


**TRINITY VALLEY COMMUNITY COLLEGE
ADMINISTRATIVE-MASTER SYLLABUS**

The Administrative- Master Syllabus is an administrative tool; it is **not intended to be distributed to students**. It is the intention of this Administrative-Master Syllabus to provide a general description of the course, outline the required elements of the course and to lay the foundation for course assessment for the improvement of student learning, as specified by the faculty of TVCC, regardless of who teaches the course, the timeframe by which it is instructed, or the instructional method by which the course is delivered. It is not intended to restrict the manner by which an individual faculty member teaches the course but to be an administrative tool to aid in the improvement of instruction. The Administrative-Master Syllabus will demonstrate that there is consistency and comparability in course offerings.

Course Title

Organic Chemistry

Course Prefix and Number

CHEM 2425

Department – Division

Mathematics & Science

Course Type – select from one of the following categories.

- **Academic General Education Course** (from ACGM – but not in TVCC Core)
- **Academic TVCC Core Course**
- **WECM Courses**

Semester Credit Hours: Lecture Hours: Lab/other hours

Semester Credit Hours	Lecture Hours	Lab/Other* Hours
4	3	1

Other hours include practicum, clinical or other types of non-lecture instruction. *If other, please specify: _____

Course Catalog Description

A continuation of Chemistry 2423. More complex aliphatic and aromatic compounds are studied with emphasis on the mechanisms of reactions. The chemistry of carbohydrates and amino acids are introduced in the latter part of the course.

Prerequisites/co requisites

CHEM 23423

Topical Outline

The student should be able to:

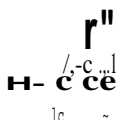
- Name the alkenes by IUPAC nomenclature, or given the name of the alkene, you should be able to draw it.
- Be able to identify cis and trans or Z and E geometric isomers.
- Illustrate the E2 mechanism of dehydrohalogenation of alkyl halides.
- Illustrate the EI mechanism of the dehydration of alcohols.
- Explain how the order of stability of alkenes $R_2-C=C-R_2 > R_2-C=C-HR > R_2-C=CH_2 > RCH=CHR > RCH=CH_2$ causes the ease of formation to follow the same order.
- Explain the reason for the following type of rearrangement, using a detailed mechanism.

$$\begin{array}{c} \text{CH)} \\ \text{CHr-C-CH- CH)} \\ \text{CH}_3 \text{ OH} \end{array} \quad \begin{array}{c} \text{H} \\ \sim \end{array} \quad \begin{array}{c} \text{CH}_3 \\ \text{CHr-C=CH-CH}_3 \\ \text{CH}_3 \end{array} \quad + \quad \begin{array}{c} \text{CH}_3 \\ \text{CH) =C-CH-CH}_3, \\ \text{CH}_3 \end{array}$$
- Explain why the reaction above gives 2,3 dimethyl-2-butene as the major product. Explain Saytzeffs orientation concept.
- In the competing reactions of elimination vs. substitution, explain the reason for the reactivity of R- toward E2 $3^\circ > 2^\circ > 1^\circ$. Explain the reactivity of RX toward EI is $3^\circ > 2^\circ > 1^\circ$. Note the different reasons for this order for EI and E2.
- Considering cis and trans isomer, indicate which isomer generally has the highest boiling point and which has the highest melting point. Explain the reason for these differences.
- In the competing reactions of substitution vs. elimination, list the conditions, which would tend to favor substitution-then list these that favor elimination.
- Be able to work problems similar to 1-9 on pages 315-316 dealing with nomenclature, synthesis, and reactions of alkenes.
- Illustrate the electrophilic addition mechanism. Be complete. Show all steps involved.
- Illustrate the mechanism of the electrophilic addition of halogen to an alkene.
- Illustrate the mechanism of the dimerization of alkenes.
- Illustrate the free radical addition mechanism of the peroxide initiated addition of HBr.
- Explain how heats of hydrogenation can be used to determine the stability of alkenes.
- Be able to complete reactions of alkenes with different electrophilic reagents. You should be able to complete reactions involving:
 - Addition of hydrogen (Catalytic hydrogenation)
 - Addition of halogens
 - Addition of hydrogen halides
 - Addition of sulfuric acid
 - Addition of water (Hydration)
 - Halohydrin formation
 - Dimerization
 - Oxymercuration-demercuration

