GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130004
Semester – III
Subject Name: Effective Technical Communication

Type of course: Communication and ethics

Prerequisite: Zeal to learn the subject

Rationale: The rationale of the curriculum is to help students learn technical communication along with necessary moral and ethical dimensions of engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Contents:

Sr. No.	Topics	Teaching Hours	Module Weightage
1	**Dynamics of Communication**: Definition and process Kinesics Proxemics Paralinguistic features Importance of Interpersonal and Intercultural Communication in today's organizations	06	20%
2	**Technical Writing**: Report writing Technical proposal Technical description Business letters(sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter) Agenda of meeting, Minutes of meeting Resume writing	08	25%
3	**Technical Communication**: Public speaking Group discussion Presentation strategies Interview skills Negotiation skills Critical and Creative thinking in communication	06	20%
4	**Ethics in Engineering**: Scope of engineering ethics Accepting and sharing responsibility Responsible professionals and ethical corporations Resolving ethical dilemmas Making moral choices	04	12%
5	**Etiquettes**: Telephone etiquettes Etiquettes for foreign business trips Visits of foreign counterparts Etiquettes for small talks	05	16%

	Respecting privacy Learning to say NO Time management		
6	**Self-development and Assessment:** Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream.	03	7%

Distribution of Theory Marks					
Remember	Understand	Analysis	Application	Evaluation	Creativity
05	**05**	**15**	**15**	**15**	**15**

Language Laboratory Activities:

Sr. No.	**Practical/ Exercise**	**Apprx. Hours required**	**Preferably to be conducted in:**
1	Role Play	02	Classroom/Hall
2	Letter writing: Formal	02	Classroom/Lab
3	Group Discussion	04	Classroom/Hall
4	Presentations	04	Classroom/Hall
5	Book Review(Preferably related to self-development)	04	Classroom/Hall
6	Mock Interview	04	Classroom/Hall
7	Report writing	02	Classroom/Lab
8	Case studies related to unit 4, 5 and 6	06	Classroom/Lab
9	Conducting meetings and minutes of meeting	02	Classroom/Hall
10	Practical assessment	02	Classroom/Lab

Suggested books for review:

1. You Can Win by Shiv Khera
2. How to Win Friends and Influence People by Dale Carnegie
3. Getting Things Done: The Art of Stress Free Productivity by David Allen
4. Quiet: The Power of Introverts in a World That Can't Stop Talking by Susan Cain
5. The Alchemist by Paulo Coelho
6. The 7 Habits of Highly Effective People by Stephen Covey
7. What to Say When You Talk to Yourself by Dr. Shad Helmstetter
8. The Big Leap by Gay Hendricks
9. Thinking Fast and Slow by Daniel Kahneman
10. The Art of Thinking Clearly by Ralf Dobelli
11. Upside Down Key by Sudha Murthy
12. Born to be Happy by Pramod Batra
13. Kiss That Frog by Brian Tracy

14. Build From Scratch by Vineet Bajpai
15. Ten Much by A G Krishnamoorthy
16. Poor Little Rich Slum by Rashmi Bansal
17. Our Ice Berg is Melting by John Paul Cotter
18. Most and More by Mahatria Ra
19. Third Curve by Mansoor Ali Khan
20. Selected Short Stories of Rabindranath Tagore edited by William Radice
21. That Thou Art by Dhruv Bhatt
22. Old Man and the Sea by Ernest Hemingway

Reference Books:

1. Raman and Sharma, *Technical Communications*, OUP, New Delhi, 2017
2. Lata and Kumar, *Communication Skills*, OUP, New Delhi, 2018
3. Mike Martin and Roland Schinzinger, *Ethics in Engineering*, McGraw Hill, New York, 2014
4. Mohapatra and Sreejesh S., *Case Studies in Business Ethics and Corporate Governance*, Pearson, UP, 2013
5. Ramesh and Ramesh, *The Ace of Soft Skills*, Pearson, UP, 2019
6. Sherfield, Montgomery and Moody, *Cornerstone: Developing Soft Skills*, UP, 2009

Open Sources:

https://www.scu.edu/ethics/focus-areas/more/engineering-ethics/engineering-ethics-cases/

Course Outcomes:

At the end of the course students will be able to:

Sr. No.	Course Outcome	Weightage
1	Define and discuss dynamics of Verbal and Non Verbal aspects of Communication	20%
2	Write various formal documents of technical and professional communication	25%
3	Communicate in diverse formal situations taking place in organizations	20%
4	Illustrate and examine the knowledge of ethical aspects of engineering	12%
5	Demonstrate and explain social and professional etiquettes	16%
6	Plan self-development and practice self-assessment	7%

