

Course Syllabus
FALL, 1999

Engine Performance Measurement

IET 219

A course in the Tuning, Diagnosis, and Performance
Enhancement of Internal Combustion Engines

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Course Description:

The course is designed to provide the student with extensive experience in vehicle fuel and ignition systems and their impact on heat engine performance. Specific areas such as high energy ignition, aspiration, emission control and engine testing will be covered. The dynamometer, flow bench, infrared exhaust gas analyzer, diagnostic oscilloscope, distributor curve tracer, are taught for mastery. Motivation for this course can rest in everything from low emissions, fuel economy, or power production!

- * It is required that all students either wear their own prescription eyeglasses or safety glasses during all demonstrations and laboratory work. No sandals or open-toed shoes will be worn.
- *If any student is not wearing their glasses, the student's grade will be lowered one full letter grade and all work in the lab will stop for **all students** for the day!
- * Although the Power Lab has a good number of tools, specialty tools or a good set of hand tools might make your day much smoother!

Course Text:

Engine Performance Diagnosis and Tuneup, Classroom and Laboratory versions
2nd Edition, Roger Fennema, Editor, Harper and Row

Course Competencies:

At the conclusion of the course, the students will be able to:

1. Accurately operate all functions on the oscilloscope analyzer
2. Operate all functions on the distributor curve tracer and derive an advance curve for a distributor
3. Operate a combustion analyzer
4. Operate the bolt-on dynamometer
5. Disassemble, rebuild, set up, and reassemble a carburetor
6. Disassemble, test, and reassemble an HEI General Motors distributor
7. Perform a quantitative measure of engine fuel consumption
8. Explain how the following emission controls operate:TAC, EGR, catalytic converter, air injection
9. Describe, using a block diagram, how electronic fuel injection operates

Course Outline:

1. Principles of engine diagnosis
2. Engine operation--air/fuel requirements
3. Engine ignition--HEI
4. Carburetion

5. Emission control
6. Fuel Injection
 - Mechanical
 - Electronic
7. Supercharging and turbocharging
8. Equipment operation
 - oscilloscope
 - infrared exhaust gas analyzer
 - Allen distributor curve tracer
 - fuel consumption meter
 - flow bench
 - large or small engine dynamometer

Course Assignments:

1. Examinations--2 @ 300 points possible each
2. Sun diagnostic Oscilloscope Tuneup using the official data sheet(100 points)
3. Software Operation(100 points)
4. Task Completion Sheet(100 points)
5. THEN Choose one of the following(for 100 points)

In every case a 5-page report will be produced (3 pages of text and 2 pages of illustration and graphs) word processed, color graphics, and graph using Excel.

a. Go Power Dynamometer Research

Either the large or small dynamometer may be used. A minimum of one variable will be selected(timing, carburetion settings, plug gap, plug type, etc.). Then, torque, horsepower, and RPM curves will be run... Your grade will be determined on sophistication, quality of the final calculations and curves.

b. OTC digital Scanner performed on a vehicle

c. Snap-On digital scanner performed on a vehicle

d. Flow Bench Research

A minimum will be a flow run on one port, run through a variety of flow rates. Change in flow characteristics will be measure, resulting from modification with a die grinder, clay, or cardboard. Graphs must be professionally produced!

e. Fuel Consumption Research

The fuel consumption instrument will be installed on an operating engine and then the fuel consumption will be measured while

monitoring the effect of one variable that has been changed. Graphs must be professionally produced!

f. Distributor Machine worksheet

g. HEI distributor worksheet

h. 4-barrel disassembly, cleaning, rebuild, all specs set, and then reassembly

i. Small Engine Dynamometer

Grading Procedure:

1. All assignments will be turned in on the day designated during the class time for the course. No grade will be given for late work !
2. No make-up assignments or examinations will be allowed except if provision for such circumstances is made in advance of the date in question.
3. All written work will be evaluated on the following criteria:
 - a. neatness
 - b. spelling
 - c. content quality
 - d. completeness
4. Please ask questions if assignments are unclear. The final responsibility for misunderstandings and late work rests with the student.
5. Points will be assigned for each student's work. The total points obtained throughout the course will then be evaluated according to the follow chart:

