7.00	Lecture Scheduled	5.00	17.5	Lecture Scheduled	87.50
Minimum	7.00	Lab Scheduled	6.50	10	Lab Scheduled	113.75
		Contact DHR	0		Contact DHR	0
		Contact Total	11.50		Contact Total	201.25
		Non-contact DHR	0		Non-contact DHR	0

Total Out of Class Hours: 175.00 Total Student Learning Hours: 376.25

Title 5 Category:	AA Degree Applicable
Grading:	Grade Only
Repeatability:	00 - Two Repeats if Grade was D, F, NC, or NP
Also Listed As:	
Formerly:	AUTO 51

Catalog Description:
Theory, design, operation, troubleshooting and overhaul of internal combustion automobile engines. Lecture, demonstration and practical lab experience also emphasize proper and safe use of tools and equipment. Prepare students to take the ASE (Automotive Service Excellence) Engine Repair Certification exam (A-1).

Prerequisites/Corequisites:

Recommended Preparation:
Eligibility for ENGL 100 or ESL 100 or equivalent; AND Course Completion of IED 190; AND Course Completion of AUTO 80 or DET 179

Limits on Enrollment:

Schedule of Classes Information:
Description: Theory, design, operation, troubleshooting and overhaul of internal combustion automobile engines. Lecture, demonstration and practical lab experience also emphasize proper and safe use of tools and equipment. Prepare students to take the ASE (Automotive Service Excellence) Engine Repair Certification exam (A-1). (Grade Only)

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Transfer Credit:
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ARTICULATION, MAJOR, and CERTIFICATION INFORMATION:

AS Degree:	**Area**	Effective:	Inactive:
CSU GE:	**Transfer Area**	Effective:	Inactive:
IGETC:	**Transfer Area**	Effective:	Inactive:

CSU Transfer:	Effective:	Inactive:
UC Transfer:	Effective:	Inactive:

CID:

Certificate/Major Applicable:
Both Certificate and Major Applicable

COURSE CONTENT

Student Learning Outcomes:
Upon completion of the course, students will be able to:
1. Troubleshoot and overhaul an internal combustion automobile engine.
2. Safely and properly use tools and equipment.
3. Demonstrate the knowledge needed to pass the ASE certification test A1-Engines.

Objectives:
Students will be able to:
1. Relate principles of internal combustion engine operation to engine performance and repair.
2. Identify internal combustion engine parts by name.
3. Explain various engine classifications and systems.
4. Identify and safely use shop tools, equipment, and chemicals.
5. Measure components and processes and interpret readings, applying common instruments and measurement systems used in automotive repair.
6. Perform calculations common to automotive diagnosis and repair.
7. Diagnose engine and engine-related problems and determine and select and perform the appropriate repair procedure.
8. Locate and interpret repair information from print and computer-based sources.
9. Disassemble and reassemble an engine and engine parts in a proper and orderly manner, identifying and labeling parts.
10. Analyze wear and damage to engine and engine-related components and parts and calculate calibrations to accomplish corrections.
11. Explain the theory of engine balancing and equalize part weight to balance an engine.
12. Explain cooling system theory.
13. Install an engine in a vehicle and inspect and complete the job following engine starting and break-in.

14. Pre-lube and make all required adjustments prior to starting an engine.
15. Demonstrate eligibility to enter the automotive trade as an apprentice level technician specializing in engine repairs.

