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: 3130005
Semester – III
Subject Name: Complex Variables and Partial Differential Equations

Type of course: Basic Science Course

Prerequisite: Geometry, trigonometry, calculus and ODE.

Rationale: This subject is a powerful tool for solving a wide array of applied problems.

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	2	0	5	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
01	Polar Form of Complex Numbers, Powers and Roots, Complex Variable – Differentiation : Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	12	28%
02	Complex Variable - Integration : Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Sequences, Series, Convergence Tests, Power Series, Functions Given by Power Series, Taylor and Maclaurin Series, Uniform Convergence.	08	20%
03	Laurent's series; Zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Residue Integration Method, Residue Integration of Real Integrals.	06	14%
04	First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method	06	14%
05	Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	10	24 %

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	**28**	**35**	0	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 from above table. This subject will be taught by Maths faculties.

Reference Books:

(1) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
(2) Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
(3) Dennis G. Zill, 4th edition, Advanced Engineering Mathematics, 4th Edition, Jones and Bartlett Publishers.
(4) Dennis G. Zill, Patrick D. Shanahan, A First Course in Complex Analysis with Applications, Jones and Bartlett Publishers.
(5) S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
(6) Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill.
(7) J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw Hill.

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	convert complex number in a polar form, plot the roots of a complex number in complex plane, find harmonic conjugate of analytic functions and apply conformal mapping in geometrical transformation	28%
CO-2	evaluate complex integration by using various result, test convergence of complex sequence and series and expand some analytic function in Taylor's series	20%
CO-3	find Laurent's series and pole of order, and apply Cauchy Residue theorem in evaluating some real integrals	14%
CO-4	form and solve first order linear and nonlinear partial differential equations	14%
CO-5	apply the various methods to solve higher order partial differential equations, modeling and solve some engineering problems related to Heat flows, Wave equation and Laplace equation	24 %

List of Open Source Software/learning website:

MIT Opencourseware. NPTEL.

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: 3131904
Semester III
MATERIAL SCIENCE AND METALLURGY

Type of Course:

Prerequisite: Zeal to learn the subject

Rationale: Basic principles of science are used to study the structure-properties relationships of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; nondestructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications. Corrosion covers the mechanism, types and prevention techniques.

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)	
3	0	2	4	70	30	30	20	150

Sr. No.	Topics	Teaching Hours	% Weightage
1	**Introduction to Material Science and Metallurgy:** Basics of Engineering Materials, their Classifications and Application, Basics of Advance Engineering Materials, Engineering requirements of materials, Properties of engineering materials, Criteria for selection of materials for engineering Applications.	4	8
2	**Crystal Geometry and Crystal Imperfection:** Unit Cell, Crystal structure, Bravise lattice, atomic packing, coordination number, crystal structures of metallic elements, crystal directions and planes, Miller indices, Polymorphism or Allotropy. Crystal structure and correlated properties. diffusion processes; Crystallization: Mechanism of crystallization - nucleation and growth, factors influencing nucleation and growth. Imperfections in crystals and their effect on properties, Solute strengthening.	5	10
3	**Metallic Materials:** Types, properties and applications, Structure of Metals, Fracture, Macro-examination, Spark Test, Sculptures Print, Macro-etching, Microscopic examinations, Magnetic Testing, Chemical analysis of steel and iron for Carbon, Sulphur & Phosphorous.	5	10
4	**Solidification and Theory of Alloys:** Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure on Mechanical Properties.	6	12