- (9) Glycol formation (Hydroxylation)
 (10) Allylic substitution (Halogenation)
 (11) Ozonolysis
18. Explain why a free radical halogen does not add to the carbon-carbon double bond of $\text{H}_3\text{C}-\text{CH}=\text{CH}_2$ -be complete.
 H
19. Give the ozonolysis product; be able to give the structure of the alkenes from which they come.
20. Be able to work problems 1,2,3,16,20, & 21 at the end of chapter 9. You should also be able to work problems similar to these.
21. Explain why the following takes place:
- $$\text{C}=\text{C} + \text{C}_6\text{H}_5\text{I} \xrightarrow{\text{NaI}} \text{C}(\text{C}_6\text{H}_5)=\text{C} + \text{I}^-$$

Explain why the Iodine (1) goes to the central carbon. Use the mechanism of the reaction in your explanation, and show the transition states involved.

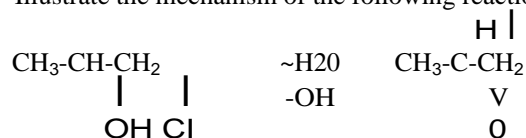
22. Illustrate the mechanism of the hydroboration reaction. Explain why it is anti-Markovnikov.
23. Explain in detail why the following compound does not undergo free radical addition under the conditions below? What would be formed?
 500-600°
- $\text{CH}_2=\text{CH}-\text{CH}_2 + \text{C}_6\text{H}_5\text{I}$
24. Explain in detail why the allyl radical, below, does not show 4 ESR signals. How many signals does it show?



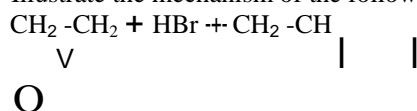
- A. Why the allyl radical $\text{C}=\text{C}-\text{C}\cdot$ is especially stable (use both the orbital model theory and the resonance and/or orbital theory to explain the following):
- B. resonance structure model)
- C. Why the order of alkyl radicals follows the order of $3^\circ > 2^\circ > 1^\circ > \text{CH}_3$ (use both models)
- D. Why the alkyl cation stability follows the order of $3^\circ > 2^\circ > 1^\circ > \text{CH}_3$ (use orbital model)
- E. Why conjugated dienes are more stable than expected (use orbital model).
- E. Why alkenes show the following order of stability .
 $\text{R}_2\text{C}=\text{C}(\text{R})_2 > \text{R}_2\text{C}=\text{CH}_2, \text{RCH}=\text{CHR} > \text{RCH}=\text{CH}_2 > \text{CH}_2=\text{CH}_2$
26. Hyperconjugation is used to explain why the single bond in propylene is shorter (1.50 Å) and stronger than expected. Explain how this is done. Dewar uses an alternative interpretation. Explain.
27. Explain in detail why conjugated dienes undergo 1,4-addition (show all steps).
28. Illustrate the competition of 1,2 and 1,4-addition of conjugated dienes using a graph showing "PE" on the vertical scale and "Progress of reaction" on the horizontal. Show how 1,2 and 1,4 addition proceed at different temperatures.
29. Be able to work problems similar to 3,4,5,7,8, and 9 at the end of chapter 11 dealing with nomenclature, synthesis, and reactions of dienes.
30. Explain in detail (using induction and resonance concepts) why the following reaction occurs to give the product shown.
- $$\begin{array}{ccc} \begin{array}{c} \text{H H} \\ | | \\ \text{H}-\text{C}=\text{C}-\text{Br} \end{array} + \text{HI} \sim & \begin{array}{c} \text{H H} \\ | | \\ \text{H}-\text{C}-\text{C}-\text{Br} \text{ (only)} \\ | | \\ \text{H I} \end{array} & \begin{array}{c} \text{H H} \\ | | \\ \text{(not) H}-\text{C}-\text{C}-\text{Br} \\ | | \\ \text{I H} \end{array} \end{array}$$

31. Illustrate in detail the mechanism of the reaction of sodium acetylides with alkyl halides. Show why the alkyl halides must be a primary and not a secondary or tertiary.

