



**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:	(8) Classification:	
Course Hours		
Weekly Lec hours: 6.00	Degree applicable:	X
Weekly Lab hours: 6.00	Non-degree applicable:	
Total Contact hours: 216.00	Basic skills:	
Lec will generate __ hour(s) outside work.	(9) RC Fulfills AS/AA degree requirement: (area)	
Lab will generate __ 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: Accounting Intern	
(6) Advisories:	(10) CSU Baccalaureate:	X
(7) Pre-requisites (requires C grade or better):	(11) Repeatable: (A course may be repeated three times)	0
• Eligibility for English 252, English 262, and Mathematics 256	(12) C-ID:	
Corequisites:	Proposed Start Date:	Spring 2013

(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.

<b>A. Writing</b>			
Check either 1 or 2 below			
X	<b>1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.</b>		
	<b>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.</b>		
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>B. Problem Solving</b>			
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.

<b>C. Skill demonstrations, including:</b>			
X	a) class performance(s)		c) performance exams(s)

X	b) field work		d) other (specify)
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**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.

<b>D. Objective examinations including:</b>			
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):

- Textbook
- Reference materials
- Instructor-prepared materials
- Audio-visual materials

College-Level Criteria Met	
YES	NO
<u>X</u>	<u>      </u>
<u>X</u>	<u>      </u>
<u>X</u>	<u>      </u>
<u>X</u>	<u>      </u>

Indicate Method of evaluation:

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

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

Content	<u>      </u>	<u>      </u>
Breadth of ideas covered clearly meets college-level learning objectives of this course	<u>  X  </u>	<u>      </u>
Presentation of content and/or exercises/projects:		
Requires a variety of problem-solving strategies including inductive and deductive reasoning.	<u>  X  </u>	<u>      </u>
Requires independent thought and study	<u>  X  </u>	<u>      </u>
Applies transferring knowledge and skills appropriately and efficiently to new situations or problems.	<u>  X  </u>	<u>      </u>

List of Reading/Educational Materials

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

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

Recommended - Dagele, 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).

  X   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 201. 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.

Check the appropriate spaces.

- Eligibility for Math 201 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.

**REQUISITES**

**Prerequisite -- ENGL 260 BASIC READING**

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• apply a variety of skills (including use of dictionary) to determine definitions of new vocabulary words while reading text.</li><li>• apply a variety of prereading, reading and postreading strategies that facilitate comprehension of below 8th grade level texts.</li><li>• determine the correct topic and main idea of expository paragraphs.</li><li>• distinguish between major supporting details and minor supporting details in text.</li><li>• interpret visual data and determine its supporting relationship to text.</li></ul> | <ul style="list-style-type: none"><li>• Explain governing systems and components.</li><li>• Explain the differences between MUI, EUI, HEUI, and common rail diesel fuel systems.</li><li>• Explain how various mechanical diesel fuel pumps operate.</li><li>• Explain the operations of diesel unit injectors.</li><li>• Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.</li></ul> |
|--|---|

**ESTABLISHING PREREQUISITES OR COREQUISITES**

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.

Justification: Indicate how this is so.

The health or safety of the students in this course requires the prerequisite.

Justification: Indicate how this is so.

The prerequisite course is part of a sequence of courses within or across a discipline.

The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.

Justification: Indicate how this is so.

The prerequisite/corequisite is required by law or government regulations.

Explain or cite regulation numbers:

The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.

Justification: Indicate how this is so.

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Justification: Indicate how this is so.

Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

**Justification:** In order for students to be successful as Power Equipment Technicians they need to be able to read and comprehend text. Our industry advisory committee strongly recommends this course as a prerequisite.

**Prerequisite -- ENGL 252 Writing Improvement**

- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• unified supporting details for each body paragraph which begin with a topic sentence</li><li>• complete sentences which includes correct capitalization, spelling, use of homophones, etc.</li><li>• an avoidance of major grammatical errors including verb tense issues, subject-verb agreement, pronoun agreement problems, fragments, fused sentences and comma splices</li><li>• writing that is free from plagiarism</li><li>• an evaluation and analysis of ideas at the appropriate course level</li><li>• appropriate use of academic language and descriptive vocabulary</li><li>• Plan and revise with guidance, employing all stages of the writing process when necessary.</li></ul> | <ul style="list-style-type: none"><li>• Explain governing systems and components.</li><li>• Explain horsepower and torque.</li><li>• Explain emissions requirements as related to diesel engines.</li><li>• Explain the differences between MUI, EUI, HEUI, and common rail diesel fuel systems.</li><li>• Explain how various mechanical diesel fuel pumps operate.</li><li>• Explain the operations of diesel unit injectors.</li><li>• Describe exhaust after-treatment systems and their function.</li><li>• Use reusability guidelines and service literature to determine component wear.</li><li>• Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.</li></ul> |
|---|---|

### ESTABLISHING PREREQUISITES OR COREQUISITES

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The prerequisite/corequisite is required by law or government regulations.

Explain or cite regulation numbers:

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Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

**Justification:** In order for students to be successful as Power Equipment Technicians they need to be able to write. Our industry advisory committee strongly recommends this course as a prerequisite.

### **Prerequisite -- MATH 250 COLLEGE ARITHMETIC**

- Apply the four arithmetic operations to fractions.
- Apply the four arithmetic operations to integers.
- Apply the four arithmetic operations to decimals.

- Explain horsepower and torque.
- Calculate fuel consumption of a diesel engine.
- Explain emissions requirements as related to diesel engines.
- Demonstrate electronic diesel engine troubleshooting techniques.
- Demonstrate fuel system adjustments and repair.
- Demonstrate proper valve adjustments on multiple diesel engines.
- Demonstrate knowledge and understanding of theory, operation, and terminology related to transmissions, including gear ratios, types of gears, and clutches.
- Measure clutch wear using outside micrometers and dial calipers to determine wear and reusability.
- Use reusability guidelines and service literature to determine component wear.
- Diagnose and repair transmission systems using pressure gauges, service literature and operational checks.
- Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.

### ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

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Justification: Indicate how this is so.

The health or safety of the students in this course requires the prerequisite.

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Justification: Indicate how this is so.

\_\_\_\_\_ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

**Justification:** In order for students to be successful as Power Equipment Technicians they need to be able to do basic math. Our industry advisory committee strongly recommends this course as a prerequisite.

## JUSTIFICATION OF LIMITATION ON ENROLLMENT

Enrollment in courses or blocks of courses may be limited based on performance, honors, or other performance based criteria. Be mindful of the disproportionate impact the limitation will have on specific groups of students. It is important to determine if the limitation will disproportionately keep under-represented students from enrolling in the course or block of courses.

Describe the reasons for limiting the enrollment.

Course Designator: MAG 31

Course Title(s): EQUIPMENT TECHNICIAN: FUEL SYSTEMS & MACHINE UNDERCARRIAGE

Rationale for Limiting Enrollment:

0