	Systems, phases and phase rule, structural constituents, Gibb's free energy for thermodynamic stability of phases, Gibb's phase rule. Solid solutions and compounds, Hume-Rothery rules; Cooling curves, lever-arm principle.		
5	**Phase and Phase equilibrium:** Unary and Binary equilibrium phase diagrams, Different reactions like eutectic, eutectoid, peritectic and peritectoid; Non-equilibrium cooling.	5	10
6	**Allotropy of Iron, Iron-Iron Carbide equilibrium system:** Allotropy of iron; Iron-iron carbide equilibrium diagram: Phases present and their properties, different reactions of the Iron-Iron Carbide equilibrium system; constituents, microstructures and properties of plain carbon steels. Alloy groups (Wrought Irons, Steels and Cast Irons) of Iron-Iron Carbide equilibrium system and their characteristics in general. Equilibrium cooling of eutectoid, hypoeutectoid and hypereutectoid steels, their resultant microstructures and hence correlated properties and applications. IS and ISO Codification, Different specifications and designations of steels.	5	12
7	**TTT diagram and Heat Treatment of Steel:** Time-Temperature-Transformation Diagram, Isothermal and continuous transformations. Study of heat treatment processes such as annealing, normalizing, spherodizing, hardening, tempering, carburizing, nitriding, cyaniding, induction hardening, flame hardening and hardenability of steel. Application of above processes to machine components and mechanical equipments such as gears, shaft bearings, turbine blades, crank shafts, pistons etc.	6	14
8	**Powder Metallurgy:** Applications of powder metallurgy, advantages of powder metallurgy, manufacturing processes, production of powder, compacting, sintering, products of powder metallurgy.	3	10
9	**Non Destructive Testing:** Non Destructive testing of materials such as Radiography Testing, Dye Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing. Eddy current testing with their Principle of non-destructive testing, the test methods, relative merits, demerits and applications.	4	10
10	**Corrosion of Metal And Alloys:** Mechanism of corrosion, types of corrosion, corrosion prevention techniques.	2	4
	Total	45	100

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	30

Comprehension	30
Application	25
Analysis	10
Evaluate	05
Create	00

References:

1. Callister's Material Science and Engineering, R. Balasubramaniam, Wiley India.
2. Elements of Material Science and Engineering, Lawrence H. Van Vlack, Pearson Education.
3. The Science and Engineering of Materials Donald R. Askeland and Pradeep P. Phule, Cengage Learning.
4. Principles of Materials Science and Engineering, W F Smith, McGraw Hill.
5. Materials Science and Metallurgy, K. I. Parashivamurthy, Pearson Education.
6. Physical Metallurgy, Sydney H. Avner, Tata McGraw-Hill.
7. Practical Non-Destructive Testing, Baldev Raj, T. Jayakumar and M. Thavasimuthu, Narosa Pub. House. ASM Handbook Vol.
8. Metallography and Microstructure, Ed. George F. Vander Voort, ASM International 2004.

Course Outcomes:
After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the basic concept of Material Science and Metallurgy	20
CO-2	Know about the ferrous and non ferrous metals and alloys and their applications	40
CO-3	Understand different non-destructive testing methods	20
CO-4	Find the causes and prevention of metallic corrosion	10
CO-5	Judge the Scope and limitations of different materials	10

List of Practical:

1. To get acquainted with the operation, construction, use and capabilities of a metallographic microscope.
2. To study procedure of specimen preparation for microscopic examination and to carry out a specimen preparation.
3. To understand what is micro examination, importance of micro examination and to study various ferrous, non-ferrous microstructures.
4. To identify the different types of material available for design, manufacturing and processing of various components based on structure-property-performance-processing relationships.
5. To show the effect of different quenching media (Oil, Water and Brine) on the hardness of medium carbon steel.
6. To understand the concept of hardenability and its relevance to heat treatment procedure to be adopted in practice.
7. To find out the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section.

8. Study of different heat treatment processes- annealing, normalizing, hardening and tempering, surface and casehardening to improve properties of steel during processes and applications.
9. To understand the procedure of testing, nature of indication, the capability and sensitivity of the liquid penetrant test and the magnetic particle test.
10. To understand the procedure of testing, nature of indication, the capability and sensitivity of the Eddy current test and the Ultrasound test.

Major Equipment:

Metallurgical microscope with computerized image analysis system, Standard specimen set of steel, cast iron and non- ferrous metals and alloys, Spectrometer, Muffle furnace, standard specimens of steels and cast iron for heat treatment, Hardness tester, Universal tensile testing machine.

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3131905
Semester – III
Subject Name: Engineering Thermodynamics

Type of course: Professional Core

Prerequisite: Zeal to learn the subject

Rationale: Engineering Thermodynamics is the first course on Thermal Science and Engineering. It studies various energy interactions notably heat and work transfer. It is based on certain laws of nature which are never seen to be violated.