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130007
Semester – III
Subject Name: Indian Constitution

Type of course: Mandatory course

Prerequisite: NA

Rationale: NA.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Contents:

Sr. No.	Topics	Total Hours
1	Meaning of the constitution law and constitutionalism	01
2	History of Indian Constitution	02
3	Salient features and characteristics of the Constitution of India	01
4	Fundamental rights	02
5	Right to Equality under Article – 14	02
6	Right to certain Freedom under Article 19	02
7	Scope of the Right to Life and Personal Liberty under Article 21	02
8	Fundamental Duties and its legal status	02
9	The Directive Principles of State Policy – Its importance and implementation	02
10	Federal structure and distribution of legislative and financial powers between the Union and the States	03
11	Parliamentary Form of Government in India – The constitution powers and status of the President of India	02
12	Powers and Procedure for Amendments in Indian Constitution	01
13	History of amendments in Indian Constitutional	02
14	Emergency Provisions : National Emergency, President Rule, Financial Emergency	03
15	Local Self Government – Constitutional Scheme in India	03

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Enhance human values , create awareness about law enactment and importance of Consitution	10%
CO-2	To Understand the Fundamental Rights and Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsbilities.	30%
CO-3	Create Awareness of their Surroundings, Society, Social problems and their sutaible solutions while keeping rights and duties of the citizen keeping in mind.	20%
CO-4	Understand distribution of powers and functions of Local Self Government.	20%
CO-5	Understand the National Emergency, Financial Emergency and their impact on Economy of the country.	20%

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130007

Reference Books :

1. Constitutional Law of India, Dr. J.N. Pandey, Central Law Agency
2. Introduction to the Consitution of India, Durga Das Basu, LexisNexis.
3. Indian Constitutional Law, M.P. Jain, LexisNexis
4. V.N.Shukla's Constitution of India, Mahndra Pal Singh, Eastern Book Company
5. Constitutional Law – I Structure, Udai Raj Rai, Eastern Book Company

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130008
Semester III
Design Engineering 1 A
Module 1: Understanding Design Thinking

Type of Course: Project Work

Prerequisite: Optimistic mind-set, Enthusiasm of learning new things, Unlearn yourself

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
0	0	2	1	0	0	80	20	100

Relevance

This course is meant for beginners. The course is designed to imbibe Design Thinking understanding and mind-set for the 3rd semester students.

Objective: Understanding Design Thinking

The course aims to expose students to the basic process and framework of Design Thinking and relevant tools & techniques for Creativity & Innovation.

Course Contents

This Course is designed to give very basic understanding of the Design Thinking methodology. In DE-1A, student will select very basic and small, individual or team project irrespective of their branch. This project would be from very general topic/domain like designing something for yourself/parents/Teacher/Friends (Whole class may select single project topic or similar topic in different small groups to have healthy competition among the class). This kind of basic project in 3rd semester would help in understanding of Design Thinking process easily when much technicality is not involve. In this module, student will use whole Design Thinking process as shown in fig.1 of general guideline document to complete their projects but here the learning objective or focus would be more on Observation or Empathy process. So students need to give more time to these phases and then reach up to the rough prototype phase. The content is divided into week-wise activities as shown below to better understand the course and to give enough time to all the learning aspects and students need to follow the same but depending upon the type and nature of projects, students and guide may allocate more/less time to the activities.

Design Thinking Process – with Tools & Techniques			
Module 1 (DE-1A): Understanding Design Thinking			
Broad segment	Week	Description	Operational need
Design Thinking Introduction	1	○ Overview, objective and goal of this course ○ What is Design Thinking? - Its importance, socio-economical relevance ○ Design thinking to foster innovation ○ Relevance of design and design thinking in engineering ○ Systematic problem identification & problem solving approaches	○ Brief lecture/exercise ○ Hands on exercise to understand attributes of Design Thinking
	2	○ Domain Selection (general topic/products in 3rd semester) ○ Team Building Exercise ○ Log book, documentation strategy – introduction, importance, preparation	○ Brief lecture/exercise ○ Hands-on sessions with cases/examples ○ Individual logbook is required
	3	○ Learning tools ✓ Design in nature/Bio-mimicry ✓ Design as a System approach ✓ Design as listening tool for mapping users' unmet needs	○ Brief lecture/exercise ○ Next week Students need to present on the learning from these topics
Empathization Phase	4,5,6	○ Observation: Through AEIOU framework ✓ Orientation to Field Work – Need for field visit? ✓ What/How/Where to Observe ✓ Ethnographic tools and its usage ✓ What difference it will make if the problem solved - partially or fully? ✓ Could solution be worse than the problem? ✓ Key pain and pleasure points ✓ Understanding of User Contexts ✓ Log book exercise ✓ Analysis of Data - Mind Mapping ○ Immerse via Role Playing	○ Students will be introduced to different observation/scouting methods in the theory session in class for all four weeks in different sessions ○ Then during weeks, they need to visit their selected domain/place for getting insights and define problems. ○ Minimum 4-5 field trips will be required to get better insights on users' needs.