Topics and Scope:

I. Engine Operation
- A. Principles of internal combustion engine operation
  - 1. Volume
  - 2. Atmospheric pressure and vacuum
  - 3. Liquids, gases and combustion
  - 4. Friction
  - 5. Work and force
  - 6. Torque
  - 7. Power
  - 8. Energy
    - a. Chemical
    - b. Electrical
    - c. Mechanical
    - d. Thermal
    - e. Radiant
- B. Four stroke engine operation
  - 1. Intake
  - 2. Compression
  - 3. Power
  - 4. Exhaust
- C. Air/fuel mixture ratio
  - 1. Stoichiometric mixture ratio
  - 2. Interactive combustion and counterflow
- D. Ignition
- E. Engine parts
- F. Engine classifications and systems

II. Shop Equipment and Safety
- A. Tools
  - 1. Principles of tool mechanics
  - 2. Selecting automotive hand tools
- B. Fasteners
  - 1. Metric
  - 2. American
  - 3. Fastener grades
    - a. Tensile strength
    - b. Proper torque specifications
  - 4. Extracting broken fasteners
- C. Micrometer
  - 1. Reading a micrometer
    - a. Ten-thousandths of an inch
    - b. One-hundredths of a millimeter
  - 2. Calculating component size using a micrometer
- D. Dial Indicator
  - 1. Reading a dial indicator
  - 2. Measuring valve movement
  - 3. Determining stem to guide clearance

4. Measuring end play on crank and cam shafts
E. Feeler gauges
1. Measuring end and side play
2. Measuring gap
3. Measuring valve lash
F. Dial bore gauge
1. Measuring cylinders
2. Measuring housing boards
G. Automotive safety
1. Chemicals
2. Asbestos
3. Proper handling of toxic waste

III. Reference Materials
A. Repair specifications
B. Engine manuals
C. Car manuals
D. Computer-based reference materials

IV. Engine Removal, Disassembly and Cleaning
A. Accessing procedures
1. CD rom
2. Online information
B. Disassembly and cleaning
1. Marking components for easy reassembly
2. Diagnosing engine problems
a. Assessing component problems
b. Determining malfunctions
C. Cleaning
1. Purpose
2. Processes
D. Crack detection
1. Magniflex
2. Chemical dye penetrant
3. Pressure testing
4. Vacuum testing
E. Repair methods
1. Plugging
2. Welding
a. Spray
b. TIG (tungsten inert gas)
F. Toxic waste disposal
1. Proper chemical disposal methods
2. Laws and regulations

V. Making Component Measurements
A. Cylinder head
1. Valve guide bore
2. Valve stems
3. Valve spring installed weight
4. Valve margins
5. Valve seat length
6. Cylinder head warpage
B. Block
1. Cylinder bore

2. Block warpage
3. Main housing bore
4. Connecting rod housing bore
5. Cam shaft housing bore
6. Crankshaft and main rod journals
7. Cam shaft journals
8. Cam shaft lobes
9. Crown wall thickness on main rod bearings
10. End play on the crank and camshafts
11. Oil pump gear clearance
12. Cylinder wall surface theory

C. Using measurements readings to determine types of repairs

VI. Cylinder Head

A. Theory

B. Service

1. Head disassembly
2. Carbon removal
3. Crack inspection and repair
4. Valve guide inspection and repair
5. Reaming valve guides
6. Valve guide seals
7. Resurfacing heads

C. Springs, valves and valve seats

1. Valve springs
2. Pushrods
3. Rocker arms
4. Valves and valve service
5. Valve seats and service
    a. Grinding the valve seat
    b. Calculating angles for 3-angle valve job

D. Valve face resurfacing

1. Machine set up
2. Grinding process
3. Inspection for margin width
4. Grinding the valve tip to specifications
5. Chamfering the valve top

E. Cylinder head assembly

VII. Cam Shaft and Valve Train Components

A. Measuring cam shaft journals and lobes

B. End play on cam shaft

C. Valve train inspection

1. Lifters
    a. Mechanical
    b. Hydraulic
    c. Roller
2. Push rods
    a. Wear
    b. Straightness
3. Rocker arm ratios
    a. Pivot
    b. Shaft

D. Cam shaft theory

1. Cam lobe shape
2. Valve timing
    a. Duration
    b. Lift
    c. Valve overlap
    d. Valve lash
    e. Regrinding cams
    f. Repairing worn cam lobes