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)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction, Basic Concepts: Thermodynamic system and control volume, Microscopic and macroscopic point of view, thermodynamic properties, state of a substance, process and cycle, Thermodynamic equilibrium, Concept of Continuum, Quasi-static process, The Zeroth Law of Thermodynamics, Temperature scales	4
2	First law of Thermodynamics: First law for a closed system undergoing a cycle and change of state, energy, PMM1, first law of thermodynamics for steady flow process, steady flow energy equation applied to nozzle, diffuser, boiler, turbine, compressor, pump, heat exchanger and throttling process, filling and emptying process Second law of thermodynamics: Limitations of first law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, PMM2, causes of irreversibility, Carnot theorem, corollary of Carnot theorem, thermodynamic temperature scale	13
3	Entropy: Clausius theorem, property of entropy, inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, entropy change for non-flow and flow processes Exergy: Exergy of a heat input in a cycle, exergy destruction in heat transfer process, exergy of finite heat capacity body, exergy of closed and steady flow system, irreversibility and Gouy-Stodola theorem and its applications, second law efficiency	14
4	Vapor Power cycles: Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of Rankine cycle, reheat cycle, regenerative cycle, reheat-regenerative cycle, feed water heaters	23

	Gas Power cycles: Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Simple Brayton cycle Refrigeration Cycles: Simple Vapour Compression Refrigeration (VCR) cycle on P-h and T-s diagrams, analysis of the simple cycle, factors affecting the performance of the cycle, actual cycle, Reversed Carnot cycle and its limitation, Bell-Coleman cycle	
5	Combustion: Combustion equations, stoichiometric air fuel ratio, enthalpy of formation, adiabatic flame temperature, determination of calorific values of fuels – calorimeter - Bomb and Junkers gas calorimeter	6

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**50**			

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. Engineering Thermodynamics by P.K. Nag, McGraw-Hill Education
2. Fundamentals of Thermodynamics by Borgnakke & Sonntag, 7th Ed. Wiley India (P) Ltd.
3. Thermodynamics – An Engineering Approach by Yunus Cengel & Boles, McGraw-Hill Education
4. Engineering Thermodynamics by Gordon Rogers and Yon Mayhew, Pearson Education Ltd.
5. Engineering Thermodynamics by Krieth, CRC Press
6. Engineering Thermodynamics by Jones and Dugan, PHI Learning Pvt. Ltd.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	To identify the unique vocabulary associated with thermodynamics and explain the basic concepts of thermodynamics	7
CO-2	To state and apply first law of thermodynamics for closed and open systems undergoing different thermodynamic processes and evaluate the feasibility of thermodynamic cycles and processes using second law of thermodynamics	22
CO-3	To apply the concept of entropy and exergy to different thermodynamic processes and cycles	23
CO-4	To analyze different gas power, vapor power and refrigeration cycles	38
CO-5	To make elementary calculation of combustion phenomenon.	10

Bachelor of Engineering
Subject Code: 3131905

List of Experiments:

1. To verify First and Second Law with Mechanical Heat Pump
2. To verify First and Second Law with I.C. Engine
3. To determine heat loss from pipe-in-pipe heat exchanger using SFEE and to verify entropy principle for the heat exchanger.
4. To understand applications of SFEE
5. To understand applications of entropy principle and Gouy-Stodola theorem
6. To compare Otto, Diesel and Dual cycles
7. To study variables affecting the performance of Rankine cycle
8. To understand different components of VCR system and to determine its COP
9. To understand the effect of various operating parameters on performance of VCR cycle.
10. To find out the calorific value of given fuel with the help of Oxygen Bomb calorimeter.
11. To find out the calorific value of given fuel with the help of Junker gas calorimeter.