		○ Interview: ✓ Formal and Informal interview ✓ Students may use Stanford methods given in below link - http://dschool.stanford.edu/wp-content/uploads/2013/10/METHODCARDS-v3-slim.pdf	
		○ Summary of AEIOU activity/inputs ○ Preparation of Mind Map, Empathy Map	○ Class as well as homework/field activity
Define Phase: Problem Definition by secondary research ,group work and presentation	7	○ Secondary research/Prior art search (prior art search is continuous activity and can be used in any phase to strengthen the idea) ○ Group wise presentation followed by Discussion ○ Define Problem statement (format is given in reference PPT on DE portal ○ Verification of problem identified by team through users/stakeholders	○ After rigorous and systematic field exercises, empathization and Secondary Research activities -student teams need to define their problem here (it can be further validate through Ideation phase)
Ideation Phase	8	○ Preparation of Ideation canvas ✓ Brainstorming (What, Why, How, When, For Whom) ✓ Situation/Context/Location ✓ Props/non-living things/tools/equipment ✓ Opportunity mapping	○ 2 hour – explanation of Ideation canvas to class ○ Then students will work on their Ideation canvas ○ Ideation activities shall be performed in class with team members under guidance of teacher
	9	○ Combination of Ideas from Ideation canvas ○ Sketching of mock concepts in log book ○ Design Thinking is a Convergent-Divergent process	○ Student teams need to discuss their Ideation canvas with other teams, faculty guides and users and take feedbacks
	10	○ Prioritizing and finalizing Idea (After group discussion and consulting with faculty guide, student teams need to select their final problem & idea for further development)	○ Students team need to validate the final Problem & idea/concept with Users/Stakeholders after this activity

Product Development Phase	11	○ Preparation of Product Development Canvas (PDC) ✓ Product Experience ✓ Product Functions ✓ Product Features ✓ Components ○ Discussion on Product Development Canvas (PDC)	○ 2 hour – explanation of product development canvas to class ○ Then students will work on their PD canvas (min 3 hour continuous workshop) ○ Till 12th week of the course, Students team will discuss on their PDC with other groups and guide ○ Refinement of PDC after discussion
	12	○ Customer/User Revalidation (Reject/Redesign/Retain) ○ Refinement	○ Till 13th week of the course, student team will consult the Users/Stakeholders for their inputs for concept finalization after various stages and incorporate necessary changes.
Proof of Concept	13	○ Rough Prototype ○ Here strategy is "to fail fast to succeed faster"	○ Very early & rough prototype ○ Made up of paper, cardboard, thermocol etc. whichever material is available
Feedback & Final Report	14	○ Upload duly signed Continuous Assessment Card ○ Feedback, Online certificate generation through DE portal ○ Final Report	○ As per the feedback received from Users/Stakeholders/other student groups/guide, student teams need to modify their design and further action plan. ○ Report writing should be continuous activity throughout the semester

Submissions by the end of 3rd semester shall be:

A. Process Report comprising:
   a. Introduction (Describe your project in detail including domain – type, place, why and how team selected this domain and why this domain is important in relation to Design Thinking/Human-Centered process etc.)
   b. Preparation of canvases based on different phase of Design Thinking
   c. Feedback analysis with the user shall be clearly included in the report
   d. Summary of findings of Prior Art Search on purpose/project theme (2 summary papers per student)
   e. Summary of the learning from Design Thinking
   f. Summary on validation process and refinement in the rough prototype
   g. Any other important aspects you feel should be included

B. AEIOU framework
C. Mind Map
D. Empathy Map
E. Ideation Canvas
F. Product Development Canvas (PDC)
G. Rough prototype model/Conceptual Plan-Layout for process related branches
H. Individual Log Book (duly signed by faculty guide)
I. Continuous Assessment Card for Internal Evaluation (Document separately available on GTU website)

Note: As per the guidelines and evaluation schemes given in this document, students need to prepare report for their projects. Separate report format will not be provided by University, students and faculty members may create their own creative formats. However, in general guidelines document uploaded on GTU website, there are some report format links are given which may help for report format.