E. Methods for synchronizing valves to pistons
1. Gears
2. Chains
3. Timing belts

F. Effect on engine performance

VIII. Cylinder Block Preparation
A. Main bearing caps
B. Measuring the bores
C. Checking block for warpage
D. Inspecting cylinder bores
E. Reboring cylinders
F. Honing cylinders to size
G. Chamfering cylinders
H. Installing cylinder sleeves
I. Lifer bore inspection
J. Final block preparation

IX. Crankshafts
A. Crankshaft design
B. Crankshaft condition
1. Taper
2. Out of round
3. Roughness

C. Regrading the camshaft to precise thousandths
D. Measuring vertical oil clearance
1. Plastigage
2. Crown wall thickness
3. Determining proper undersize bearings to use

E. Engine balancing
1. Theory thereof
2. Types of imbalance
3. Equalizing part weight

X. Piston and Connecting Rod Service
A. Pistons
1. Cast
2. Forged
3. Piston head shapes
4. Piston clearance
5. Piston pin offset
6. Wear problems
7. Ring groove wear/side clearance check
8. Piston service
    a. Ring groove service
    b. Knurling pistons

B. Piston rings

1. Oversize
2. Compression ring design
    a. Torsional twist rings
    b. Reverse twist rings
    c. Ring materials and coatings
3. Oil control rings
4. Ring gap clearance
5. Installing rings on pistons
    a. Ring gap position
    b. Staggering the ring positions

C. Piston pin retaining methods
1. Press fit in the rod
2. Full floating
3. Installing pistons and rods together
4. Direction of piston on connecting rod

D. Connecting rods
1. Alignment
2. Resizing the crankshaft end
3. Rod piston end bushing installation

XI. Engine Assembly

A. Reassembly on the block
1. Cam bearing installation
2. Installation of the camshaft
3. Installation of the crankshaft
4. Checking end play on the crankshaft
5. Timing gears
6. Synchronizing valve train components
7. Installing pistons and rods
8. Installing cylinder heads
9. Installing lifters and other valve train components
10. Adjusting valve lash
11. Installation of oil pump and pan
12. Pressure checking oil system
13. Installation of intake manifold

B. Testing the engine on a test stand

XII. Lubrication

A. Oil
B. Oil pumps
C. Priming the system
D. Oil filters
E. Crank case ventilation

XIII. Cooling System

A. Theory
B. Cooling system circulation
C. Belts and hoses
D. Thermostat
E. Thermostat bypass
F. Radiators
G. Water pumps

All topics are covered in both lecture and lab parts of the course

Assignment:

Lecture-Related Assignments:
1. Reading: 20 - 50 pages per week
2. Notebook: Compile lab notes, class notes, and handouts
3. Tests and final exam
4. Exercises using formulas and calculations related to engine performance and operation

Lab-Related Assignments:
1. Lab activities: hands-on engine diagnosis, repair, and rebuilding activities
2. Lab notes: record measurements and calculations for all activities
3. Performance exams: demonstrate a running reassembled engine

Methods of Evaluation/Basis of Grade:

Writing: Assessment tools that demonstrate writing skills and/or require students to select, organize and explain ideas in writing.

None, This is a degree applicable course but assessment tools based on writing are not included because problem solving assessments and skill demonstrations are more appropriate for this course.	Writing 0 - 0%

Problem Solving: Assessment tools, other than exams, that demonstrate competence in computational or non-computational problem solving skills.

Lab reports, calculation exercises	Problem solving 5 - 10%

Skill Demonstrations: All skill-based and physical demonstrations used for assessment purposes including skill performance exams.

Lab activities and performance exam	Skill Demonstrations 30 - 40%

Exams: All forms of formal testing, other than skill performance exams.

Tests and final exam	Exams 35 - 45%

Other: Includes any assessment tools that do not logically fit into the above categories.

Attendance and participation; notebook	Other Category 10 - 15%

Representative Textbooks and Materials:
Automotive Engines; Diagnosis, Repair, Rebuilding. 7th ed. Gilles, Tim. Delmar Publications. 2014 (classic)
Instructor prepared materials.