Major Equipment:
Mechanical Heat Pump, Internal combustion engine, Heat exchanger, Vapor compression test rig, Bomb calorimeter, Junker gas calorimeter

List of Open Source Software/learning website: https://nptel.ac.in/course.php

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3131906
Semester III
KINEMATICS AND THEORY OF MACHINES

Type of course: Engineering Science

Prerequisite: Professional Core Course

Rationale: Kinematics and theory of machines is a fundamental course for mechanical engineering. It is intended to introduce essential elements of machines and their functionality. This course is essential for synthesis and kinematics analysis of machine elements like linkages, cams, belt, rope, brakes, clutch and gear.

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.	Topics	Teaching Hrs.
1	**Introduction of Mechanisms and Machines:** Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom,Mobility and range of movement - Kutzbach and Grubler's criterion, Number Synthesis, Grashof's criterion , straight line mechanisms	8
2	**Graphical and Analytical Linkage Synthesis:** Synthesis, Function, Path, and Motion Generation, Dimensional synthesis (Graphical): Two position synthesis, Three Position synthesis, Coupler curves, Position Analysis : Graphical position analysis of linkages, Algebraic position analysis of linkages, Four bar slider crank position solution, Two position motion generated by analytical synthesis, Three position motion generated by analytical synthesis.	10
3	**Velocity and Acceleration Analysis:** Graphical and analytical velocity analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Instant centers of velocity, Graphical and analytical acceleration analysis of fourbar pin jointed linkages and fourbar slider crank linkages, Graphical velocity and acceleration analysis of quick return mechanisms	10
4	**Cams:** Types of cams, Types of followers, Follower displacement programming, Derivatives of follower Motion, Motions of follower, Layout of cam profiles.	5
5	**Belt, Ropes and Chains:** Types of belt drive, Velocity ratio, Slip, Pulley arrangement, Length of belt, Law of belting, Ratio of friction tension, Power transmitted, Centrifugal effects on belts, Maximum power transmitted, Creep, Chains, Chain length, Angular speed ratio, Classification of chain	5
6	**Friction, Clutch and Brake:** Introduction to friction, Law of friction, Coefficient of friction, Inclined plane, Pivot and Collars, Friction clutches, Rolling Friction, Types of brakes, Block and Shoe brakes, Differential band brake, Internal expanding shoe brake, Braking effect in vehicle.	6
7	**Gears and Gear Trains:** Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, centre distance variation, minimum number of teeth, contact ratio, spur,	8

	helical, spiral bevel and worm gears, problems. **Gear Trains:** Synthesis of Simple, compound & reverted gear trains, Analysis of epicyclic gear trains.	

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	15
Comprehension	15
Application	15
Analysis	25
Evaluate	25
Create	05

References:

1. Theory of Machines, Rattan S S, Tata McGraw-Hill
2. Theory of Machines and Mechanisms, Uicker J J Jr., Pennock G R, Shigley J E, Oxford Press.
3. Kinematics and Dynamics of Machinery, Norton R L, McGraw-Hill
4. Mechanism and Machine Theory, Ambekar, A G, Prentice Hall
5. Theory of Machines, Singh Sadhu, Pearson Education

Course Outcomes:

After learning the course the students should be able to :

Sr. No.	CO statement	Marks % weightage
CO-1	Understand basic structure and elements of machines.	20
CO-2	Identify functional characteristics of various machine elements.	20
CO-3	Synthesize various mechanisms based on position, velocity and acceleration requirement.	20
CO-4	Determine position, velocity and acceleration of linkages in mechanism at any instant.	20
CO-5	Understand basics related to friction and its practical application in mechanical engineering.	20

List of Practicals:

1. Drawing work related to inversion of four bar mechanism and slider and crank mechanism.
2. Drawing work related to velocity and acceleration diagram of various mechanisms.
3. Drawing work related to cam profile.
4. Drawing work and computation related to synthesis.
5. Computerised Synthesis.
6. Analysis related to belt, rope, and chain drive.
7. Analysis related to brakes, and clutches.
8. Analysis related to gears and gear train.

List of Major Equipments :

- Drawing hall facility.

- Models of different mechanisms like four bar mechanism, quick return mechanisms, mechanisms with lower pairs and machine elements like belt, pulley, gear, gear train and cams.

List of open source:

- https://nptel.ac.in/courses/112104121/