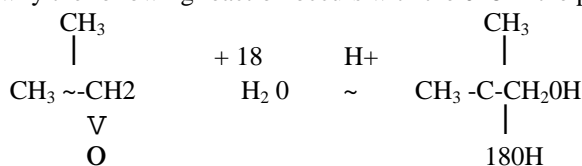
32. Illustrate why the addition of H_2O , H_2SO_4 , and HgSO_4 to acetylene forms acetaldehyde instead of a vinyl alcohol. Illustrate and name the phenomenon that occurs.
33. Be able to work problems 2, 3, 4,5 and 7. dealing with nomenclature, synthesis, and reactions of alkynes
34. Explain the Baeyer strain theory. What did it attempt to explain? In what way was it correct? In what way was it not correct?
35. Be able to work problems 1(a-h) and 2(a-s), skip q dealing with nomenclature, synthesis, and reactions of cyclic aliphatic compounds.
36. Illustrate the mechanism of the following reaction.



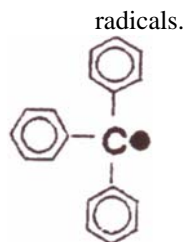
37. Illustrate the mechanism of the following reaction.



Explain why the following reaction occurs with the OH in the position



39. Draw the resonance theory to explain benzene.
40. Draw the quantum orbital picture of benzene. Show all bond lengths, distances, and angles.
41. Describe the Huckel $4n+2$ rule. Be able to identify aromatic compounds using this rule.
42. Given the names of aromatic compounds, you should be able to draw the structures.
43. Given the structures of aromatic compounds, you should be able to name the compounds.
44. Work problem I on page 515 dealing with nomenclature of aromatics.
45. Illustrate the mechanism of electrophilic aromatic substitution using Y and Z groups.
46. Illustrate the mechanism of electrophilic aromatic substitution of nitration.
47. Illustrate the mechanism of electrophilic aromatic substitution of sulfonation.
48. Illustrate the mechanism of electrophilic aromatic substitution of halogenation
49. Illustrate the mechanism of electrophilic aromatic substitution of Friedel-Crafts alkylation
50. Explain and illustrate why electron donating groups are activators toward electrophilic aromatic substitution.
51. Explain and illustrate why a methyl group is an ortho-para director. Use drawings in your illustration showing the positive charge of the carbocation on the aromatic ring.
52. Explain and illustrate why NH_2 is a meta director. Use drawings in your illustration showing the positive charge of the carbocation on the aromatic ring.
53. Explain and illustrate why NH_2 is an ortho-para director. Use drawings in your illustration showing the positive charge of the carbocation on the aromatic ring.
54. Explain and illustrate why chlorine is an ortho-para director yet a deactivator. Use drawings in your illustration showing the positive charge of the carbocation on the aromatic ring.
55. Be able to work problems 1-4,15, & 16 at the end of chapter I 5 dealing with nomenclature, synthesis, and reactions of aromatics.
56. You should be able to name compounds using the nomenclature at arenes and their derivatives.
57. You should be able to briefly explain and illustrate the two mechanisms of Friedel-Crafts alkylation.
58. You should be able to list and briefly explain five limitations of Friedel-Crafts alkylation.
59. You should be able to explain why an allyl radical and a benzyl radical are more stable than a tertiary free radical. Use both the resonance theory and the quantum theory to illustrate.
60. You should be able to explain why the triphenylmethyl radical is so much more stable than other free radicals.



