



CREDIT COURSE OUTLINE

I. COVER PAGE

(1) MAG 31

(2) EQUIPMENT TECHNICIAN: FUEL SYSTEMS & MACHINE UNDERCARRIAGE

(3) 8

Number	Title	Units
(4)	Lecture / Lab Hours: Total Course Hours	(8) Classification:
	Total Lec hours: 108.00	Degree applicable: X
	Total Lab hours: 108.00	Non-degree applicable:
	Total Contact hours: 216.00	Basic skills:
	Lec will generate <u>0</u> hour(s) outside work.	(9) RC Fulfills AS/AA degree requirement: (area)
	Lab will generate <u>0</u> hour(s) outside work.	General education category:
(5)	Grading Basis: Grading Scale Only X	Major: MECHANIZED AGRICULTURE
	Pass/No Pass option	Certificate of: MECHANIZED AGRICULTURE
	Pass/No Pass only	Certificate in:
(6)	Advisories: Eligibility for Math 101 Eligibility for English 126 Eligibility for English 125	(10) CSU Baccalaureate: X
(7)	Pre-requisites (requires C grade or better): Corequisites:	(11) Repeatable: (A course may be repeated three times) 0

(12) Catalog Description:
This course provides in-depth instruction in diesel engine fuel systems, tuning, and troubleshooting procedures. Additional instruction will cover differentials, final drives, braking and steering systems, tracks, and machine undercarriage. Emphasis will be placed on fuel injection system calibration and adjustment, and the procedures used to test and adjust various undercarriage components.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

- I. Properly diagnose, tune, and repair diesel fuel system.
- II. Trouble-shoot and repair problems and failures associated with differentials, steering clutches, brakes, final drives and track systems.

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

- I. Demonstrate the proper safety procedures related to fuel systems repair and tune-up.
- II. Explain governing systems and components.
- III. Identify fuel system components and their functions.
- IV. Explain horsepower and torque.
- V. Calculate fuel consumption of a diesel engine.
- VI. Explain emissions requirements as related to diesel engines.
- VII. Exhibit the ability to trouble shoot a diesel fuel system.
- VIII. Explain the differences between MUI, EUI, HEUI, and common rail diesel fuel systems.
- IX. Demonstrate electronic diesel engine troubleshooting techniques.
- X. Demonstrate fuel system adjustments and repair.
- XI. Troubleshoot electronic diesel engine components.
- XII. Explain how various mechanical diesel fuel pumps operate.
- XIII. Demonstrate proper valve adjustments on multiple diesel engines.
- XIV. Explain the operations of diesel unit injectors.

- XV. Test and diagnose injector functions for proper operation.
- XVI. Demonstrate proper diesel fuel injector sleeve removal and installation.
- XVII. Describe exhaust after-treatment systems and their function.
- XVIII. Demonstrate proper safety procedures related to transmissions as well as the tools and equipment used to repair these systems.
- XIX. Demonstrate knowledge and understanding of theory, operation, and terminology related to transmissions, including gear ratios, types of gears, and clutches.
- XX. Demonstrate the ability to correctly disassemble, repair and reassemble a torque converter.
- XXI. Demonstrate the ability to correctly disassemble, repair and reassemble a flywheel clutch.
- XXII. Perform correct disassembly and assembly and trace power flow of a planetary power-shift transmission.
- XXIII. Perform correct disassembly and assembly and trace power flow of countershaft power-shift transmission.
- XXIV. Demonstrate ability to disassemble, inspect and identify components, and reassemble hydraulic control valves used in power-shift transmissions.
- XXV. Identify various bearing common to drive systems and demonstrate correct procedures in handling bearings.
- XXVI. Measure clutch wear using outside micrometers and dial calipers to determine wear and reusability.
- XXVII. Use reusability guidelines and service literature to determine component wear.
- XXVIII. Diagnose and repair transmission systems using pressure gauges, service literature and operational checks.
- XXIX. Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.
- XXX. Exhibit habits of cleanliness and organization in shop practices.
- XXXI. Demonstrate the ability to safely rig and lift heavy components using chains, straps and hoists.

