



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110001
CHEMISTRY
1ST YEAR

Type of course: Basic Science.

Prerequisite: Zeal to learn the subject.

Rationale: Chemistry is considered as Basic Science subject.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	General Chemistry: Introduction to Chemical Sciences, Basics includes: Periodic properties, Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries Structure of an Atom, Formation of molecules – Kossel – Lewis approach to Chemical Bonding, Lewis Representations of Simple Molecules and Ions, Types of Bonds.	5	40%
2	Water Technology: Introduction, Sources of water, Impurities in water, Hardness of Water, Boiler Problems, Softening of water (External & Internal treatments), Domestic water treatments, Waste water treatments, Desalination of Brackish water.	5	
3	Metals, Alloys and Corrosion: Introduction, Physical properties of Metals, Definition and purpose of alloy, Classification of alloys. Alloys: Steel, Cu, Al, Pb and its industrial applications. Introduction to Corrosion, Theories of corrosion, Protective measurements against corrosion – organic and inorganic materials, Inhibitors, Cathodic protection.	6	
4	Polymers and Fibers Introduction, Classification based on Source, Structure, Molecular forces. Polymerization and its mechanism. Definition of Rubber, Types of Rubber, Vulcanization of rubber. Application of Rubber. Biodegradable Polymers, Commercially important polymers- PE, PP, PS, PVC, ABS, PMMA, Glyptal and their uses. Types of fibers – Natural, semi synthetic, synthetic fibers. Physical properties of fibers and uses of Cellulose acetate, Viscose Rayon, Nylon, Polyesters acrylic, Glass fibers and Liquid Crystals.	7	40%



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5	Nano material: Introduction, Sources, Properties and application of fullerenes, fullerols, Metal based nanoparticles, Carbon nanotubes and nanowires. Synthesis: Top down and Bottom up approaches, Nanoelectronics. Applications of nanomaterial in catalysis, textile and medicine.	5	20%
6	Fuel and Combustion: Definition, Types of fuel and their applications. Calorific Value, Characteristics of good fuel. Analysis of coal – ultimate and proximate analysis, LPG, Natural gas, Biogas, Refining of Petroleum by Fractional distillation, Octane and Cetane Number, Unleaded Petrol and Diesel.	5	
7	Chemical aspect of Biotechnology: Introduction, Scope, importance and application, Benefits through biotechnology – Agriculture, Food quality, Medicines, Fermentation processes: Preparation of Ethanol and Acetic acid, Enzymes and its application in industries, Importance of Biofuels, Bio fertilizers, Bio surfactants and Bioreactors.	5	
8	Analytical Techniques: Measurement and understanding of pH, Conductance, and Potential, Spectroscopic techniques: Principles of Spectroscopy and Selection rules. UV-Visible Spectroscopy and its Application, Vibrational and Rotational spectroscopy (IR) of diatomic molecules and its application.	4	

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	50	10	30	0	0

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

Reference Books:

1. Engineering Chemistry by Jain and Jain, Dhanpat Rai Publishing Co.
2. Engineering Chemistry Willey India Publisher
3. Engineering Chemistry by Marry Jane & Shultz, Cencage Learning Publisher
4. Engineering Chemistry by N. Krishnamurthy, P. Vallinaygam and D. Madhavan, Prentice Hall of India Pvt. Ltd.
5. Engineering Chemistry by K. Sesha Maheswaramma and Mridula Chugh, Pearson India Education Pvt Ltd.
6. Engineering Chemistry by B K. Sharma, Krishna Prakashan Media (P) Ltd.
7. A textbook of Engineering Chemistry by Shashi Chawla, Dhanpatrai Publishing Co. Ltd.
8. Fundamentals of Biotechnology by B D Singh, Kalyani Publisher. New Delhi.
9. Essential of Physical Chemistry by Bahl and Tuli., S Chand & Co. Ltd, New Delhi.
10. Introduction to Nano Science by N N. Lindsay, Oxford University Press.
11. NANO: The Essentials by T Pradeep Tata McGraw-Hill Publishing Company, New Delhi.

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Relate periodic properties such as ionization potential, oxidation states and electro negativity.	15
CO-2	Analyze microscopic chemistry in terms of atomic and molecular orbital's and inter molecular forces.	10



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CO-3	Describe the importance and relevance of chemistry in our everyday life	10
CO-4	Select the appropriate chemical material and utilization of it.	50
CO-5	Interpret the methods of science as a logical means of problem solving	10
CO-6	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	5

LIST OF PRACTICALS: (Minimum 8 to be performed.)

1. Analysis of Steel Sample.
2. Analysis of Pyrolusite Ore.
3. Analysis of Brass Alloy.
4. Estimation of Hardness.
5. Gravimetric Analysis of decomposition of Na_2CO_3 & NaHCO_3 .
6. Determination of Concentration of Unknown Solution Spectrophotometrically.
7. To study Wet Corrosion loss of Steel by weight loss method using electrochemical theory.
8. Stress Corrosion Cracking of Brass in NH_3 Solution.
9. To determine Alkalinity of a given Water Sample.
10. Determination of Saponification Value of Oil.
11. Determination of chloride content of water
12. Study of decomposition reaction of ZnCO_3 by Gravimetric analysis.
13. To determine the moisture content in coal.