A	100-90%
B	90-80%
C	80-70%
D	70-60%
F	60 and Below
6. **Missing class is not OK.** Discussion, questions, safety instruction, and instruction on machines are all valuable and should not be missed. Absences cause expensive wear and tear on equipment, supplies, and facility. Demonstrations on equipment and technique cannot be given over.
7. Students are expected to perform ongoing cleaning and minor maintenance on equipment in the laboratory. Work areas should be straightened up and clean before leaving the Power Laboratory.
8. All written work will be typed or word-processed double-spaced, with 1" margins. Papers will be stapled in the upper left hand corner.
9. In those courses where laboratory work is done, cleanup assignments will be made. For each day that cleanup is not done completely, for whatever reason, one percentage point will be subtracted from the percent accumulated for a grade in the class.
10. Appointments can be made directly with Dr. Wieking. His Voice mail and Power Lab number are 963-1770. WIEKINGB@CWU.edu
11. "Close" grades will be determined by class attendance patterns, enthusiasm, and willingness

Carburetor Components

These are the components that you are to be responsible for!

Venturi
Choke
Throttle
Accelerator Pump

Automatic choke
float
Float needle/seat
Idle mixture screw
Idle speed screw
Fast-idle (cold idle) screw
Slow- idle (hot idle) screw
Throttle-stop solenoid(anti diesel solenoid)
metering rods
main jet
Idle jet
Power valve
Choke break(choke pulloff)

Engine Performance Measurement Course Schedule

Week #	Chapter/Topic	Assign Due
1	* Engine operating Principles 1 * Air/Fuel Reqmts. 2	Background Sheet
2	* Engine operating Principles 1 * Air/Fuel Reqmts. 2	
3	Emission Control 5,18,19,20,21	
4	Ignition System 8,9,10,11	
5	Fuel System Operation 12 Carburetion 13	Examination #1
6	Electronic Fuel Injection 16	
7		first Lab due
8		second Lab due
9		third Lab due
10		fourth Lab due Exam #2 on the regular scheduled final time

Name _____

Task Completion Record Engine Performance Measurement

Instructions: Each of the following tasks is to be performed this quarter. When you have completed four or five, contact Dr. W, who will punch off your Task Completion Record. This Record is the only official document showing that your efforts have been noticed and recorded! This is Mastery Learning where Dr. W must ascertain that you have all the experience and knowledge connected with each Task. You may be re-cycled if you do not exhibit the minimum quality standard that Dr. W believes is acceptable!

1	Compression test on four cylinders
2	Test manifold vacuum on a running engine
3	HEI Distributor sheet(syllabus)
4	Ignition wires--remove!, test with VOM, and re-install
5	Carburetor--disassemble, set, measure, describe to W
6	Tuneup--SUN Investigator sheet(according to SUN sheet provided in syllabus)
7	Float--adjustment, and measurement
8	Automatic choke--set
9	Fast idle--set
10	TAC valve on air cleaner--measurement with tester
11	Infrared efficiency meter--HC and CO
12	Spark plugs--read and diagnose 4 spark plugs. Conduct a "plug chop" on plug

Distributor Diagnosis Experiment Sheet

Name _____

Perform these tests on the red-and-white Allen distributor tester.
Make sure that you refer to your tuneup specification references!

1. Point Resistance _____
2. Dwell measurement(cam angle) _____
3. Dwell variation _____
4. Point Bounce --"extra arrows" _____
5. Cam Lobe accuracy--"cam symmetry" _____

Coil and condensor tests **Perform these on the slant-face grey tester**

1. condensor leakage _____
2. condensor series resistance _____
3. condensor value(microfarads) _____
4. condensor charging action(describe(_____
data must be in your possession when you go for task checkoff!

High Energy Distributor Exercise...HEI!
Name _____

Note: Each student will complete and turn in this worksheet during their verbal checkoff. You will be responsible for all terminology and operation.

1. Using an ohmmeter, measure the resistance of the **pickup coil**. Wiggle the connectors--do you have any intermittent problems Explain!_____

2. Check for **pickup coil**-to-housing shorts _____ ohms

3. Spin the **timer core**--what is the maximum voltage that you can read from the **pickup coil**?_____ volts

4. Place your distributor in the Distributor Tester--connect an oscilloscope to the **pickup coil** and adjust for 1000 RPM--Draw the waveform that you see.

5. Measure the primary and secondary resistance of the **ignition coil**
primary _____
secondary _____

6. Measure the **carbon button** resistance _____ ohms

7. Completely disassemble your unit and make a sketch, naming all parts for Dr. W. Make all drawings in a clear and professional manner on a separate piece of paper.