GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester – III

Course Title: Advanced Chemistry
(Course Code: 4335201)

Diploma Program in which this course is offered	Semester in which offered
Ceramic Technology	Third

1. RATIONALE

Advanced Chemistry has intricate and profound relationship with Ceramic technology. Ceramic Technology is the science of creating objects from the material that are inorganic and non-metallic. Though ceramic is related to fine arts, yet it requires an adequate knowledge.
Advanced chemistry is an intensive study of matter and the changes that matter undergoes. Students in this course will attain a depth of understanding of fundamentals, Surface chemistry - Adsorption, Catalysis, Colloids; Thermodynamics and a reasonable competence in dealing with Chemical and Spectral Analysis of Ceramic Materials.
This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of advanced chemistry to solve broad problems in ceramic industries.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competencies through various teaching-learning experiences:
Use principles of Advanced Chemistry to solve broadly-defined Ceramic Engineering problems.

3. COURSE OUTCOMES (COs)

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

a) Solve various engineering problems using some basic concepts of chemistry such as matter, gas laws, mole concept and solutions.
b) Apply different adsorption phenomena, its isotherms and catalysis for domestic and industrial applications.
c) Apply principles of colloids in various aspects in ceramic industries.
d) Use laws of thermodynamics which deals with energy changes of various systems in industries.
e) Perform chemical as well as spectral analysis of ceramic materials in industries.

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	-	4	5	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 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 the sub-components of the COs. *Some of the **PrOs** marked **'*'** (in* Approx. Hrs. required *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	Follow the General & Specific - Precautions and Instructions in Chemistry Laboratory & Understand the Format for reporting the experiment in the Laboratory Manual/Journal.	--	02*
2	Familiarize with the Basic Laboratory Apparatus & Equipments used in the Chemistry Laboratory and their uses.	--	04*
3	Make use of Basic Laboratory Techniques: Heating solution in a Test tube, Heating solution in a beaker or a flask, Filtration, Measuring volume of liquids (Using graduated cylinder, Using Burette, Using Pipette, Using Measuring Flask), Weighing technique : Setting of a weighing balance and weighing.	--	04*
4	Verify Boyle's law of relation between pressure and volume of a gas at constant temperature.	I	02
5	Determine the equivalent weight of Mg metal by hydrogen displacement method.	I	04
6	Prepare stock solutions of NaOH (1N, 2N).	I	02*
7	Prepare stock solutions of HCl (0.5N, 1N).	I	02
8	Prepare standard solutions of $KMnO_4$ (0.1N, 0.25N).	I	02
9	Prepare standard solutions of Na_2CO3 / $K_2Cr_2O_7$ (0.1M).	I	02*
10	Purify raw sugar using activated charcoal.	II	02*
11	Experiment with adsorption of methylene blue from its aqueous solution on activated charcoal.	II	02
12	Determine the adsorption isotherm of acetic acid by activated charcoal.	II	02*
13	Prepare lyophilic sol of starch / gum.	III	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
14	Prepare lyophobic sol of ferric hydroxide / aluminium hydroxide.	III	04
15	Purify starch/gum sol by dialysis.	III	02*
16	Compare the role of emulsifying agents in stabilizing the emulsions of different oils.	III	02*
17	Compare the precipitation values of sodium chloride, barium chloride and aluminium chloride for arsenious sulphide sol.	III	02
18	Determine the enthalpy of dissolution of given solid copper sulphate/potassium nitrate.	IV	02*
19	Determine the enthalpy of neutralisation of a strong acid (HCl) solution with a strong base (NaOH) solution.	IV	04*
20	Determine concentration of given solution of $KMnO_4$ / $CuSO_4$ using Beer's law.	V	04*
21	Verify Beer's law for solution of $KMnO_4$ / $K_2Cr_2O_7$ using colorimeter.	V	04
22	Determine the amount of Ni^{2+} in the given solution of Ni^{2+} colorimetrically.	V	02
23	Determine the amount of Fe^{2+} in the given solution of Fe^{2+} colorimetrically.	V	02*
	Total		**Atleast 56 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	20
2	Operate the equipment setup or circuit	20
3	Observance/Follow safe practices measures	10
4	Record observations correctly	20
#5	Does Calculations, Interpret the Results and their Conclusion/s	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipments/instruments and Softwares required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management