Reference Books:

1. Laboratory Manual of Engineering Chemistry, by S K. Bhasin & Sudha Rani.
Publisher: Dhanpat Rai Publishing Company Ltd.
2. Engineering Chemistry with Laboratory Experiments, by M S. Kaurav.
Publisher: PHI Learning Pvt. Ltd. New Delhi.
3. Vogel's textbook of Quantitative Chemical Analysis, by Arthur I Vogel, Revised by Jeffery et al, Publisher: Addison Wesley, Longman Ltd, England
4. Engineering Chemistry with Laboratory Experiments, by R. P. Mani & Mishra, Publisher: Cen cage Publisher.

Major Equipment:

1. Spectrophotometer.
2. Laboratory Oven.
3. Melting Point Instrument.
4. Electronic Balance

List of Open Source Software/learning website:

NPTEL, World Wide Web, etc.



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110002

ENGLISH
B.E. 1ST YEAR

Type of course: Language and Communication

Prerequisite: Zeal to learn the subject

Rationale: The rationale of the curriculum is to help students refresh their knowledge of English language. It also targets the understanding of grammar, focusing on comprehension, and reading, speaking and writing skills. This would be developed through balanced and integrated tasks.

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)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hours	Module Weightage
1	Vocabulary building: Introduction to Word Formation Types of word formation processes: compounding, clipping, blending, derivation, creative respelling, coining and borrowing Acquaintance with prefixes and suffixes Synonyms, antonyms, and standard abbreviations.	06	20%
2	Phonetics: IPA Transcription Introduction to different accents	04	10%
3	Identifying Common Errors in Writing: Tenses Subject-verb agreement Noun-pronoun agreement Misplaced modifiers Articles Prepositions Modal Auxiliaries Redundancies	06	20%
4	Basic Writing Skills: Sentence Structures Use of phrases and clauses in sentences Importance of proper punctuation Creating coherence Organizing principles of paragraphs in documents	04	10%



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5	Nature and Style of Writing: Describing Defining Classifying Writing introduction and conclusion	06	20%
6	Writing Practices: Comprehension Précis Writing Letter Writing Email etiquettes Abstract Memo writing	06	20%

Suggested Specification table with Marks (Theory):

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

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:

- (i) Technical English, Dr. M. Hemamalini, Wiley. 2014
- (ii) Practical English Usage, Michael Swan, OUP. 1995
- (iii) Remedial English Grammar, F.T. Wood, Macmillan. 2007
- (iv) Oxford Language Reference, (Indian Edition) OUP
- (v) On Writing Well, William Zinsser, Harper Resource Book. 2001
- (vi) Study Writing, Liz Hamp-Lyons and Ben Heasley, Cambridge University Press. 2006
- (vii) Communication Skills, Sanjay Kumar and Pushp Lata, Oxford University Press. 2011
- (viii) Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press
- (ix) The Study of Language, George Yule, CUP, 4th Edition. 2010
- (x) A Course in English Phonetics, T R Kansakar, Orient Longman. 1998
- (xi) Spoken English, R K Bansal and J B Harrison, Orient Longman. 2013

Course Outcome: At the end of the course students will be able to –

Sr. No	Course Outcomes	Weightage
CO1	Use various forms of vocabulary in varied situations in oral and written communication.	10%
CO2	Understand the phonetics and the transcription pattern to learn correct pronunciation.	10%
CO3	Comprehend the dynamics of various rules of grammar and check its validation while they speak and write language correctly.	20%



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CO4	Use grammar effectively to make themselves competent Listener, Speaker, Reader and Writer by exposing to various set of situations.	20%
CO5	Write various formal and informal documents of day to day life and professional set up.	20%
CO6	Demonstrate the qualities of writing in diverse situation by using the nuances such as conciseness, clarity, accuracy, organization, and coherence.	20%

List of Experiments:

Sr.No.	Activity type	Duration in hrs	Preferably to be conducted in:
1	Word Formation-1	2	Lab/classroom
2	Word Formation-2	2	Lab/classroom
3	Listening Comprehension	2	Lab/classroom
4	Transcription and dictionary usage	2	Lab/classroom
5	Common Everyday Situations: Conversations and Dialogues	4	Classroom/Hall
6	Communication at Workplace	4	Classroom/Hall
7	Common errors in writing	4	Classroom/Hall
8	Reading Comprehension	2	Classroom/Hall
9	Letter Writing, Precis Writing	4	Classroom/Hall
10	Email Writing: Formal and Informal	2	Lab/classroom
11	Practical assessment	4	Lab/classroom



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110003
PROGRAMMING FOR PROBLEM SOLVING
1ST YEAR

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

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)
3	0	2	4	70	30	30	20	150	

Content:

Sr. No.	Topics	Teaching Hours	Module Weightage
1	Introduction to computer and programming: Introduction, Basic block diagram and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high level programming, Flowcharts and Algorithms	5	11
2	Fundamentals of C: Features of C language, structure of C Program, comments, header files, data types, constants and variables, operators, expressions, evaluation of expressions, type conversion, precedence and associativity, I/O functions	4	9
3	Control structure in C: Simple statements, Decision making statements, Looping statements, Nesting of control structures, break and continue, goto statement	5	11
4	Array & String: Concepts of array, one and two dimensional arrays, declaration and initialization of arrays, string, string storage, Built-in-string functions	6	13
5	Functions: Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing	5	11
6	Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	4	9
7	Pointers: Basics of pointers, pointer to pointer, pointer and array, pointer to array, array to pointer, function returning pointer	4	9
8	Structure: Basics of structure, structure members, accessing structure members, nested structures, array of structures, structure and functions, structures and pointers	4	9
9	Dynamic memory allocation: Introduction to Dynamic memory allocation, malloc, calloc	4	9
10	File management: Introduction to file management and its functions	4	9



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Suggested Specification table with Marks (Theory):

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

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

Reference Books:

1. Programming in ANCI C, Seventh edition, by Balagurusamy E, Tata McGraw-Hill Publishing Company Limited
2. Programming with C, Second edition, by Gottfried, Tata McGraw-Hill Publishing Company Limited
3. Star C Programming, Pub: STAR Certification
4. C Programming language, Second edition, by Kernighan B W and Ritchie D M Prentice Hall,
5. Let us C, Fifth edition, by Kanetkar Y. P., BPB Publication
6. Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009 by Pradip Dey, Manas Ghosh,
7. "Computer programming", Pearson Education, 2007 by Ashok N. Kamthane.
8. "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007 by R.G. Dromey.
9. Programming in C, Reema Theraja, Oxford.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Formulate algorithm/flowchart for given arithmetic and logical problem	10
CO-2	Translate algorithm/flowchart into C program using correct syntax and execute it	10
CO-3	Write programs using conditional, branching, iteration, and recursion	40
CO-4	Decompose a problem into function	20
CO-5	Develop an application using the concepts of array, pointer, structure, and file management to solve engineering and/or scientific problems	20

List of Experiments:

1. Write a program to that performs as calculator (addition, multiplication, division, subtraction).
2. Write a program to find area of triangle($a=h*b*.5$)
a = area
h = height
b = base
3. Write a program to calculate simple interest ($i = (p*r*n)/100$)
i = Simple interest
p = Principal amount
r = Rate of interest
n = Number of years
4. Write a C program to interchange two numbers.
5. Write a C program to enter a distance in to kilometre and convert it in to meter, feet, inches and centimetre



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6. Write a program to compute Fahrenheit from centigrade ($f=1.8*c+32$)
7. Write a C program to find out distance travelled by the equation $d=ut+at^2$
8. Write a C program to find that the accepted number is Negative, or Positive or Zero.
9. Write a program to read marks of a student from keyboard whether the student is pass or fail(using if else)
10. Write a program to read three numbers from keyboard and find out maximum out of these three. (nested if else)
11. Write a C program to check whether the entered character is capital, small letter, digit or any special character.
12. Write a program to read marks from keyboard and your program should display equivalent grade according to following table(if else ladder)

Marks	Grade
100 - 80	Distinction
79 - 60	First Class
59 - 40	Second Class
< 40	Fail

13. Write a c program to prepare pay slip using following data.
Da = 10% of basic, Hra = 7.50% of basic, Ma = 300,
Pf = 12.50% of basic, Gross = basic + Da + Hra + Ma, Nt = Gross – Pf.
14. Write a C program to read no 1 to 7 and print relatively day Sunday to Saturday.
15. Write a C program to find out the Maximum and Minimum number from given 10 numbers
16. Write a C program to input an integer number and check the last digit of number is even or odd.
17. Write a C program to find factorial of a given number.
18. Write a program to reverse a number.
19. Write a program to generate first n number of Fibonacci series
20. Write a program to find out sum of first and last digit of a given number.
21. Write a C program to find the sum and average of different numbers which are accepted by user as many as user wants
22. Write a program to calculate average and total of 5 students for 3 subjects (use nested *for* loops)
23. Read five persons height and weight and count the number of person having height greater than 170 and weight less than 50,
24. Write a program to check whether the given number is prime or not.
25. Write a program to evaluate the series $1^2+2^2+3^2+.....+n^2$
26. Write a C program to find $1+1/2+1/3+1/4+....+1/n$.
27. Write a C program to find $1+1/2!+1/3!+1/4!+.....+1/n!$.
28. Write a program to evaluate the series $sum=1-x+x^2/2!-x^3/3!+x^4/4!.....-x^9/9!$
29. Write a program to print following patterns :

i	*	ii	*	iii	*****
	**		* *		*****
	***		* * *		***
	****		* * * *		**
	*****		* * * * *		*