To,

The Principals/Directors of Colleges/Institutes, the Heads of Departments and GTU/Design Engineering coordinators:

Students deserve a proper practical/ viva/project examination of the work that they have done over the semester (or over the year for a 2-semester project). It is the responsibility of the University and Colleges that all its examinations are conducted fairly, sincerely and with due diligence. So please look into the following:

1. Please make proper arrangements so that all the examinations start in-time. If due to any reason, the exam should not start at the scheduled time, please inform the examiners that they should take extra time. But in no case the viva/ practical exam be conducted in a hurry without giving sufficient time for evaluation of every student. If an exam is scheduled to be held over two days, please make the necessary arrangements.

2. The University expects the Deans (and or special teams headed by the Dean or his/ her nominee) to visit the Colleges during the practical/ viva examinations. As it came to University's notice that some examiners and colleges are completing viva exam in 1 or 2 hours' time of entire class which is not acceptable in any case and it's immoral practice for any education institute. So all stakeholders need to take extra care of this issue.

3. Please see that all the necessary help and information is provided to examiner. Please receive them so that they can do their job properly without wasting their time in searching for the place and in contacting the concerned departments and students. If they wish to visit the laboratories/workshops, please make the necessary arrangements.

4. Please inform the examiner that he/she must note down the best 3 projects of the department and convey the details of such projects by uploading the details of the project or/and the complete project report on the University's server or send it to design@gtu.edu.in .

5. In case Internet or the server should not work, please provide the technical help to the examiner for preparing a CD of the reports of the best three projects of every department and please make arrangements to deliver the CD to the examination/BE section of the University.

PROCESS OF EVALUATION: At the ensuing 3rd semester examinations, the work of the students in Design Engineering – 1A is to be evaluated through Internal Viva exam and the evaluation is to be out of 80 marks. Institute may organize inter-department viva or project show case so students would get various expert opinions to motivate them.

For 3rd semester, internal Viva-Voce examination will be conducted at the end of the semester by a team of three examiners - One internal guide, one inter/own departmental faculty, one industry expert (industry expert may be optional but recommended). Internal examiners/teachers must be trained in Design Thinking through the FDP conducted by University.

EVALUATION SCHEME:

Sr. No.	Particular	Sub-Head Weightage
1.	Understanding of Design Thinking methodology/ need ✓ Importance and understanding of Design Thinking for innovation, entrepreneurship, societal solutions with various learning tools	15
2.	Observation towards Empathy ✓ Field Activity/observation and outcome ✓ Mind Mapping - Summarization and data analysis ✓ Observation Technique (AEIOU Framework)	20
3.	Log book (Individual completed log book, duly signed by guide regularly) Continuous Assessment Card for Internal Evaluation (Complete and duly signed by guide regularly)	10
4.	Understanding of Canvases/Framework ✓ AEIOU, Mind Mapping ✓ Empathy mapping ✓ Ideation Canvas ✓ Product development Canvas	15
5.	Design Problem Definition ✓ Prior art search/Secondary research ✓ Diachronic and Synchronic analysis	10
6.	Report: Compilation of work report (process report), Online Certificate generated through DE Portal, Future action plan, Question and Answer, Communication Skill, Attitude	10
		80

Note:

- ✓ Total Marks for the subject: 100 (Internal end semester viva exam – 80 & Internal continuous evaluation – 20)
- ✓ Minimum passing marks: 40/80
- ✓ Examiner essentially needs to evaluate the learning process of the student during the semester, not only the final outcome. As outcome is important for any project but during the student stage, projects are intended for practical learning and "Learning by doing" is the Mantra for Design Engineering subject (One should celebrate the failure also and learn from it to get success). So

please evaluate the Design Thinking process and their learning properly with giving sufficient time for each project.

- ✓ Students need to explain all canvases prepared in hard copy to the panel of examiners.
- ✓ Power point presentation is not mandatory.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130502
Semester – III
Subject Name: Fluid Flow Operations

Type of course: Core course

Prerequisite: Elements of Physics

Rationale: This Subject is essential for Chemical engineering to know the effect of pressure and stress of fluid on different bodies. Further, it is useful for students to know the metering devices for different type of fluids.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Fluid static and its application: Properties of fluids, Pressure concept, Hydrostatic equilibrium, decanters like continuous gravity, centrifugal etc. Fluid Flow Phenomena: Velocity fluid, Velocity gradient and rate of shear, Newtonian and Non Newtonian fluids, Viscosity and momentum flux, Reynolds number and its significance, laminar and turbulent flow; Laminar and Turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary separation and wake formation.	12
2	Basic equations of Fluid Flow: Mass velocity; average velocity; potential flow; streamlines, stream tubes, macroscopic momentum balance, momentum correction factor, Equation of continuity, Bernoulli's equation, corrections for fluid friction, pump work in Bernoulli's equations, angular momentum equations.	10
3	Flow of incompressible fluids: in Conduits and Thin Layers: Flow of incompressible fluids in Conduits and Thin Layers in pipes, relation between skin friction and wall shear, friction factor laminar flow in pipes, kinetic energy correction factor and momentum correction factor for laminar flow of Newtonian fluids, Hagen-Poiseuille equation, effect of roughness, friction factor chart, friction factor inflow through channels of non-circular cross section, equivalent diameter, hydraulic radius, friction from changes in velocity or direction, flow through sudden enlargement of cross section, flow through sudden contraction of cross section, effect of fittings and valves, form friction losses in Bernoulli's equations, separation of boundary layers in diverging channel.	12
4	Flow of Compressible fluids: Mach number, continuity equation total energy balance equation, velocity of sound. Introduction of isentropic expansion, adiabatic frictional flow, isothermal frictional flow, velocity in nozzles.	10

