Description
This course introduces students to petroleum refining processes, operations, feedstock and products characteristics. Description of main conversion processes and their evolution will be discussed in view of environmental and economic considerations. Current trends and future of the industry will be addressed.

Prerequisites
CBE 2206A/B and 2207A/B or the former CBE 2216 or Chemistry 2213A/B and 2223B or GPE 2213A/B and 2214A/B, CBE 2224A/B or GPE 2218A/B, CBE 3315A/B or GPE 3315A/B.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Corequisites
None

Antirequisites
None

Contact Hours
3 lecture hours, 1 tutorial hour, 0.5 course.

Instructor
Prof. A. Prakash (TEB 441) Telephone: 519-661-2111 ext: 88528 email: aprakas2@uwo.ca

Undergraduate Assistant
(TEB 477) Telephone: 519-661-2111 ext: 82131 email: cbeundergraduate@uwo.ca

Required Text
None
Reference Texts

Course Notes
Summery notes and handouts will be posted on course website.

Units
SI units will be used in reports with British Engineering units between brackets.

General Learning Objectives

<table>
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<th>General Learning Objectives (cont’d)</th>
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<td>The general objectives are for the students to be able to:</td>
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<tr>
<td>• Become knowledgeable in composition, properties and classification of crude oil or petroleum.</td>
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<td>• Become familiar with operations and processes in petroleum processing as well related chemistry and catalysis.</td>
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<td>• Become knowledgeable about impurities in crude oil and how to remove them from products.</td>
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<td>• Develop understanding of refinery products and their specifications.</td>
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<td>• Develop understanding of safety and environmental issues in petroleum refining.</td>
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<td>• Search the academic and technical literatures for information on the selected process area to present in formal report.</td>
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Specific Learning Objectives

Introduction to the Petroleum Industry
At the end of this section, students should be familiar with:
• History and origin and occurrence of crude oil.
• Exploration, recovery and transportation of crude oil.

Feedstock and Products Composition, Properties and Specifications
At the end of this section, students should become familiar with:
• Composition and classification of crude oil.
• Physical properties such as gravity, pour point and impurities level in petroleum.
• Specifications of main products from petroleum refinery i.e. gasoline, diesel, kerosene etc.

Crude Distillation
At the end of this section, students should become familiar with:
• Typical fraction cuts and boiling ranges for atmospheric and vacuum still fractions.
• Flow diagram of atmospheric topping unit and vacuum distillation unit.

Catalytic Cracking and Hydrocracking
At the end of this section, students should become familiar with:
• Chemistry and catalysis of catalytic cracking and hydrocracking reactions.
• Fluidized bed catalytic cracking (FCC) and hydrocracking unit configurations.
• Process variables, heat recovery, yield estimation.

Catalytic Reforming and Isomerization
At the end of this section, students should become familiar with:
• Chemistry and catalysis of catalytic reforming and isomerisation.
• Catalytic reforming and isomerization processes with process variables and yields.

Hydrotreating and Hydrodesulfurization
At the end of this section, students should become familiar with:
• Chemistry and catalysis of hydrotreating reactions for sulfur and nitrogen removal.
• Unit configurations, process variables, heat recovery, yield estimation.

Alkylation and Polymerization
At the end of this section, students should develop understanding of:
• Alkylation feedstocks, reactions, catalysts and products.
• Various alkylation processes and their comparison.
• Polymerisation processes to make high-octane gasoline product.

Coking and Thermal Processes
At the end of this section, students should be able to:
• Process descriptions and review – delayed coking, flexicoking, fluid coking, visbreaking.
• Process variables, products property and yields.
Safety, Loss Prevention and Environmental Analysis
At the end of this section, students should be able to:
• Become knowledgeable about safety and health hazards in petroleum refinery.
• Develop understanding of fugitive emissions and loss prevention handling of products.
• Become familiar with acids gas removal, sulfur recovery, waste water treatment in refinery.

Evaluation
The final course mark will be determined as follows:
Assignments and Quizzes 15%
Midterm Examination 25%
Literature Review Report 15%
Final Examination 45%

The final Examination will be closed book, 3 hours in length. Two pages of crib notes and calculators allowed.

Notes
1) Students must pass the final exam to pass this course. Students who fail the final exam will be assigned 48% if the aggregate mark is higher than 50%.
2) Assignments are to be handed in to the CBE 4432b locker (# C450) located in the Thompson Engineering Building, on the specified due date provided by the Instructor.
3) The deadline for submitting the Literature Review Report will be announced.