30. Write a program to print following patterns :

i	1	ii	12345	iii	55555	iv	1
	12		1234		4444		22
	123		123		333		333
	1234		12		22		4444
	12345		1		1		55555



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31. Write a program to print following patterns:
- | | | | |
|---|-------|----|-------|
| i | AAAAA | ii | ABCDE |
| | BBBB | | ABCD |
| | CCC | | ABC |
| | DD | | AB |
| | E | | A |
32. Write a C program to read and store the roll no and marks of 20 students using array.
33. Write a program to find out which number is even or odd from list of 10 numbers using array
34. Write a program to find maximum element from 1-Dimensional array.
35. Write a C program to calculate the average, geometric and harmonic mean of n elements in an array.
36. Write a program to sort given array in ascending order (Use Insertion sort, Bubble sort, Selection sort, Mergesort, Quicksort, Heapsort).
37. Write a program to find a character from given string.
38. Write a program to replace a character in given string.
39. Write a program to delete a character in given string.
40. Write a program to reverse string.
41. Write a program to convert string into upper case
42. Write a program that defines a function to add first n numbers.
43. Write a function in the program to return 1 if number is prime otherwise return 0
44. Write a function Exchange to interchange the values of two variables, say x and y . illustrate the use of this function in a calling function.
45. Write a C program to use recursive calls to evaluate $F(x) = x - x^3 / 3! + x^5 / 5! - x^7 / 7! + \dots x^n / n!$.
46. Write a program to find factorial of a number using recursion.
47. Write a C program using global variable, static variable.
48. Write a function that will scan a character string passed as an argument and convert all lowercase character into their uppercase equivalents
49. Write a program to read structure elements from keyboard.
50. Define a structure type *struct* personal that would contain person name, date of joining and salary using this structure to read this information of 5 people and print the same on screen.
51. Define structure data type called time_struct containing three member's integer hour, integer minute and integer second. Develop a program that would assign values to the individual number and display the time in the following format: 16: 40:51
52. Define a structure called cricket that will describe the following information:
Player name
Team name
Batting average
Using cricket, declare an array player with 50 elements and write a C program to read the information about all the 50 players and print team wise list containing names of players with their batting average.
53. Design a structure student_record to contain name, branch and total marks obtained. Develop a program to read data for 10 students in a class and print them.
54. Write a program to print address of variable using pointer.
55. Write a C program to swap the two values using pointers.



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56. Write a C program to print the address of character and the character of string using pointer.
57. Write a program to access elements using pointer.
58. Write a program for sorting using pointer.
59. Write a program to write a string in file
60. A file named data contains series of integer numbers. Write a c program to read all numbers from file and then write all odd numbers into file named “odd” and write all even numbers into file named “even”. Display all the contents of these file on screen

List of Open Source Software/learning website : Students must refer to following sites to enhance their learning ability.

- 1) Vlabs.iitb.ac.in
- 2) NPTEL tutorials
- 3) www.coursera.org
- 4) www.udacity.com



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110005
BASIC ELECTRICAL ENGINEERING
1st Year

Type of course: Engineering Science

Prerequisite: NA

Rationale: Electricity has been the main source of energy for the developing and developed countries. Per capita consumption of electricity of a country can be considered as an indicator of the development of the country. In view of this, it is essential for all engineering graduates to know the basic aspects of electrical engineering. This subject deals with basic circuit solution methods, introduction to electrical machines and basics of domestic electrical installations.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	ESE (V)	PA(I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8	20
2	AC Circuits Representation of sinusoidal waveforms, peak and RMS values, Phasor representation of AC quantities, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Series and parallel resonance. Three phase balanced circuits, voltage and current relations in star and delta connections, Power measurement in three phase circuits.	10	25
3	Transformers Magnetic materials, BH characteristics. Construction and working principle of single phase and three phase transformers. Ideal and practical transformer. Auto-transformer and its applications.	8	15
4	Electrical Machines Generation of rotating magnetic fields.	8	20



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	Construction and working of following machines: • Three-phase induction motor • Single-phase induction motor. • Separately excited DC motor. • Synchronous generators.		
5	<i>Electrical Installations</i> Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB. Types of Wires and Cables. Earthing – Types of earthing and its importance. Safety precautions for electrical appliances. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption. Basics of power factor improvement.	8	20

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	20	20	20	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:

- (i) D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
- (ii) Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press
- (iii) B. L. Theraja, "Electrical Technology – Part I and II", S. Chand and Co. 2012
- (iv) D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
- (v) L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
- (vi) E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
- (vii) V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Outcomes

Sr. No.	CO statement	Marks % weightage
CO-1	Apply fundamental electrical laws and circuit theorems to electrical circuits.	20
CO-2	Analyze single phase and three phase AC circuits.	25
CO-3	Describe operating principle and applications of static and rotating electrical machines.	35
CO-4	Comprehend electrical installations, their protection and personnel safety.	20



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List of Experiments:

- (1) Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Resistors, Capacitors and Inductors.
- (2) To verify the DC circuit currents and voltages by calculations and actual measurements.
- (3) To verify the Kirchoff's current and voltage laws.
- (4) To verify the Network theorems.
- (5) To obtain sinusoidal steady state response of R-L and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
- (6) Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a Digital Storage Oscilloscope).
- (7) To verify the resonance in R-L-C circuits.
- (8) To measure the power in three phase circuits using two wattmeter method.
- (9) To verify the current and voltage relationships in three phase star and delta connections.
- (10) Demonstration of cut-section models and charts of various machines.
- (11) Demonstration of domestic installations like MCB, ELCB, MCCB etc.
- (12) Understanding of various safety precautions for electrical installations.
- (13) Demonstration of various types of wires and cables.
- (14) Understanding of various electricity bills and calculations for energy consumption.
- (15) To verify the power factor improvement in single phase AC circuit.

Major Equipment:

Ammeters, Voltmeters, Wattmeters, Resistors, Capacitors and Inductors of appropriate rating. Multimeters, Digital storage oscilloscope, Cut section models/charts of various machines, Demo units for MCB, ELCB, MCCB etc, Samples of wires and cables. Charts for earthing and safety precautions.

List of Open Source Software/learning website:

www.vlabs.co.in



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110006

Semester – I/II

Subject Name: Basic Mechanical Engineering

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

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)	
3	0	2	4	70	30	30	20	150

Content:

Sr #	Topic	Total Hrs.
1	Introduction: Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth law and First law	4
2	Energy: Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydro, Solar, Wind, and Bio-fuels, Environmental issues like Global warming and Ozone depletion	3
3	Properties of gases: Boyle's law, Charles's law, Gay-Lussac's law, Avogadro's law, Combined gas law, Gas constant, Relation between c_p and c_v , Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Polytropic process	5
4	Properties of Steam: Steam formation, Types of steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of steam tables, steam calorimeters	6
5	Heat Engines: Heat engine cycle and Heat engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles	5
6	Steam Boilers: Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, Functioning of different mountings and accessories	-
7	Internal Combustion Engines: Introduction, Classification, Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies	4
8	Pumps: Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming	3
9	Air Compressors: Types and operation of Reciprocating and Rotary air compressors, significance of Multistage	3
10	Refrigeration & Air Conditioning: Refrigerant, Vapor compression refrigeration system, Vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners	4



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110006

11	Couplings, Clutches and Brakes: Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc)	-
12	Transmission of Motion and Power: Shaft and axle, Different arrangement and applications of Belt drive; Chain drive; Friction drive and Gear drive	-
13	Engineering Materials: Types, properties and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer	4

Note: Topic No. 6, 11 and 12 of the above syllabus are to be covered in Practical Hours.

Distribution of marks weightage for cognitive level:

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	40	-	-	-

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. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
2. Basic Mechanical Engineering by Pravin Kumar, Pearson Education
3. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi
4. Elements of Mechanical Engineering by Sadhu Singh, S. Chand Publication
5. Introduction to Engineering Materials by B.K. Agrawal, McGraw Hill Publication, New Delhi

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Discuss the various sources of energy and basic terminology of Mechanical engineering	14
CO-2	Make calculations for commonly used working fluids i.e. ideal gases and steam	22
CO-3	Analyze various heat engine cycles and understand construction and working of IC engines	20
CO-4	Discuss working and applications of steam boilers and various energy conversion systems	28
CO-5	Discuss various power transmission elements and properties of various engineering materials with their applications	16



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3110006

List of Experiments:

1. To understand construction and working of various types of boilers.
2. To understand construction and working of different boiler mountings and accessories.
3. To understand construction features of two/four stroke petrol/diesel engines
4. To determine brake thermal efficiency of an I. C. Engine.
5. To understand construction and working of different types of air compressors.
6. To demonstrate vapor compression refrigeration cycle of domestic refrigerator OR window air conditioner OR split air conditioner.
7. To understand construction, working and application of clutches, coupling and brakes
8. To understand different arrangement and application of various power transmission drives

Major Equipment: Models of Cochran, Lancashire and Babcock and Wilcox boilers, models of various mountings and accessories, Models of various types of IC engines, Single cylinder two stroke /four stroke petrol/ diesel engine, models of pumps, compressors, Domestic refrigerator/window air conditioner/split air conditioner, models of various types of brakes, coupling, clutches, drives

List of Open Source Software/learning website: <https://nptel.ac.in>, www.vlab.co.in



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110007

ENVIRONMENTAL SCIENCE
1st Year

Type of course: Mandatory Course

Prerequisite: Interest in natural systems sustaining the life on the earth.