	Flow past immersed bodies: Introduction to Drag, drag coefficient, form drag, and stream lining. Dimensional Analysis: Different methods of dimensional analysis applied to fluid flow problems.	
5	Transportation and Metering of fluid: Pipe and tubing, joint and fittings selection of pipe sizes, prevention of leakage around moving parts, stuffing boxes, mechanical seals, valves like Gate, Globe, Plug cocks, Ball, Check valves. Fluid moving machinery: Pumps its characteristics like developed head power requirement suction lift and cavitations; positive displacement pumps like reciprocating, rotary pumps, centrifugal pumps and its theory, characteristic of head capacity relation, pump priming, fans, blowers like positive displacement, centrifugal blowers, compressor efficiency, vacuum pumps, jet ejectors, comparison of devices for moving fluids. Measurement of flowing fluids: Full bore meter like venturimeter, orifice meter, coefficient of discharge of venturimeter, orifice meter, area meters like Rotameter, target meters, vortex-shedding meters, coriolis meters, magnetic meters etc., insertion meters like pitot tubes.	**16**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
17	**14**	**18**	**7**	**7**	**7**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

"Unit Operations of Chemical Engineering", McCabe W L, Smith J C, Harriott P, Mc Graw Hill Publication, 7th edition 2005.
"Chemical Engineering" Vol. I – Fluid flow, Heat Transfer and Mass Transfer; Coulson & Richardson's, Butterworth – Heinemann Publication, 6 th Edition.
"Fluid Dynamics and Heat Transfer", James G. Knudson and Donald L. Katz, Mc Graw Hill Publication.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Identify fluid properties and memorize the concepts of pressure.	25
CO-2	Classify different types of fluid and generalize the concepts of boundary layer and its estimation in different flows.	20
CO-3	Apply and demonstrate the basic equations of fluid flow.	25

CO-4	Calculate and examine the flow in compressible and incompressible fluid along dimensional analysis for problems in fluid flow.	10
CO-5	Propose appropriate pipe size, joints, fitting and valve for chemical processes.	10
CO-6	Evaluate and compare the performance of various fluid flowing machinery i.e pumps and compressor and metering devices i.e. flow meters.	10

Suggested list of experiments

10 experiments needs to be performed during the semester.

1. To study and verify Bernoulli's Theorem
2. To calibrate Venturi meter and obtain it's coefficient of discharge.
3 To calibrate an Orifice meter and obtain it's coefficient of discharge.
4. To study a Rotameter and obtain it's coefficient of discharge.
5. To Study Notched Weirs Apparatus and obtain its discharge coefficient.
6. Study of Pressure measurement devices.
7. Pressure drop in various size of circular pipes.
8. Friction factor for various size of pipes.
9. Pressure drop and friction factor measurement in bend, valves and different fittings.
10. Pressure drop in non-circular pipes of different size.
11. To observe Reynolds's number and flow pattern in Reynolds Apparatus.
12. Centrifugal Pump testing and characteristic curves.
13. Reciprocating Pump testing and characteristic curves.
14. Determination of metacentric heights for floating bodies.

Major Equipment:

Bernoulli's experiment, Reynolds experimental set up.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Chemical Engineering)
Subject Code: 3130506
Semester III
Subject Name: Applied Chemistry

Type of course: Basic Science**.**

Prerequisite: Zeal to learn the subject.