of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications	PrOs. No.
1	**Laboratory 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	**Boyle's law apparatus:** Material : Wooden, MS and rubber tube Height : 1 meter	4
3	**Eudiometer tube:** Capacity: 100 mL. Graduation: 0.1 mL. Length: 23.5".	5
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.	8, 9, 10, 11, 13, 14, 16, 17
5	**Calorimeter:** Calorimeter outer container: Aluminum with rolled rim, Shape of the container: Cylindrical, Type of top cover: Removable, Stirrer with a loop at the bottom to fit inside the Calorimeter, Thermometer holder. **OR** Polythene Bottle Calorimeter	18, 19
6	**Colorimeter:** Output Optical Density: 0 to 1.99 Light Source : 6.2V 0.3 Amp Display Type: LED No.of digit: 2.5 Size or Dimension: 225 x 230 x 150mm Weight : 4kg approx	20, 21, 22, 23

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 fulfil the development of this competency.

a) Inculcate professional skills and ethical values in the context of Advanced Chemistry.
b) Work as a leader/a team member.
c) Follow ethical practices.

d) Observance/Follow safety rules.
e) Housekeeping
f) Time management
g) Does Calculations, Interpret the Results and their Conclusion/s.
h) Practice environmental friendly methods and processes for industrial purposes. (Environment related)

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 Application level)	Topics and Sub-topics
Unit – I **Some Basic Concepts of Chemistry**	1a. Define matter. 1b. Classify the matter based on physical state and chemical structure. 1c. Explain the characteristics of different states of matter. 1d. Discuss intermolecular forces and thermal energy. 1e. Describe the inter-conversion of Matter. 1f. Describe gas laws. 1g. Calculate molecular mass, number of moles and molecules. 1h. Prepare the stock solutions and standard solutions of given concentrations.	1.1 Nature of Matter, Classification of matter based on Physical State and Chemical structure 1.2 Characteristics of different States of Matter 1.3 Intermolecular forces and Thermal Energy 1.4 Inter-conversion of matter 1.5 Gas Laws 1.5.1 Boyle's Law 1.5.2 Charle's Law 1.5.3 Gay-Lussac's Law 1.5.4 Combined Gas Equation (Equation of state) for Real Gases 1.5.5 Ideal Gas Equation 1.6 Atomic Mass, Molecular Mass, Equivalent mass, Molar Mass, Avogadro's number and Mole Concept 1.7 Stock solutions and Standard solutions

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
Unit– II **Adsorption and Catalysis**	2a. Define and explain the terms : Adsorption, Adsorbent, Adsorbate, Desorption, Absorption, Sorption. 2b. Compare absorption and adsorption. 2c. Describe the types of adsorption. 2d. Comprehend the different factors affecting the adsorption. 2e. Describe adsorption isotherms. 2f. State the applications of adsorption. 2g. Define catalyst. 2h. Explain the various types of catalysis and their theories. 2i. Describe types of catalyst. 2j. Explain nature of solid catalyst. 2k. List the industrial applications of catalysts.	2.1 Adsorption, Adsorbent, Adsorbate, Desorption; Absorption, Sorption 2.2 Differences between Absorption and Adsorption 2.3 Types of Adsorption 2.3.1 Physical adsorption 2.3.2 Chemical adsorption 2.4 Factors influencing Adsorption 2.5 Adsorption Isotherms 2.5.1 Freundlich adsorption isotherm 2.5.2 Langmuir adsorption isotherm 2.6 Applications of Adsorption 2.7 Catalyst and Catalysis 2.7.1 Types of catalysis 2.7.2 Theory of catalysis 2.8 Types of Catalyst 2.8.1 Positive catalyst 2.8.2 Negative catalyst 2.8.3 Auto catalyst 2.9 Catalytic promoter and Catalytic inhibitor 2.10 Nature of Solid Catalysts 2.11 Industrial Applications of Catalysts
Unit – III **Colloids**	3a. Compare different types of solutions. 3b. Explain colloids and types of colloids. 3c. Classify Colloids with examples. 3d. Describe methods of preparation of colloids. 3e. Describe the methods for the purification of colloids. 3f. Describe properties of colloids. 3g. Explain emulsion. 3h. State the applications of colloids.	3.1 Comparison of properties of true solutions, colloids and suspensions. 3.2 Colloids – Dispersion medium and Dispersed phase 3.3 Types of Colloidal Dispersion 3.4 Classification of Colloids 3.4.1.Multimolecular colloids 3.4.2 Macromolecular colloids 3.4.3 Associated colloids (Micelles) 3.5 Methods of Preparation of Colloids/Sols 3.5.1 Dispersion methods 3.5.2 Condensation methods 3.6 Purification of Colloidal Dispersion 3.6.1 Dialysis and Electrodialysis 3.6.2 Ultra-filtration 3.6.3 Ultra-centrifuging 3.7 Properties of Colloids 3.7.1 Colligative Properties 3.7.2 Optical Property – Tyndall Effect 3.7.3 Kinetic Property – Brownian