IV. COURSE OUTLINE:

Lecture Content:

- A. Career Preparation
 - 1. Supervision
 - 2. Time management and planning
 - 3. Personnel management
 - 4. Job application and resume update
 - 5. Employer/employee relationships
- B. Hydraulically Driven Machines
- C. Differentials
- D. Brakes and Steering Systems
- E. Tracks and Undercarriage Components
- F. Final Drives and Tires
- G. Diesel engines
 - 1. Principles of operation
 - 2. Two and four strokes
 - 3. Gasoline engine comparison
 - 4. Troubleshooting
- H. Air Induction System
- I. Cooling System
- J. Valve Train
- K. Diesel Fuel Systems
 - 1. Introduction
 - 2. Injection principles
 - 3. Injection nozzles—capsule, pencil 7000, unit, electronic unit
 - 4. Injection fuel systems—distributor (3054), sleeve metering (3208), new scroll (3406B engines), electronic unit injection (EUI-C10, C12, C15, C16), hydraulic electronic unit injection (HEUI-C7, C9, 3408E)
- L. Diesel Engine Performance
 - 1. Fuel advance curves
 - 2. Horsepower/torque curves
 - 3. Dynamometer testing

Lab Content:

- Fuels Labs
- Lab 1: 3126 MUI (Mechanical Unit Injection) Injector Synchronization
- Lab 2: 3126 MUI Injector Timing
- Lab 3: 3126 MUI Maximum Fuel Setting
- Lab 4: 3126 MUI Governor disassembly & Assembly
- Lab 5: Injector Sleeve Removal – 3126 Copper
- Lab 6: Injector Sleeve Removal – 3126 Stainless Steel
- Lab 7: Valve Adjustment – Sequence Method for Inline 6 Cylinder
- Lab 8: Valve Adjustment – Matched Throw Method

- Lab 9: Valve Adjustment – Degree Method
- Lab 10: Testing Nozzles – Capsule
- Lab 11: Testing Nozzles – Pencil
- Lab 12: Testing Nozzles – 7000 Series
- Lab 13: Pump Timing – New Scroll Fuel Pump
- Lab 14: Pump Timing – Sleeve Metered Fuel Pump
- Lab 15: Pump Timing – Distributor Fuel Pump
- Labs 16-18: Disassembly and Assembly of New Scroll, Sleeve Metered and Distributor Fuel Pumps
- Labs 19-21: 3406E Engine Simulator Testing and Adjusting
- Labs 22-24: Electronic Unit Injection (EUI) Testing and Adjusting
- Labs 25-27: Hydraulic Electronic Unit Injection (HEUI) Testing and Adjusting
- Undercarriage
- Lab 1: Differentials
- Lab 2: Differential Adjustments
- Lab 3: Steering Clutches and Brakes
- Lab 4: Wheel Loader Axle Disassembly and Assembly
- Lab 5: Steel Track Removal and Installation
- Lab 6: Final Drives
- Lab 7: Undercarriage Components and Wear Determination
- Lab 8: ASV Track Removal and Adjustment
- Lab 9: Challenger Belt Removal

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

I. Sample Text Title:

1. Recommended - Caterpillar, Inc. *Caterpillar Small and Medium Fuel Systems*, -, 2004,
2. Recommended - Caterpillar Inc *Powertrains II*, -, 2004,
3. Recommended - Dagele, J.F., Brady R.N. *Diesel Engines and Fuel System Repair*, ed. 5th Prentice Hall, 2002,

II. Other Readings

1. Recommended - *Tech Prep Job Manual, SCCCD*

Global or international materials or concepts are appropriately included in this course

Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing			
Check either 1 or 2 below			
X	1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
X	a) essay exam(s)	X	d) written homework
X	b) term or other paper(s)	X	e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:

Service reports will be written for all lab assignments. Students will complete lab write-ups outlining work performed, service literature used, procedures followed and relevant details of machine or component status.

See Attached Caterpillar Equipment Technician Service Report

B. Problem Solving			
Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)	X	d) laboratory reports
X	b) quizzes		e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:

Problem solving activities to include calculating compression ratios, displacement of cylinders, torque and horsepower, gear ratios, and other computations.