Use of English
In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance
Attendance in lectures, tutorials and laboratories is mandatory. Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

Cheating
University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).
Plagiarism
Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

Conduct
Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems
Students should immediately consult with the instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Notices
Students are responsible for regularly checking their Western email and notices posted on the Instructor’s door.

Consultation
Students are encouraged to discuss problems with their teaching assistant and/or instructors in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultations can be arranged by appointment with the appropriate instructor.

Accreditation (AU) Breakdown
Engineering Science  = 70%
Engineering Design  = 30%
INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC ACCOMMODATION WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE IF YOU ARE IN FIRST YEAR) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC ACCOMMODATION WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2014 UWO ACADEMIC CALENDAR).

A. GENERAL REGULATIONS & PROCEDURES

1. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

2. Bring your request for academic accommodation to the attention of the chair of your (or the Undergraduate Services office if you are in first year) **PRIOR** to the scheduled time of the test or final examination or due date of the assignment. If you are unable to contact the relevant person, leave a message with the appropriate department (or with the Undergraduate Services Office if you are in first year). The address, telephone and fax numbers are given at the end of these instructions. Documentation must be provided as soon as possible.

3. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are unable to write a term test, inform your instructor and the Chair of your Department (or the Undergraduate Services Office if you are in first year) **PRIOR** to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office and inform the Chair of the Department (or the Undergraduate Services Office if you are in first year).

2. Be prepared to provide supporting documentation to the Chair and the Undergraduate Services Office (see next page for information on documentation).

3. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair (or the Undergraduate Services Office if you are in first year) is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number (please spell your full name).

2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.

3. In order to receive permission to write a special examination, you **must** obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

**N.B.** It is the student's responsibility to check the date, time and location of the special examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).

2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).

3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.

4. i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.

   ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.
E. **SHORT ABSENCES**

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. **EXTENDED ABSENCES**

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms Karen Murray in the Undergraduate Services Office if you are in first year.

G. **DOCUMENTATION**

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, you must provide the doctor with a Student Medical Certificate to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office if you are in first year). This note must contain the following information: severity of illness, effect on academic studies and duration of absence.

**In Case of Serious Illness of a Family Member:** Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**In Case of a Death:** Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

**For Other Extenuating Circumstances:** If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

**Note:** Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. **ACADEMIC CONCERNS**

You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

**Calendar References:** Check these regulations in your 2014 Western Academic Calendar available at [www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca).

Absences Due to Illness: [http://www.westerncalendar.uwo.ca/2014/pg117.html](http://www.westerncalendar.uwo.ca/2014/pg117.html)

Academic Accommodations for Students with Disabilities: [http://www.westerncalendar.uwo.ca/2014/pg118.html](http://www.westerncalendar.uwo.ca/2014/pg118.html)

Academic Accommodations for Religious or Holy Days: [http://www.westerncalendar.uwo.ca/2014/pg119.html](http://www.westerncalendar.uwo.ca/2014/pg119.html)


Examinations: [http://www.westerncalendar.uwo.ca/2014/pg129.html](http://www.westerncalendar.uwo.ca/2014/pg129.html)

Scheduling of Term Assignments: [http://www.westerncalendar.uwo.ca/2014/pg113.html](http://www.westerncalendar.uwo.ca/2014/pg113.html)

Scholastic Offences: [http://www.westerncalendar.uwo.ca/2014/pg97.html](http://www.westerncalendar.uwo.ca/2014/pg97.html)


Engineering Academic Regulations: [http://www.westerncalendar.uwo.ca/2014/pg142.html](http://www.westerncalendar.uwo.ca/2014/pg142.html)

**Note:** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

**Drop Deadlines:**

- First term half course (i.e. “A” or “F”): November 5, 2014
- Full courses and full-year half courses (i.e. “E” or “Y” or no suffix): November 30, 2014
- Second term half or second term full course (i.e. “B” or “G”): March 7, 2015

Undergraduate Services Office: SEB 2097 telephone: (519) 661-2130 fax: (519) 661-3757

Dept. of Chemical and Biochemical Engineering & Green Process Engineering TEB 477 telephone: (519) 661-2131 fax: (519) 661-3498

Dept. of Civil and Environmental Engineering: SEB 3005 telephone: (519) 661-2139 fax: (519) 661-3779

Dept. of Electrical and Computer Engineering, Software Engineering, Mechatronics Engineering: TEB 279 telephone: (519) 661-3758 fax: (519) 850-2436

Dept. of Mechanical and Materials Engineering: SEB 3002 telephone: (519) 661-4412 fax: (519) 661-3020

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