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
		Movement 3.7.4 Electrophoresis 3.7.5 Electro-osmosis 3.7.6 Coagulation of sols 3.8 Emulsion 3.8.1 Tests of Emulsion 3.8.2 Preparation of Emulsions 3.8.3 Demulsification 3.9 Applications of Colloids
Unit– IV **Thermodyn-amics**	4a. Explain the terms of thermodynamics. 4b. Explain zeroth law of thermodynamics with its limitations. 4c. Explain enthalpy of reaction. 4d. Describe different enthalpies with examples. 4e. Understand how to measure ΔU and ΔH using Calorimetry. 4f. Explain Hess's law of constant heat summation. 4g. State first law of thermodynamics, its mathematical form, convention of signs, applications and limitations. 4h. Explain spontaneity of reaction. 4i. Discuss about entropy. 4j. Elaborate the second law of thermodynamics and its limitations. 4k. Define Gibbs free energy. 4l. Explain absolute entropy and the third law of thermodynamics.	4.1 Basic concepts of thermodynamics 4.1.1 System, Boundary and Surrounding 4.1.2 Types of the System 4.1.3 Process, Types of Processes 4.1.4 Extensive Properties and Intensive Properties 4.1.5 State Function 4.1.6 Thermodynamically Reversible Process 4.1.7 Internal Energy (U) 4.1.8 Heat (q), Work (w) 4.2 Zeroth Law of Thermodynamics 4.2.1 Limitations 4.3 Enthalpy of reaction (H) 4.4 Enthalpy change, $\Delta_f H$ of a reaction – Different Enthalpies for different types of reactions 4.5 Measurement of ΔU and ΔH: Calorimetry 4.6 Hess's Law of Constant Heat Summation 4.7 First law of Thermodynamics 4.8.1 Mathematical form 4.4.2 Convention of Signs regarding heat (q) and work (w) 4.4.3 Applications 4.4.4 Limitations 4.8 Spontaneous Processes 4.9 Entropy and Second Law of Thermodynamics 4.10.1 Limitations of Second Law of Thermodynamics 4.10 Gibbs Free Energy (G) 4.11 Absolute Entropy and Third Law of Thermodynamics

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application level)	Topics and Sub-topics
Unit– V **Chemical and Spectral Analysis of Ceramic Materials**	5a. Explain about titration and its types. 5b. State and illustrate Spectrophotometry. 5c. Give idea about spectrophotometer, its parts, advantages and limitations of it. 5d. Describe various types of Spectrophotometers. 5e. Explain Beer's Law and its applications. 5f. Describe atomic absorption spectroscopy. 5g. Explain X-ray diffraction. 5h. Derive Bragg's law of diffraction.	5.1 Titration 5.1.1 Types of Titrations 5.2 Spectrophotometry: Definition, Principle, Types and Working 5.2.1 Spectrophotometers : (a) Single beam Spectrophotometer (b) Digital Colorimeter 5.2.2 Beer's law (Lambert-Beer's law): Statement, Mathematical form and Application 5.4 Spectroscopy: Definition 5.3.1 Atomic Absorption Spectroscopy (AAS): Principle, Working and Application 5.5 X-Ray Diffraction: Principle and Application 5.5.1 Bragg's Law of Diffraction