Rationale: Applied Chemistry is considered as Basic Science subject.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE Pr/Viva (V)	PA (I)	
3	0	4	5	70	30	30	20	150

Contents:

Sr. No.	Content	Total Hrs.
1	**Physical Properties and Chemical Constitution of matter**: Additive & Constitutive properties: Parachor, Viscosity, Dipole Moment, Molar Refraction, Optical activity, Magnetic properties. Preparation and theory of Solution: Mole Fraction, Normality, Molality, Molarity, Lowering of vapor pressure, Elevation of Boiling point, Depression of Freezing point, Osmosis & Osmotic pressure.	4
2	**General Principle of Organic Reactions:**Electronegativity, Electron Displacement Effect, Fission of Covalent Bond, Reactive Intermediate, Organic Species based on Carbon and Nitrogen, Types of Organic reaction and Mechanism.	5
3	**Stereochemistry::** Optical, Geometrical and Conformational Isomerism: Optical activity, Polarimeter, Specific rotation, Enantiomers, Diasteromers, Optical activity in Lactic and Tartaric acid, R and S configuration of Optically active compound and E and Z designation of Geometrical isomers. Resolution of racemic mixture.Conformations of cyclic and acyclic systems.	4
4	**Introduction to quantum theory for chemical systems/Co-ordination Chemistry (Chemical Bonding):** Wave Mechanical approach of atom, Heisenberg Uncertainty Principle, Schrodinger Wave Equation, Applications to Hydrogenatom, Atomic orbitals& MO theory, Types of Hybridisation, Structure-Bonding and shapes of certain molecules. Understanding of different bonds.	6
5	**The Phase Rule:** Introduction, Phase, Components, Degree of freedom, Derivation of Gibb's Phase, Three & Four Phase-One component system like water, sulphur systems, Two component -Eutectic systems like Silver-Lead, Zinc-Cadmium, Ferric Chloride-Water system	5
6	**Chemical Kinetics:** Introduction, Reaction rate, Units of rate, Rate laws, Order of a reaction, Zero order reaction, Molecularity of a reaction, Pseudo-order reaction, first order reaction with numerical, second order reaction, third order reaction, units of rate constant.	5
7	**Thermochemistry:**	5

	Introduction, Internal Energy, Enthalpy of reaction, Endothermic reaction, Exothermic reaction, ΔH and ΔE and numerical. Thermo-chemical equations like heat of reaction, heat of combustion, heat of neutralisation, heat of transition, Hess's Law of constant heat summation and its application, Experimental measurement of heat of reaction.	
8	**Semi&Non-crystalline/amorphous materials**: Classification, structure and configuration of Ceramics, Refractories & Insulators, polymers,copolymers, liquid crystals and amphiphiles: Silicates, glass transition temperature and viscoelasticity.NanoComposites: role of reinforcement-matrix interface. Strength on composite behaviour, Biomaterials, material related to catalyst such as zeolites, silica.	5
9	**Analytical Techniques:** Principles of Electronic, Florescence, NMR & Mass spectroscopy, Surface characterization techniques: SEM and TEM.Introduction to experimental techniques:XRD, PSA, etc. for material characterizationhighlighting links between molecular structure and macroscopic properties.	6

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
07	42	11	10	-	-

Legends: R: Remembrances; U: Understanding; A: Application; N: Analyze; E: Evaluate; C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Essential of Physical Chemistry by B. S, Bahl and Tuli., Publisher: S Chand & Co. Ltd, New Delhi

2. A textbook of Physical Chemistry by A S Negi& S C Anand, Publisher: New Age International Publisher Private Ltd. New Delhi

3.A textbook of Organic Chemistry by ArunBahl& B S Bahl, Publisher: S Chand & Co. Ltd, New Delhi.

4. A textbook of Inorganic Chemistry by P L Soni, Publisher: Sultan Chand & Sons, New Delhi

5. Physical Chemistry, by Peter Atkins, Julio de Paulo, Publisher: W H Freemann, UK

6. Engineering Chemistry by B K. Sharma, Publisher: Krishna Prakashan Media (P) Ltd.

7. A textbook of Engineering Chemistry by Shashi Chawla, Publisher:Dhanpatrai Publishing Co. Ltd.

8. Principle of Instrumental Analysis by Douglas A Skoog, F. James Holler, Stanely R Crouch, Publisher: Cencage.

9. Instrumental Method of Chemical Analysis by B K Sharma, Publisher: Krishna Prakashan Media.

10. Materials Science and Engineering: A First Course, byV. Raghavan5th Edition Prentice HallIndia, 2004.

11. B. S. Mitchell,An Introduction to Materials Engineering and Science for Chemical and Materials Engineers, John Wiley & Sons, 2004.

Course Outcomes:

Sr. No.	CO Statements	Marks % Weightage
1.	Identify and describe reactivity patterns in organic reaction.	**15**
2.	Explain theoretical principles underlying molecular structure, bonding and properties	**20**
3.	Describe the importance and relevance of Hard and soft materials and also their characterization, properties and uses in engineering applications.	**15**
4.	Distinguish the difference between the different orders of reaction and apply accordingly.	**15**
5.	Utilize different thermo dynamical laws to explain course of reactions.	**15**
6.	Apply the different spectroscopic techniques to explain the inner & surface characteristic of molecules.	**20**

List of Experiments : (Minimum 8 to be performed in Physical and 8 to be performed in Inorganic/Organic Chemistry.)