Rationale: To inculcate the environmental values translating into pro-conservation actions. Honorable Supreme Court of India has made it 'mandatory' to introduce a basic course on environment at the undergraduate level.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	ESE (V)	PA(I)	
2	2	0	0	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	INTRODUCTION TO ENVIRONMENT Definition, principles and scope of Environmental Science. Impacts of technology on Environment, Environmental Degradation, Importance for different engineering disciplines	02	8
2	ENVIRONMENTAL POLLUTION a) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants b) Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO ₂ , NO _x , Auto exhaust, Effects of common air pollutants c) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects d) Solid Waste: Generation and management e) Bio-medical Waste: Generation and management f) E-waste: Generation and management	14	44
3	GLOBAL ENVIRONMENTAL ISSUES Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change	06	24



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Bachelor of Engineering
Subject Code: 3110007

4	BASIC CONCEPT OF GREEN BUILDING AND SMART CITIES Green Building: Introduction, Objectives, Fundamental Principles, Benefits of Green Building, Examples of Green Building Smart Cities: Concept	04	16
5	CONCEPT OF 4R's Principles, Application of 4R's	02	8

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40	40	20	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 slightly from above table.

Reference Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha Second edition, 2013 Publisher: Universities Press (India) Private Ltd, Hyderabad.
2. Basics of Environmental Studies by Prof Dr N S Varandani ,2013 Publisher: LAP -Lambert Academic Publishing , Germany
3. Environmental Studies by Anindita Basak ,2009 Publisher: Drling Kindersley(India)Pvt. Ltd Pearson
4. Textbook of Environmental Studies by Deeksha Dave & S S Kateva , Cengage Publishers.
5. Environmental Sciences by Daniel B Botkin & Edward A Keller Publisher: John Wiley & Sons.
6. Environmental Studies by R. Rajagopalan, Oxford University Press
7. Environmental Studies by Benny Joseph, TMH publishers
8. Environmental Studies by Dr. Suresh K Dhameja, 2007 Published by : S K Kataria & Sons New Delhi
9. Basics of Environmental Studies by U K Khare, 2011 Published by Tata McGraw Hill

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Identify the types of pollution in society along with their sources	45
CO-2	Realize the global environmental issues	25
CO-3	Conceptualize the principles of Green Buildings and Smart cities	15
CO-4	Implement the concept of recycle and reuse in all fields of engineering	15



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110007

List of Tutorials: Based on

1. Introduction to Environment
2. Water Pollution
3. Air Pollution
4. Noise Pollution
5. Solid Waste
6. Bio-medical Waste
7. E-waste
8. Global Environmental Issues
9. Concept of Green Building
10. Concept of Smart Cities
11. Concept of 4R's

List of Open Source Software/learning website: MOEF, NPTEL



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110012

WORKSHOP/ MANUFACTURING PRACTICES

B.E. 1st YEAR

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. Irrespective of branch, the use of workshop practices in day to day industrial as well domestic life helps to dissolve the problems.

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)	
0	0	4	2	0	0	80	20	100

Contents:

Introduction to various shops / sections and workshop layouts. Safety norms safety equipment's to be followed in a workshop.

Demonstration of hand tools, power tools, basic measuring instruments, marking and measurement. Overview of Carpentry, Fitting, Smithy shop, Welding, Tin smithy, Electrical and Electronic, Plumbing, Machine shop and machine tools.

Practice:

Students are required to prepare one job each in the following shops: Fitting, Carpentry, Smithy /Tin smithy, Electric Arc welding/ Resistance welding.

Demonstrations of Jobs in following machine shops: Lathe Machine, Drilling Machine, Hacksaw Machine

Course Outcome:

Sr. No.	CO statement
CO-1	Understand various manufacturing processes in machine shop and perform basic operations of welding, fitting, smithy and carpentry work a) perform basic operations of welding, fitting, smithy and carpentry work b) Explain various manufacturing processes in machine shop
CO-2	Discuss application of plumbing fitting, masonry items and about plastic molding and glass cutting for various engineering application
CO-3	Measure different electrical quantities and trouble shoot electrical and electronics appliances.
CO-4	Conduct experiments with various kits such as Raspberry and Arduino for embedded system development
CO-5	Use basic commands of computer operating systems



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110012

Workshop Practice:

- 1) Machine shop
- 2) Fitting shop
- 3) Carpentry
- 4) Welding shop
- 5) Electrical
- 6) Electronics
- 7) Casting
- 8) Smithy
- 9) Plastic moulding & Glass Cutting
- 10) Plumbing and its fitting
- 11) Masonry Work
- 12) IOT
- 13) **Software Tools & OS Commands**

List of Experiments

Machine shop

1. Demonstration of job on Lathe machine
2. Demonstration of job on Drilling machine
3. Study of different types of power tools

Fitting Shop

Hands on Practice and job making in Fitting shop

Carpentry

Hands on Practice and job making in Carpentry shop.

Welding shop

1. Hands on Practice and job making using Electric arc Welding / Resistance welding process
2. Hands on Practice and job making using Soldering process

Casting:

Demonstration of Pattern Making by sand moulding

Smithy

Hands on Practice and job making in Smithy/ Tin smithy shop.