***Note**: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Some Basic Concepts of Chemistry	6	4	4	3	11
II	Adsorption and Catalysis	8	4	5	5	14
III	Colloids	10	5	5	6	16
IV	Thermodynamics	12	5	6	7	18
V	Chemical and Spectral Analysis of Ceramic Materials	6	4	4	3	11
Total		**42**	**22**	**24**	**24**	**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 vary slightly 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 small reports of 1 to 5 pages for each activity, also collect/record physical evidences (such as photographs/videos of the activities) for their (student's) portfolio which will be useful for their placement interviews:

a) Collect different samples of matter and prepare chart of their properties.
b) Prepare a poster of compounds existing in various physical state.
c) Prepare a chart showing classification of matter based on physical state and chemical structure.
d) Prepare stock and standard solutions of various concentration units.
e) Prepare a table showing the differences between physisorption and chemisorption.
f) Undertake micro-projects in teams on industrial application of catalysis.
g) Prepare model of dialyzer used for purification of colloids.
h) Make animated videos of different colloidal solution.
i) Prepare colloidal solution or emulsion and show their properties.
j) Investigate the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on their foaming capacity.
k) Survey at library regarding study of chemical thermodynamics.
l) Carry out chemical analysis of any material used in industry.
m) Prepare flow charts showing working of spectrometers.
n) Collect various raw materials used in ceramic industry and write their chemical composition.
o) Give seminar on any relevant topic.

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) Different types of teaching methods i.e. video demonstration, activity-based learning, case study, m-learning need to be employed by teachers to develop the outcomes.
d) **Some *of the topics/sub-topics*** which are relatively simpler or descriptive are to be given to the students for ***self-learning*** but to be assessed using different assessment methods.
e) Teachers need to ensure to create opportunities and provisions for ***co-curricular*** activities.
f) Guide students to address issues on environment and sustainability with reference to using the knowledge of this course.
g) OERs, Vlab, and Olabs may be used to teach the different concepts.

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 micro-project should be about ***14-16 (fourteen to sixteen) student engagement hours*** (i.e. about one hour per week) during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

For micro project report should be as per suggested format, for other activities students and teachers together can decide the format of the report. Students should

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 models of different matter having different physical states and chemical structure.
b) Prepare a chart of compounds and solutions which affect human life positively and negatively.
c) Make a chart showing different gas laws with mathematical forms.
d) Make a chart showing the comparison between properties of true solutions, colloids and suspensions with examples.
e) Collect different adsorbates and adsorbents and make a chart based on their type, properties, and uses. Also write examples illustrating absorption, adsorption, desorption and sorption.
f) Differentiate adsorption and absorption through model.
g) Make a chart showing differences between Freundlich adsorption isotherm and Langmuir adsorption isotherm.
h) Prepare lock and key model to explain specificity of catalyst.
i) Prepare animated videos or power point presentation on colloidal solution.
j) Prepare any colloidal solution and show its properties.
k) Prepare a chart on types of systems and types of processes with figures &/or examples.
l) Prepare a chart showing the different enthalpies with examples.
m) Prepare a model to demonstrate the application of spectrophotometer.
n) Prepare chart on absorption spectra in IR region.
o) Prepare charts of various ceramic materials and their chemical compositions.
p) Prepare a PowerPoint presentation or animation on any relevant topic.
q) Give Seminar with presentation on any relevant topic.
r) Prepare a micro-project from the suggested practical exercises.
s) Prepare presentation/poster on chemicals with its chemical and physical properties and structure used in day-to-day life.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with the place, year, and ISBN
1	Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2015, ISBN: 93-521-6000-2
2	A Textbook of Engineering Chemistry	Dr. S. S. Dara & Dr. S. S. Umare	S. Chand & Co.(P) Ltd., New Delhi, 2014, ISBN:81-219-0359-9
3	Textbook of Chemistry for Class XI & XII (Part-I & II)	NCERT	NCERT, New Delhi, 2017-18, Class-XI, ISBN: 81-7450-494-X (part-I), 81-7450-535-O (part-II), Class-XII, ISBN: 81-7450-648-9 (part-I), 81-7450-716-7 (part-II)
4	Engineering Chemistry	Shikha Agarwal	Cambridge Uni. Press, New Delhi, 2019, ISBN: 978-1-108-72444-9
5	Principle of Physical Chemistry	Puri, Sharma and Pathania	Vishal publishing Co, 2020 ISBN: 9786445809996
6	Engineering Chemistry	Dr. Vikram, S.	Wiley India Pvt. Ltd., New Delhi, 2013, ISBN: 9788126543342
7	Applied Chemistry Laboratory Practices, Vol. I & II	Dr. G.H. Hunger & Prof. A.N. Pathak.	NITTTR, Chandigarh, Publication, 2013-14
8	Chemical analysis of ceramic and allied materials.	S.Dasgupta and S.K.Roy	Calcutta : Indian Institute of Ceramics, 1985
9	Ceramic Materials Science and Engineering	C. Barry Carter, M. Grant Norton	2nd Edition, Springer, ISBN: 978-1-4614-3523-5