61. You should be able to work problems I ,2,3-4, and 18 at the end chapter 16 dealing with nomenclature, synthesis, and reactions of arenas.
62. Given a NMR graph and appropriate qualitative analysis results, draw the chemical structure of the compound illustrated.
63. Given a NMR graph and appropriate information, identify the compound.
64. Name aldehydes, ketones, amines, amides, and diazonium salts.
65. Synthesize aldehydes, ketones, amines, amides, and diazonium salts as demonstrated by synthesis problems in the Morrison and Boyd text.
66. Show the common reactions of aldehydes, ketones, amines, amides, and diazonium salts as demonstrated by problems in the Morrison and Boyd text.
67. Be able to name by common name nomenclature all the carboxylic acids through carbon 6 and all the even numbered carboxylic acids through carbon 6. You should also be able to name all the acids through carbon 20 by IUP AC .nomenclature.
68. Be able to explain in detail a method that could be used to separate a heavy carboxylic acid from other non-acid organic materials.
69. Be able to explain in detail the reason that carboxylic acids tend to release a hydrogen ion easier than alcohols. In other words, why are carboxylic acids more acidic than alcohols?
70. Be able to explain in detail why 2 chloro ethanoic acid is more acidic than ethanoic acid. Use models in your explanation.
71. Outside of class you should work problems 2 (a-k), 3 (a-f), 4 (a-l), 6 (a-p), 13 (a-g), and 14 (a-I) on pages 747-749 dealing with nomenclature, synthesis, and reactions of carboxylic acids.
72. Illustrate in detail the mechanisms of the following:
 - a. nucleophilic acyl substitution
 - b. hydrolysis of amides (specific form of nucleophilic substitution.
 - c. alkaline hydrolysis of esters
 - d. acid hydrolysis of esters
 - e. reaction of esters with grignard reagents
73. Explain in detail why aldehydes and ketones undergo nucleophilic addition reactions while carboxylic acids undergo nucleophilic substitution.
74. Compare acyl and alkyl nucleophilic substitution. How are they alike? How are they different?
75. Be able to answer a selection of problem parts taken from problems 2 (a-n); 7 (a-n) on pages 787-788 dealing with nomenclature, synthesis, and reactions of functional derivatives of carboxylic acids.

Course Learning Outcomes

Relationship to General Education Outcomes – In addition to the core competencies, Trinity Valley Community College has established ten general education goals which specify knowledge and skills that students should gain from completing courses in the various component areas of the core curriculum. Information regarding curriculum and assessment as a means for the improvement of student learning through the general education component. (Select all that apply.)

Mark with an "X"	General Education Outcome
	A. To communicate clearly and effectively in both oral and written English.
	B. To improve reading skills focused on comprehending, analyzing, interpreting, and evaluating printed materials.
	C. To understand mathematical information and utilize mathematical skills.
X	D. To demonstrate qualitative and quantitative critical thinking skills.
	E. To understand and appreciate cultural and ethnic diversity.
	F. To utilize computer based technology in accessing information, solving problems, and communicating.
	G. To recognize and evaluate artistic achievements in the visual and performing arts.
	H. To improve basic understanding of political, economic, and social systems.
X	I. To demonstrate knowledge of the physical universe and living systems.
X	J. To develop skills and strategies to become an engaged learner.

Required Text(s)

Textbooks: Organic Chemistry, 6th edition; Morrison, Robert T., and Boyd, Robert N. Prentice Hall, 2004

Lab Manual: Macroscale and Microscale Organic Experiments. Williamson, Kenneth, 4th edition.

Optional Text(s)

Material/Technology to be supplied by the student.

Course Requirements/Grading System – describe any course specific requirements such as research papers or reading assignments and the generalized grading format for the course; not intended to restrict the individual nature by which each faculty member who teaches the course determines course requirements and final student performance, but should offer consistency within reason for all sections taught for those departments without a standardized format.

METHODS OF INSTRUCTION: Direct and indirect lecture methods are used. An effort is made to totally involve the student in problem solving and theory discussions. Laboratory experiments are performed by the students working in pairs. Problem solving is an extremely important part of the course. Many problems are worked by the instructor and/or the students.

METHODS OF EVALUATION: 4-5 tests are designed to test the objective. These tests constitute 50% of the student's grade. 10-14 laboratory exercises are performed by the student. These labs constitute 25% of the total grade. A final comprehensive exam constitutes 25% of the total grade. A total average grade of 70 is necessary for a passing grade of C.

Approvals – the contents of this document have been reviewed and are found to be accurate.

Prepared by	Signature	Date
Department Head	Signature	Date
Division Chair	Signature	Date
Vice President	Signature	Date