San Bernardino Valley College
Curriculum Approved: May 6, 2002
Last Updated: April 26, 2002

I. CATALOG DESCRIPTION:

A. Department information:

Division:	Technical
Department:	Automotive
Course ID:	AUTO 090
Course Title:	Engine Repair
Units:	6
Lecture:	3 Hours
Laboratory:	9 Hours
Prerequisite:	None

B. Catalog and Schedule Description:
This course is based on NATEF standards and designed for students and current technicians to gain knowledge and skills in automotive engine repair. Instruction in removal, disassembly, inspection, reconditioning and reassembling of engines. Rebuilding of components using automotive machine shop equipment. Study progressing to the operation of automotive machine shop equipment. Theory and instruction of gasoline, diesel and rotary engines. Theory and practical work in the repair and rebuilding of automotive gasoline, diesel, and rotary engines. Shop instruction to include safety, engine reconditioning, auto shop machinery, and failure analysis of components. This course may be used in preparation for the Automotive Service Excellence (ASE) National Test A-1.

C. Schedule Description:
Theory and practical work in the repair and rebuilding of automotive gasoline, diesel, and rotary engines. Instruction to include safety, engine reconditioning, shop machinery, and failure analysis. (ASE) National Test A-1 applicable.

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: One

III. EXPECTED OUTCOMES FOR STUDENTS:

Upon completion of the course the student should be able to: Upon completion of the 1st semester, the student will be able to:

A. Recognize engine types and identify the components;
B. Demonstrate diagnostic service;
C. Differentiate serviceable parts from worn parts using precision instruments.
D. Understand proper safety practices;
E. Apply knowledge and skills attained to pass the (A-1) Automotive Service Excellence (ASE) national test for automobile engines.

Upon completion of the 2nd semester, the student will be able to:

F. Operate simple engine machine shop equipment;
G. Calculate horsepower using engineering formulas;
H. Machine and assemble an automobile engine, complete overhaul.

Upon completion of the 3rd semester, the student will be able to:

I. Operate complex engine machine shop equipment;
J. "Blueprint" an automotive engine;
K. Balance components of an automobile engine.

IV. COURSE CONTENT:

A. Shop safety
   1. Hazardous materials
   2. Material Safety Data Safety Sheets
   3. Machinery Hazards
B. Shop techniques
   1. Tools
   2. Torque
   3. Fasteners
C. Engine operation and Identification
   1. Engine principles

a) Energy and Power
b) Four-stroke operation
c) Bore, stroke, displacement
d) Compression ratio

2. Horsepower
   a) Horsepower calculations
   b) Watts = horsepower
   c) Altitude vs. horsepower
   d) Gross vs. net horsepower
   e) DIN horsepower, JIS horsepower, SAE horsepower

D. Lubrication
   1. Properties of engine oil
      a) Types of oil
      b) Oil ratings
      c) Operating conditions and change intervals
   2. Engine lubrication system
      a) Oil passages in the block
      b) Oil pumps, regulators
      c) Oil filters
      d) Oil coolers
      e) Positive crankcase ventilation

E. Electrical system
   1. Batteries
      a) Purpose of battery
      b) Construction of battery
      c) Ratings and testing of battery
      d) Proper battery jump starting
   2. Cranking circuit
      a) Starting motors
      b) Testing and trouble shooting
   3. Charging circuit
      a) AC Generators
      b) Testing and trouble shooting
   4. Ignition systems
      a) Principles of operation
      b) Types of ignition systems
      c) Trouble shooting, service, inspection

F. Fuel and emission systems
   1. Gasoline
      a) Grades of gasoline and properties
      b) Combustion chemistry, abnormal combustion
      c) Valve recession and unleaded fuels
      d) Government fuel testing and standards
   2. Fuel system operation
      a) Carburation, mechanical pumps
      b) Fuel injection, electric pumps
      c) Throttle-body injection
      d) Port fuel injection
   3. Emission systems
      a) Need for emission controls
      b) Chemistry of emission controls
      c) Positive ventilation systems
      d) Air-pump systems
      e) Evaporative emission control systems
      f) Exhaust gas recirculation system
      g) Catalytic converters

