GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester -II

Course Title: Organic Chemistry
(Course Code: 4322801)

Diploma programmes in which this course is offered	Semester in which offered
Textile Processing Engineering	Second

1. RATIONALE

The course provides the basic knowledge of organic compounds and their properties and applications. The study of organic chemistry allows engineers to get the most out of raw materials in creating textile processing like scouring, bleaching, dyeing, printing, finishing etc. needed in the wide variety of engineering and technological application in the field of textile industries.

The deep understanding of various topics/subtopics of organic chemistry would enable the diploma engineers to the various engineering problems, developments and breakthrough in textile processing engineering and technology in a very systematic and scientific way.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use principles of organic chemistry to solve broadly-defined textile processing engineering problems.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

a) Solve textile processing problems using the knowledge of organic materials.
b) Use the relevant purification methods in the textile industries.
c) Select appropriate engineering materials for textile processing industrial application.
d) Choose various types of unit processes for preparing the textile processing related materials.
e) Select various types of dyes and carbohydrates for domestic and industrial application.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	2	4	30*	70	25	25	150

(*):Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are thesub-components of the COs. *Some of the **PrOs** marked **'*'** (in approx. Hrs column) are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Determine the nature of the given organic compound (acidic, phenolic, basic and neutral) using organic qualitative analysis.	I		06*
2	Detect the functional group present in the given organic compound.	I		04*
3	Purify the given organic compound using crystallization method	II	Any three	02*
4	Purify the given organic compound using solvent treatment method	II		02
5	Purify the given organic compounds using distillation method	II		02
6	Purify the given organic compound using sublimation method	II		02*
7	Detect the elements present in the given organic compounds by Lassaigne's test	II		02
8	Determine the melting point of the given organic compound.	II, III	Any one	02
9	Determine the boiling point of the given organic compound.	II, III		02
10	Determine the given alcohol using qualitative analysis	III	Any two	02
11	Determine the given aldehyde using qualitative analysis	III		02
12	Identify the given aromatic carboxylic acid using qualitative analysis	III		02
13	Identify the given aromatic amine using qualitative analysis	III		02
14	Prepare nitrobenzene from benzene	IV	Any one	04
15	Prepare phenyl–azo–β-naphthol (an azo dye) from aniline	IV		04
16	Identify the given dye using qualitative analysis	V	Any one	02
17	Identify the given carbohydrate using qualitative analysis	V		02
	Total			**28 Hrs.**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list**.***
ii. *The following are some **sample** 'Process' and 'Product' related skills(more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises**of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare experimental setup accurately.	10
2	Use apparatus for precise measurements.	20
3	Practice and adapt good and safe measuring techniques.	10
4	Good record keeping of the observations accurately.	20
5	Interpret the results and their conclusion.	20
6	Prepare report in prescribed format	10
7	Viva-Voce	10
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Digital weighing balance:** Type of Laboratory Balance: Analytical, Sensitivity (mg): 1 mg, Maximum Capacity of weighing (grams): 200 g, Shape of PAN: Circular, Power Supply: Single Phase, Display: LED.	All
2	**Distillation Assembly:** Made by borosilicate Glasses	5
3	**Digital Melting and Boiling Point Apparatus:** Semi-Automatic, Material: Mild Steel, Temp. range: RT to 300 °C, Resolution:1 °C, Accuracy: 1°C, Display: Digital LED Display	8,9
4	**Hot plate with Magnetic stirrer:** Number of stirring Positions:1, Calibration: Automatic Calibration, Magnetic stirrer with a hot plate, Speed Control Accuracy of set speed (+/-) (RPM): 5, Maximum Stirring capacity per position: 3000 ml, Top plate Material: Stainless steel.	3,7, 10,11,12,13,16, 17

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Inculcate life skills and ethical values in the context of organic chemistry.
b) Acquaint students with different aspects of organic chemistry used in daily life.