C. Skill demonstrations, including:			
X	a) class performance(s)		c) performance exams(s)
X	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:

Skill demonstrations to include laboratory practical assignments in the area of diesel engine fuel systems and machine undercarriage.

D. Objective examinations including:			
X	a) multiple choice	X	d) completion
X	b) true/false	X	e) other (specify): Drawing, schematics
X	c) matching items		

COURSE GRADE DETERMINATION:

Description/Explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.

Exams and Quizzes 25% Assignments 25% Lab Participation 25% Lab Assignments 25%

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):

	College-Level Criteria Met	
	YES	NO
Textbook	<u>X</u>	_____
Reference materials	<u>X</u>	_____
Instructor-prepared materials	<u>X</u>	_____
Audio-visual materials	<u>X</u>	_____

Indicate Method of evaluation:

Used readability formulae (grade level 10 or higher)	_____
Text is used in a college-level course	<u>X</u>
Used grading provided by publisher	_____
Other: (please explain; relate to Skills Levels)	_____

Computation Level (Eligible for MATH 101 level or higher where applicable)

	YES	NO
Content		
Breadth of ideas covered clearly meets college-level learning objectives of this course	<u>X</u>	_____
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	<u>X</u>	_____
Requires independent thought and study	<u>X</u>	_____
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	<u>X</u>	_____

List of Reading/Educational Materials

Recommended - Caterpillar, Inc. *Caterpillar Small and Medium Fuel Systems*, -, 2004,

Recommended - Caterpillar Inc *Powertrains II*, -, 2004,

Recommended - Dagle, J.F., Brady R.N. *Diesel Engines and Fuel System Repair*, ed. 5th Prentice Hall, 2002, ISBN: 0130929816

Comments:

_____	This course requires special or additional library materials (list attached).
<u>X</u>	This course requires special facilities: Adequate shop facility

Attached Files:

[CAT Equipment Technician Service Report](#)

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 101. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.

(eligibility for Math 101)
(as outcomes for Math 250)

Performing the four arithmetic operations on whole numbers, arithmetic fractions, and decimal fractions.

Making the conversions from arithmetic fractions to decimal fractions, from decimal fractions to percents, and then reversing the process.

Applying the concepts listed above to proportions, percents, simple interest, markup and discount.

Applying the operations of integers in solving simple equations.

Converting between the metric and English measurement systems

1. Ability to calculate engine specifications including torque, horsepower, and fuel consumption.
2. Ability to convert metric prefixes for torque and power.
3. Ability to accurately use English and metric precision measuring devices.

(eligibility for English 126)
(as outcomes for English 262)

Using phonetic, structural, contextual, and dictionary skills to attack and understand words.

Applying word analysis skills to reading in context.

Using adequate basic functional vocabulary skills.

Using textbook study skills and outlining skills.

Using a full range of literal comprehension skills and basic analytical skills such as predicting, inferring, concluding, and evaluating.

1. Ability to comprehend a textbook.
2. Ability to comprehend various industry publications containing concepts and terms of applied physics as they relate to power transmitting systems.
3. Ability to outline the textbook and classroom lectures; ability to outline ideas and analysis for unit tests, midterm, and final.

(eligibility for English 125)
(as outcomes for English 252)

Writing complete English sentences and avoiding errors most of the time.

Using the conventions of English writing: capitalization, punctuation, spelling, etc.

Using verbs correctly in present, past, future, and present perfect tenses, and using the correct forms of common irregular verbs.

Expanding and developing basic sentence structure with appropriate modification.

Combining sentences using coordination, subordination, and phrases.

Expressing the writer's ideas in short personal papers utilizing the writing process in their development.

1. Ability to compose accurate and detailed industry machine service reports that record troubleshooting procedures and work performed.
2. Ability to compose well organized, analytical responses to short answer/essay questions in unit tests, midterm, and final.
3. Ability to compose accurate and detailed project plan descriptions including procedures required for successful completion.

Check the appropriate spaces.

Eligibility for Math 101 is advisory for the target course.

Eligibility for English 126 is advisory for the target course.

Eligibility for English 125 is advisory for the target course.

If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.

CONTENT REVIEW

REQUISITES

No requisites