G. Heat transfer

1. Coolant
    a) Antifreeze properties
    b) Organic additive technology coolant
    c) Propylene glycol antifreeze
    d) Phosphate free antifreeze
    e) Hydrometer testing
    f) Recycling/disposing of coolant
2. Cooling system
    a) Purpose and function
    b) Design
    c) Radiators and caps
    d) Coolant fans
    e) Water pumps
    f) Thermostatic fans
    g) Coolant recovery system
    h) Passenger compartment heating
    i) Cooling system maintenance
    j) Common causes of overheating

H. Engine condition diagnosis
1. Typical engine related complaints
    a) Engine smoke
    b) Engine noise
    c) Rough running/power loss
    d) Excessive oil, fuel, and water consumption
    e) Low oil pressure
2. Engine testing
    a) Compression test, wet, dry, running
    b) Cylinder leakage test
    c) Power balance test
    d) Vacuum testing
    e) Exhaust gas analyzing and combustion efficiency
    f) Oil analysis
    g) Timing chain slack diagnosis
    h) Studying test results and mechanical failures

I. Engine repairs, removal and disassembly
1. Types of repairs
    a) Repair as needed, valve job
    b) Minor overhaul
    c) Major overhaul
    d) Short block
    e) Fitted block
    f) Long block
    g) Remanufactured engines
2. Engine Removal
3. Engine disassemble
    a) Removing cylinder ridge
    b) Piston removal, inspection
    c) Rotating assembly removal
    d) Cylinder head disassembly

J. Engine cleaning, crack detection, and repair
1. Cleaning techniques
    a) Chemicals cleaners
    b) Ultrasonic cleaners
    c) Vibratory cleaning
    d) Media blasters
    e) Hot vs. cold solutions
2. Inspection
    a) Visual inspection

b) Dye penetrate
c) Pressure testing

3. Crack repair
   a) Welding cast
   b) Welding aluminum
   c) Crack plugging

K. Engine measuring and math
   1. Precision instruments
      a) Micrometers
      b) Dial gauges
      c) Standards and thickness gauges
   2. Engine math and formulas

L. Cylinder head design and service
   1. Construction and styles
   2. Head overhaul
      a) Disassembly and inspection
      b) Resurfacing
      c) Straightening
      d) Valve guide reconditioning
      e) Valve rotator spring testing
      f) Seat grinding
      g) Face grinding
      h) Reassemble
      i) Cylinder head flow versus horsepower

M. Camshaft and valve train
   1. Function and design
   2. Camshaft replacement
   3. Drive types
   4. Camshaft to valve linkage
   5. Valves
   6. Mechanical service and diagnosis

N. Engine block
   1. Construction
   2. Block service

O. Internal components
   1. Purpose of pistons, rings, and connecting rods
   2. Pistons
      a) Design
      b) Piston pins
      c) Service
   3. Rings
      a) Style
      b) Installation
   4. Connecting rods
      a) Design
      b) Rod reconditioning

P. Crankshaft and bearings: Crankshaft
   1. Purpose and design
   2. Inspection
   3. Reconditioning

Q. Engine Assembly
   1. Block preparation
   2. Installing components
   3. Assembly chemicals
   4. Gaskets
   5. Engine manufacturers specifications

R. Engine installation and in-vehicle service
   1. Installation
   2. Start-up system tests
      a) Electrical
      b) Cooling
      c) Lubrication
   3. Engine break-in
      a) Precautions
      b) Break-in oil
      c) Operating parameters

S. Automotive Service Excellence
   1. History of ASE
   2. Sample ASE type questions

V. METHODS OF INSTRUCTION:

A. Lecture: Instructional lectures will emphasize safety aspects in an automotive repair environment, types of engines, supporting systems, failure analysis, and construction.

B. Discussion: Topics for discussion will be related to automotive engines, machinery operation, testing and theory. (Typical) What are the advantages of using four valves per cylinder as opposed to two?