13. SUGGESTED LEARNING WEBSITES

1. http://gujarat-education.gov.in/textbook/Images/12sem4/chemistry12-guj/chap2.pdf
2. http://gujarat-education.gov.in/textbook/Images/12sem4/chemistry12-eng/chap2.pdf
3. http://gujarat-education.gov.in/textbook/Images/11sem2/chemistry-11guj/chap3.pdf
4. http://gujarat-education.gov.in/textbook/Images/11sem2/chemistry-11eng/chap3.pdf
5. https://ncert.nic.in/textbook.php?lech1=0-9
6. http://gujarat-education.gov.in/TextBook/Textbooks/new-syllabus/std11_2018.htm
7. http://gujarat-education.gov.in/TextBook/Textbooks/new-syllabus/std12_2019.htm
8. https://ncert.nic.in/science-laboratory-manual.php
9. http://www.chemguide.co.uk/atommenu.html
10. https://www.visionlearning.com
11. http://www.chem1.com
12. http://www.em-ea.org
13. www.onlinelibrary.wiley.com
14. www.rsc.org
15. www.chemcollective.org

16. www.wqa.org
17. https://docslib.org/insulation-materials-science-and-application
18. http://www.olabs.edu.in/
19. http://chemcollective.org/activities/type_page/1
20. http://www.presentingscience.com/vac/corrosion/index.htm
21. https://vlab.amrita.edu/index.php?sub=2&brch=190

15. PO-COMPETENCY-CO MAPPING

Semester – III	Advanced Chemistry (Course Code: 4335201)						
	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 Advanced Chemistry to solve broadly-defined Ceramic Engineering problems.*	3	2	2	1	1	1	1
Course Outcomes							
CO a) Solve various engineering problems using some basic concepts of chemistry such as matter, gas laws, mole concept and solutions.	3	1	-	1	-	-	1
CO b) Apply different adsorption phenomena, its isotherms and catalysis for domestic and industrial applications.	3	1	1	1	1	-	1
CO c) Apply principles of colloids in various aspects in ceramic industries.	3	1	-	1	1	-	1
CO d) Use laws of thermodynamics which deals with energy changes of various systems in industries.	3	1	1	1	1	-	1
CO e) Perform chemical as well as spectral analysis of ceramic materials in industries.	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/ PSO.

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Mr. Darshit B. Chhag Lecturer in Chemistry, Member of BOS (GTU-Diploma)	Government Polytechnic, Rajkot.	9408046467	dbchhag@gmail.com

2	Miss Vaishnavi P. Gilava Lecturer in Chemistry	L. E. College (Diploma), Morbi.	9426383248	vaishnvi.gadhavi@gmail.com
3	Mr. Bharat B. Patel I/C HOD Ceramic Deptt.	L. E. College (Diploma), Morbi.	8160590472	bharat.lecollege@gmail.com