1. Heat of Solution.
2. Ester Hydrolysis (Ist&IInd Order reaction).
3. Measurement of Conductance.
4. Lambert's Beers Law.
5. Turbidity.
6. Potentiometer.
7. Viscosity Measurement.
8. pH Meter.
9. Polarimeter.
10. Inorganic Qualitative Analysis.
11. Inorganic Quantitative Analysis.
12. Organic Qualitative Analysis.
13. Organic Quantitative Analysis.

Reference Books:

1. Experimental Physical Chemistry, by Athawale. V D, Publisher: New Age International Publishing Ltd.
2. Vogel's Textbook of Practical Organic Chemistry by Hannaford, Smith &Tatchell, Publisher: Elbs with Longman
3. Vogel's textbook of Quantitative/ Qualitative Chemical Analysis, by Arthur I Vogel, Revised by Jeffery et al, Publisher: Addison Wesley,Longman Ltd, England
4. Engineering Vogel's Textbook of Quantitative Chemical Analysis by Jeffery. G H Publisher: Addison Wesley Longman/Pearson Education Asia.

Major Equipments:

1. Spectrophotometer, Conductometer, Potentiometer, pH meter, Polarimeter.
2. Laboratory Oven, Stirrer Hot Plate, Hot plates.
3. Turbidity Meter, Viscometer, Temperature Control Bath,
4. Electronic Balance.

List of Open Source Software/learning website:

NPTEL, World Wide Web, etc.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Chemical Engineering)
Subject Code: 3130507
Semester –III
Subject Name: Chemical Engineering Thermodynamics-I

Type of course: Engineering Science

Prerequisite: None

Rationale: Knowledge of thermodynamics from a chemical engineering view point is essential to study principles and applications of laws of thermodynamics to real systems. This subject is also useful to calculate thermodynamic properties of any chemical species and their mixtures.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	1	0	4	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**INTRODUCTION AND FIRST LAW OF THERMODYNAMICS:** The scope of thermodynamics, Dimensions and units, Measures of amount or size, Force, temperature, pressure, work, energy, heat, etc. Internal Energy, Enthalpy, The first law of thermodynamics, Thermodynamic state, state functions, Energy balance for closed systems, Equilibrium, The Phase rule, The reversible process, Heat capacity, Application of first law of thermodynamics to steady state flow process.	9
2	**VOLUMETRIC PROPERTIES OF PURE FLUIDS :** PVT behavior of pure substances, Ideal and non-ideal gases, Equation of states, Virial, Cubic, Vanderwaals EOS, Redlich/Kwong (RK) EOS etc., Calculation of constants in terms of Pc, Tc, Vc. Generalized Correlations for gases and liquids.	9
3	**HEAT EFFECTS:** Sensible heat effects, Temperature dependence of the heat capacity, Latent heats of pure substances, Approximate methods for the estimation of the latent heat of vaporization, Standard heat of reaction, Standard heat of formation, Standard heat of combustion, Temperature Dependence of ΔH^{o}, Heat effects of Industrial Reactions.	6
4	**SECOND LAW OF THERMODYNAMICS:** Statements of second law of thermodynamics, Heat engines, Thermodynamic Temperature Scales, Concept of entropy, Entropy changes of an Ideal Gas, Third law of thermodynamics.	6
5	**THERMODYNAMIC PROPERTIES OF FLUIDS:** The fundamental property relations for homogeneous phases, Maxwell's equations, Residual properties, Mathematical relations among thermodynamic properties, Two phase systems, Thermodynamic diagrams.	5

6	**THERMODYNAMICS OF FLOW PROCESS:** Fundamental equations and relationships, flow in pipes, maximum velocity in pipe flow, nozzles, Single and Multistage compressors and ejectors.	**5**
7	**REFRIGERATION AND LIQUEFACTION:** Carnot refrigerator, Vapor compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump, Liquefaction processes.	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
18	**24**	**23**	**5**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. "Introduction to Chemical Engineering Thermodynamics"; J. M. Smith, H. C. Vanness, M. M. Abbott, The McGraw-Hill Companies, Inc.
2. "Chemical, Biochemical and Engineering Thermodynamics"; S.I. Sandler, Wiley India Edition.
3. "A text book of Chemical Engineering Thermodynamics"; K. V. Narayanan, Prentice-Hall of India Pvt. Ltd.
4. "Chemical and Process Thermodynamics"; B.G. Kyle, Prentice-Hall Inc.
5. " Introduction to Thermodynamics"; Y.V.C. Rao, 2nd Edition, Wiley Eastern Limited