Plumbing and its fitting

- 1) Types of Pipes and Fittings
- 2) Joints (PVC and Metal)
- 3) Plumbers tools and equipment's
- 4) Cutting and bending of different metal pipes



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- 5) Pipe fitting
- 6) Plumbing symbols
- 7) Plumbing services
- 8) Sanitary Pipes and Fittings
- 9) Joints

Plastic moulding & Glass Cutting

Masonry Work

- 1) Different types of Bricks
- 2) Different size and part of Bricks
- 3) Different types of Bonds
- 4) Types of tools used for various masonry works

Electrical

1. Measure voltage, current, frequency, phase difference, power, power factor for single and three-phase supply
2. Wire fan, tube light, two-way control (staircase wiring).
3. Wire MCB, ELCB for a given load circuit
4. Preparing the drawing for wiring a newly built room, without any electrical wiring along with a bill of materials with specifications; the room may be a class-room, an office, a shop, a clinic, a small workshop etc.
5. Identify and rectify open circuit, and short circuit faults in PCB/System
6. Solder and de-solder electronic components on different types of PCB
7. Identify various types of ports and connectors

Electronics:

- 1) Introduction to basic electronics components and its testing: Resistors, Inductors, Capacitor, Diode, BJT
- 2) Introduction to testing and Measurement Instruments: Power Supply, Function Generator, Oscilloscope

IOT

Arduino starter kits or raspberry pi

i.e. Arduino Starter kit mostly includes following:, Similarly for Raspberry pi use whatever required

- An Arduino or Raspberry
- Jumper wires
- Resistors
- Breadboard
- LEDs
- Buttons



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Case Studies/Demonstration

1. Arduino LED On/Off
2. Or Raspberry LED/On

It requires

- LED
 - Resistor
 - Connecting wires
3. Arduino alarm system which detects movement of an intruder with a high pitched alarm sounds and flashing lights.

It requires

- An ultrasonic “ping” sensor –HC-SR04 or PIR
 - A piezo buzzer
 - LED strip light
4. Arduino Traffic Light Controller
 5. raspberry pi on screen keyboard app.

It requires

- Red, yellow and green LEDs.
- A breadboard.
- 6 x 220 resistors.
- Connecting wires.
- 1 x pushbutton switch.
- 1 x 10k resistor

Software Tools & OS Commands

- **Dream weaver Web development Tool**

Student Has to build his own Web Site consisting of basic profile about his department,his own personnel profile and basic Institute Details

Student Has to learn any of Two OS (Windows,Linux,Unix,MacOS,Apple,Android)

Student has to learn basic Windows and Linux/Ubuntu shell commands and have to develop simple shell script.

Journal is to be prepared covering the topics of demonstration and report about process / methodology /



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inspection for making jobs.

Major Equipment: Lathe machine, drilling machine, grinding machine, Resistance and Arc Welding machine, Hacksaw machine, Fitting, Carpentry and Plumbing vice, various types of files for fitting shop, hand hacksaw, monkey spanner, die, chisels, jack plane, furnace, anvil, different types of hammers for various shops, tongs, scissors, hand shear machine, sheet cutter, welding goggles, welding gloves, Soldering iron, Moulding box, different wooden/ metal patterns.

List of Open Source Software/learning website: <http://nptel.iitm.ac.in/courses.php>

Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw Hill House, 2017.
3. Workshop Technology Vol. 1 and 2 by Raghuvanshi B.S. Dhanpat Rai & Sons 1998
4. Workshop Technology by Chapman W.A. J and Arnold E. Viva low priced student edition, 1998
5. Workshop Practices, H S Bawa, Tata McGraw-Hill, 2009

P.S: Out of 13 activities, college has to opt for any 8 activities for a specific branch.

Each activity will be of 4 hours per semester.



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110013
ENGINEERING GRAPHICS & DESIGN
1st YEAR

Type of course: Engineering Science

Prerequisite: Zeal to learn the subject

Rationale: Engineering Drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to Engineering Graphics: Drawing instruments and accessories, BIS – SP 46. Use of plane scales, Diagonal Scales and Representative Fraction	2 (Lab teaching)	20%
2	Loci of Points: Path of the points moving on Simple mechanisms, Slider crank mechanism, Four bar mechanism	2	
3	Engineering Curves: Classification and application of Engineering Curves, Construction of Conics, Cycloidal Curves, Involute and Spirals along with normal and tangent to each curve	6 (Lab teaching)	
4	Projections of Points and Lines: Introduction to principal planes of projections, Projections of the points located in same quadrant and different quadrants, Projections of line with its inclination to one reference plane and with two reference planes. True length and inclination with the reference planes	8	30%
5	Projections of Planes: Projections of planes (polygons, circle and ellipse) with its inclination to one reference plane and with two reference planes, Concept of auxiliary plane method for projections of the plane	6	
6	Projections of Solids, Section of Solids and Development of Surfaces: Classification of solids. Projections of solids (Cylinder, Cone, Pyramid and Prism) along with frustum with its inclination to one reference plane and with two reference planes, Section of such solids and the true shape of the section, Development of surfaces	10	15%
7	Orthographic Projections: Fundamental of projection along with classification, Projections from the pictorial view of the object on the	2	25%