C. Lab demonstrations: Instructor will demonstrate tasks set forth by NATEF standards and outlined in workbook.(Typical lab demonstration) Check, record and analyze engine compression both wet and dry.

IV. TYPICAL ASSIGNMENT(S):

A. Reading: Read textbook and review answer questions at end of chapter: Describe the new engine break-in procedure, and why it is necessary.

B. Critical thinking and problem solving
   1. Review a manufacturers procedures and write an overview of the article
   2. Inspect and evaluate failed parts, then write a report
   3. Compare the cost of a proper engine repair to a cut rate repair demonstrating cheaper is not economical.

C. Lab assignments (Typical)
   1. Complete task sheets as per NATEF standards, from workshop textbook (Copy on file in Technical Dept.).
      a) Perform machine work to complete a “valve job”.
      b) Write a work order detailing customer’s repair needs.
      c) Evaluate a customer’s vehicle and prepare an accurate cost of repairs.

VI. EVALUATION(S):

A. One midterm and final examination
   1. Essay questions, Multiple choice and True/False.
      Typical questions:
      a) Explain why a 50/50 mixture of antifreeze and water is commonly used as coolant.
      b)What are the visual checks to determine engine condition?

B. Chapter review questions (Example)
   1. Explain how a micrometer is read.
   2. How is thrust-bearing clearance measured?

D. Communication: Writing assignments:
   1. Research paper pertaining to automotive technology
   2. Compose a work order detailing customers needed repairs

E. Frequency of evaluation
   1. One mid-term evaluation
   2. One final examination
   3. Weekly assigned laboratory projects
   4. One writing assignment
   5. Text book chapter review questions, approximately 18 chapters with 10 questions per chapter
   6. Four in-class quizzes with 10 critical thinking questions

F. Levels of evaluation upon repetition

1. First enrollment Students are expected to:
   a) Recognize engine types and name the components. Typical Question: Sketch a 4 stroke-cycle engine and identify the components.
   b) Selection of and proper use of tools Typical questions:
      i) What tools would be used to adjust the valves on a Toyota Camary engine?
      ii) What is the importance of a torque wrench?
   c) Distinguish between usable and failed components. Lab assignment:
      i) Examine failed parts and compare to specification found in a service manual.
      ii) Using a live vehicle, that prior to class has been set with a malfunction, student must solve problem.
   d) Understand proper safety practices. Typical Question:
      i) What type of extinguisher is used on a gasoline fire?
      ii) Explain "rotating hazards".
   e) Disassemble and reassemble a small engine
   f) Assigned lab projects as per NATEF standards
   g) Tasks P-1 95% of 16
   h) Tasks P-2 80% of 23
   i) Tasks P-3 50% of 20
2. Second enrollment Students are expected to:
   a) Demonstrate diagnostic service. Typical lab assignment
   b) Appraise the condition of an engine and calculate the cost of repairs. Typical lab assignment: Using test equipment, find the cause of a failure and prepare a written estimate. This is to be accomplished with the aid of vendors and industry labor guides.
   c) Understand the operation of machine shop equipment. Typical question:
      i) Explain why it is important to center a boring bar
      ii) What is the typical fit of a wrist pin bushing?
3. Third enrollment students are expected to:
   a) Setup and operate complex automotive machines, examples boring bar, pin holding, cylinder head broach, valve grinder. Typical question:
      i) What is an interference valve seat fit?
      ii) Recondition a set of connecting rods
   b) Assemble an automobile engine blueprinting to optimum manufacturers specifications. Typical Lab Assignment: Completely rebuild an automobile engine returning all specifications to OEM standards

VIII. TYPICAL TEXT(S):

. Halderman James D., Automotive Engines (2nd Edition), Columbus, Ohio: Prentice Hall 2000.
Schawaller Anthony, Motor Automotive Technology (3rd Edition), Albany, New York: Delmar Publishers.
Gilles Tim, Automotive Engines (4th Edition), Albany, New York, Delmar Publishers 2002.

IX. OTHER SUPPLIES REQUIRED OF STUDENTS:

Personal safety gear to include safety glasses, adequate works clothes and shoes providing proper personal protection.