Course Outcomes:

Students should be able to

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Develop fundamental understanding of the basic principles of thermodynamics and related calculations.	20
CO-2	Demonstrate the use and applications of the first and second laws of thermodynamics.	25
CO-3	Evaluate changes in different thermodynamic properties for pure fluids using equations of state (EOS).	20
CO-4	Apply mass and energy balance to closed and open systems.	15
CO-5	Apply thermodynamic principles to the analysis of chemical processes and equipment such as turbines, compressors, heat pumps etc.	10
CO-6	Solve problems of refrigeration and liquefaction processes.	10

List of Tutorials: Numerical/problems based on topics of each theme of content.

List of Open Source Software/learning website:

1. Students can refer to video lectures available on the websites including NPTEL.
2. Students can refer to the CDs which are available with some reference books for the solution of problems using softwares. Students can develop their own programs for the solutions of problems.
3. XSEOS–an Open Software for Chemical Engineering Thermodynamics

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130508
Semester – III
Subject Name: Material and Energy Balance Computations

Type of course: Professional Core Course

Prerequisite: Basics of Mathematics and Chemistry

Rationale: The main objective of course is to make a clear conceptualized knowledge regarding various unit operations carried out in Chemical Engineering. This will provide a background for applying these principles to industrial problems

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical/Tutorial Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	1	0	5	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Units & Dimensions:** Dimensions & system of units, Fundamental and derived units, Unit conversion and its significance, Dimensional consistency, Dimensional Equations	04
2	**Basic Chemical Calculations** Concepts of atomic weight, equivalent weight and mole. Composition of solids, liquids and solutions (weight percent, mole percent, molarity, normality etc.), other expressions for concentration, Average molecular weight and density, Gaseous mixtures, Ideal gas laws and its applications, Raoult's law, Henry's law, Amagat's Law & Dalton's law, Humidity and Saturation	12
3	**Material Balance without Chemical Reactions:** Introduction, Process flow sheet, solving material balance problems without chemical reactions of unit operations like Absorption and Stripping, Distillation, Extractions and Leaching, Drying, Evaporation, crystallization, Mixing/Blending, etc., Material balance of unsteady state operations, Material balance with and without recycle; Bypass and Purge streams.	14
4	**Material balances with Chemical reaction:** Concept of limiting and excess reactants, percentage conversion, selectivity and yield. Material balance involving reactions with special reference to fertilizers, petrochemicals, dyestuffs, electrochemical industries. Complex material balances	10
5	**Energy balances:** Heat capacity of gases and gaseous mixtures, liquids & solids, Sensible heat change in liquid & gases, enthalpy changes during phase transformation, enthalpy changes	10

	accompanied by chemical reactions, standard heat of reaction, Hess's law, dissolutions of solids, Adiabatic reactions, heat of solution by partial molar quantities	
6	**Fuel & Combustion** Types of fuels, calorific value of fuels, liquid fuels, gaseous fuel etc. Proximate and ultimate analysis, combustion calculations, Air requirement and flue gases.	**10**

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**10**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Basic Principles & Calculations in Chemical Engineering, D.M.Himmelblau. 6th Ed., 2004
2. Stoichiometry, B.I.Bhatt &Thakore, Tata McGraw Hill Book Company, 5th Ed, 2010
3. Chemical Process Principles, Vol.1, O.A.Hougen, K.M.Watson, R.A.Ragatz., Indian print, CBS Publishers, 2nd Ed., 1995
4. Stoichiometry & Process Calculations, Narayanan K.V., &Lakshmikutti B., Prentice Hall, 2006
5. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004
6. Chemical Process Calculations Manual, David Carr Igbinoghene, McGraw Hill Professional, 2004
7. Optimization of Chemical Processes, T F Edgar, D M Himmelblau and L S Lasden, Tata McGraw Hill, 2001

Course Outcomes:

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	To identify different system of units and dimensions with conversion	7
CO-2	To distinguish concepts for expressing compositions and behaviour of	18

	different gases and solutions.	
CO-3	To demonstrate material balance in steady and unsteady state unit operations with and out recycle.	21
CO-4	To analyze Material balance involving Chemical reactions in fertilizer, petrochemicals, dyestuff and electrochemical industries.	18
CO-5	To describe energy changes in liquid and gases accompanying various chemical reactions with terms used to associate energy changes in different phases.	18
CO-6	To evaluate fuel quality and to device requirement of gases in combustion.	18

List of Open Source Software/learning website:

- Reference to NPTEL lectures can be made for a better understanding regarding various unit operations.