c) Use environment friendly methods and processes for preparation purpose.
d) Work as a leader/a team member.
e) Follow ethical practices.
f) Observe safety measures.
g) Realize importance of green chemistry.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit-1: CONCEPT OF ORGANIC CHEMISTRY	1a. Classify the organic compounds 1b. Classify organic compounds based on their functional groups 1c. Write the IUPAC name of organic compounds 1d. Describe the different types of isomerism 1e. Differentiate geometrical and optical isomerism	1.1 Classification of organic compounds 1.2 Classification of hydrocarbons 1.3 Functional groups classification of organic compounds 1.4 IUPAC system of nomenclature of organic compounds Isomerism: Structural isomerism: Chain isomerism, Position isomerism, Functional group isomerism, Metamerism, Tautomerism; Stereo Isomerism: Geometrical isomerism, Optical Isomerism

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit-2: PURIFICATION AND COMPOSITION OF ORGANIC COMPOUNDS	2a. Differentiate crystallization and sublimation method 2b. Apply the different distillation methods for purification of organic solvents 2c. Use the different distillation process for solve wide variety of industrial problems 2d. Use the different methods for detection and testing of elements present in the organic compounds 2e. Estimate elements using different methods 2f. Solve the problems related to method of estimation	2.1. Crystallization and Sublimation 2.2. Distillation: Simple distillation, Fractional distillation, Distillation under reduced pressure, Steam distillation 2.3. Purification Tests: Melting Point and Boiling Point of Organic compounds 2.4. Detection of C, H, N, Halogen & S. 2.5. Detection of N, Cl, Br, I & S using Lassaigne's tests. 2.6. Estimation of Carbon & Hydrogen using Liebig's method. 2.7. Estimation of Nitrogen by Duma's method and Kjeldahl's method. 2.8. Estimation of Halogen and Sulphur by Carius method 2.9. Problems based on methods of estimation
Unit-3: STUDY OF ALIPHATIC AND AROMATIC COMPOUNDS	3a. Differentiate aliphatic and aromatic compounds 3b. Choose appropriate raw materials as a solvent based on their properties and uses 3c. Describe the different methods of preparation of aliphatic and aromatic compounds 3d. Write uses of aliphatic and aromatic compounds 3e. Describe different greener synthetic routes for aliphatic and aromatic compounds	3.1 Aliphatic and Aromatic compounds 3.2 Preparation, properties and uses of Methanol, Ethanol, Acetaldehyde, Acetone, Acetic acid, Oxalic acid, Ethyl acetate, Diethyl ether 3.3 Preparation, properties and uses of Benzene, Toluene, Phenol, Benzoic acid, Nitrobenzene, Aniline, Naphthalene 3.4 A greener alternative synthetic route for aliphatic and aromatic compounds: Grignard reaction, Friedel-crafts Alkylation & Acylation reaction, Esterification reaction.
Unit-4: BRIEF STUDY OF UNIT PROCESSES	4a. Identify the different unit processes 4b. Classify the unit process 4c. Choose appropriate reagent for preparation of organic compounds 4d. Differentiate various unit process based on their reagents. 4e. Write suitable reagents for unit process like Nitration, Sulphonation, Halogenation,	4.1 Unit process: Classification and application of unit process 4.2 Unit processes with suitable reagent and application: 4.2.1 Nitration 4.2.3 Sulphonation 4.2.4 Halogenation 4.2.5 Alkylation 4.2.6 Acylation 4.2.7 Diazotization.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
	Alkylation, Acylation, Diazotization.	
Unit-5 CHEMISTRY OF DYES AND CARBOHYDRATES	5a. Describe the term dyes and pigments. 5b. Differentiate among the term of chromogen, chromophore and auxochrome. 5c. Describe the dyes based on their structures 5d. Describe the dyes based on their applications 5e. Describe Carbohydrates with suitable examples 5f. Use of natural dyes in various fabrics.	5.1 Dyes and Pigments 5.2 Nomenclature of Dyes intermediates 5.3 Chromogen, Chromophore and Auxochrome 5.5 Classification of dyes based on Structures 5.6 Classification of dyes based on methods of applications 5.7 Natural dyes and their applications 5.8 Carbohydrates: Classification of Carbohydrates with suitable examples.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1.	Concept of organic chemistry	08	4	4	5	13
2.	Purification and composition of organic compounds	12	5	8	6	19
3.	Study of aliphatic and aromatic compounds	10	4	8	4	16
4.	Brief study of unit processes	06	3	5	2	10
5.	Chemistry of dyes and carbohydrates	06	4	5	3	12
Total		**42**	**20**	**30**	**20**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may varyslightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Prepare a power point presentation or animation showing different types of isomerism.
b) Preparation of a table showing the different methods used for purification of organic compounds.
c) Prepare a model of a aliphatic and aromatic compounds with the help of a ball and stick or of any other items.
d) Solve simple Problems based on methods of estimation.
e) Library survey of different organic materials and compare their properties and applications.
f) Market survey of different dyes and prepare the chart/Power point based on their types, properties and uses.
g) Group discussion and self-learning activities on recent innovation in organic chemistry for sustainability and green approach.
h) Oral presentation/Webinar/Seminar/Expert lecture related to different unit processes used in industry.
i) Prepare a list of do's and don'ts during practical work in laboratories and industries.
j) Identify green synthesis of various intermediates and renewable raw materials of organic compounds using in industries.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessedusing different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability.
g) Guide students for using of open e-learning resources, web links and software's for micro project work.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar

presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Prepare Qualitative analysis report for different organic compounds.
b) Prepare power point animation that can explain the IUPAC nomenclature system
c) Prepare a model to demonstrate the different types of isomerism with example.
d) Prepare testing report of different aliphatic and aromatic compounds based on their melting point and boiling point.
e) Prepare a model to demonstrate the application of different types of distillation process
f) Collect list of standard methods used to prepare different aliphatic and aromatic compounds in industry.
g) Prepared list of green synthesis of organic renewable raw materials used in industries
h) Prepare list of different unit processing reagent used in industrial unit process for preparation of different organic compounds.
i) Prepare report on application of dyes on different types of fabric used in industries.
j) Prepare a report of dyeing process on Wool, Silk and Cotton with natural dyes.
k) Prepare list of different dyes with their application in textile industry.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	A Textbook of organic chemistry	S.Chand & Co.,	S.Chand Publication, New Delhi,2019, ISBN-9789352837304,
2	Organic Chemistry (Pearson 7th Edition)	R.T.Morrison, R.N.Boyd and S.K.Bhattacharjee	Pearson Education, India ,2010 ISBN:978-8131704813
3	Practical Organic Chemistry (4th edition)	F.G.Mann & B.C.Saunders	Pearson Education India, 2009 ISBN: 978-8131727102
4	Vogels' Textbook of practical organic chemistry (5th edition)	B.S.Furniss, A.J.Hannaford, P.W.G.Smith, A.R.Tatchell	Pearson Education India,2003 ISBN: 978-8177589573
5	Textbook of Organic Chemistry	P.L.Soni & H.M.Chawla	S.Chand & Sons Publication,2012, ISBN: 978-8180547676
6	Synthetic Dyes	Gurdeep R.	Himalaya Publishing House, 2009

S. No.	Title of Book	Author	Publication with place, year and ISBN
		Chatwal	ISBN: 978-8184882193
7	Green Chemistry	V. K. Ahluwalia	Narosa Publishing House Pvt. Ltd,2012, ISBN -978-8184872019

14. SOFTWARE/LEARNING WEBSITES

a) https://organicchemistrydata.org/links/
b) https://www.coursera.org/
c) http://ocw.uci.edu/collections/open_chemistry.html
d) http://chemcollective.org/
e) http://www.olabs.edu.in/
f) https://nptel.ac.in/courses/116/104/116104046/
g) https://www.science.gov/
h) https://fsffrance.org/science/chimie.en.html
i) mygreenlab.org/
j) https://www.organic-chemistry.org/
k) https://en.wikibooks.org/wiki/Organic_Chemistry
l) https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/intro1.htm
m) http://www.digitalbookindex.org/_search/search010chemorganica.asp

15. PO-COMPETENCY-CO MAPPING

Semester I	Organic Chemistry (Course Code: 4322801)						
	Pos						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Use principles of organic chemistry to solve broadly-defined textile processing engineering problems.						
Course Outcomes CO a) Solve textile processing problems using the knowledge of organic materials	3	1	1	-	-	-	1
CO b) Use the relevant purification methods in the textile	3	1	1	1	1	-	1
CO c) Select appropriate engineering	3	-	1	1	1	-	1

materials for textile processing industrial application							
CO d) Choose various types of unit processes for preparing the textile processing related materials	3	-	1	1	1	-	1
CO e) Select various types of dyes and carbohydrates for domestic and industrial application	3	1	1	1	1	-	1

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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