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Bachelor of Engineering
Subject Code: 3110013

	principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view		
8	Isometric Projections and Isometric View or Drawing: Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing of simple objects	2 (Lab teaching)	
9	Computer Aided Drawing: Introduction to AutoCAD, Basic commands for 2D drawing like : Line, Circle, Polyline, Rectangle, Hatch, Fillet, Chamfer, Trim, Extend, Offset, Dim style, etc..	4 (Lab teaching)	10%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	30	30	5	5	5

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

Reference Books:

1. A Text Book of Engineering Graphics by P.J.Shah S.Chand & Company Ltd., New Delhi
2. Elementary Engineering Drawing by N.D.Bhatt Charotar Publishing House, Anand
3. A text book of Engineering Drawing by R.K.Dhawan, S.Chand & Company Ltd., New Delhi
4. A text book of Engineering Drawing by P.S.Gill, S.K.Kataria & sons, Delhi
5. Engineering Drawing by B. Agrawal and C M Agrawal, Tata McGraw Hill, New Delhi

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Know and understand the conventions and the methods of engineering drawing.	15
CO-2	Interpret engineering drawings using fundamental technical mathematics.	25
CO-3	Construct basic and intermediate geometry and comprehend the theory of projection.	25
CO-4	Improve their visualization skills so that they can apply these skills in developing new products.	25
CO-5	Improve their technical communication skill in the form of communicative drawings.	05
CO-6	Use computer software for engineering drawing.	05



GUJARAT TECHNOLOGICAL UNIVERSITY
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Subject Code: 3110013

List of Practical:

Students must prepare sketch book and drawing sheets on the following topics. **Minimum three problems must be given for sheet number 3 to 9.**

1. Practice sheet (which includes dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
2. Plane scale and diagonal scale
3. Loci of points (only sketch book)
4. Engineering curves
5. Projection of line
6. Projection of plane
7. Projection of solid, section of solid and development of surfaces
8. Orthographic projection
9. Isometric projection
10. At least one orthographic drawing (three views) using above mentioned AutoCAD commands.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110014

SUBJECT NAME: Mathematics-1

1st Year

Type of course: Basic Science Course

Prerequisite: Algebra, Trigonometry, Geometry

Rationale: The study of rate of changes, understanding to compute area, volume and express the function in terms of series, to apply matrix algebra.

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)
3	2	0	5	70	30	0	0	100	

Content:

Sr. No.	Content	Total Hrs	% Weightage
01	Indeterminate Forms and L'Hôpital's Rule.	01	15 %
	Improper Integrals, Convergence and divergence of the integrals, Beta and Gamma functions and their properties.	03	
	Applications of definite integral, Volume using cross-sections, Length of plane curves, Areas of Surfaces of Revolution	03	
02	Convergence and divergence of sequences, The Sandwich Theorem for Sequences, The Continuous Function Theorem for Sequences, Bounded Monotonic Sequences, Convergence and divergence of an infinite series, geometric series, telescoping series, $\square^{\square\square}$ term test for divergent series, Combining series, Harmonic Series, Integral test, The p - series, The Comparison test, The Limit Comparison test, Ratio test, Raabe's Test, Root test, Alternating series test, Absolute and Conditional convergence, Power series, Radius of convergence of a power series, Taylor and Maclaurin series.	08	20 %
03	Fourier Series of $2\square$ periodic functions, Dirichlet's conditions for representation by a Fourier series, Orthogonality of the trigonometric system, Fourier Series of a function of period $2\square$, Fourier Series of even and odd functions, Half range expansions.	04	10 %
04	Functions of several variables, Limits and continuity, Test for non existence of a limit, Partial differentiation, Mixed derivative theorem, differentiability, Chain rule, Implicit differentiation, Gradient, Directional derivative, tangent plane and normal line, total differentiation, Local extreme values, Method of Lagrange Multipliers.	08	20 %
05	Multiple integral, Double integral over Rectangles and general regions, double integrals as volumes, Change of order of integration, double integration in polar coordinates, Area by double integration, Triple integrals in rectangular, cylindrical and spherical coordinates, Jacobian, multiple integral by substitution.	08	20 %
06	Elementary row operations in Matrix, Row echelon and Reduced row echelon forms, Rank by echelon forms, Inverse by Gauss-Jordan method,	07	15%



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110014

	Solution of system of linear equations by Gauss elimination and Gauss-Jordan methods. Eigen values and eigen vectors, Cayley-Hamilton theorem, Diagonalization of a matrix.		
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Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	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).

Reference Books:

- (1) Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.
- (2) Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.
- (3) James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
- (4) Anton and Rorres, Elementary Linear Algebra, Applications version,, Wiley India Edition.
- (5) T. M. Apostol, Calculus, Volumes 1 & 2,, Wiley Eastern.
- (6) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Edition.
- (7) Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.

Course Outcomes

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and matrices. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Sr. No.	Course Outcomes	Weightage in %
1	To apply differential and integral calculus to improper integrals and to determine applications of definite integral. Apart from some other applications they will have a basic understanding of indeterminate forms, Beta and Gamma functions.	15
2	To apply the various tests of convergence to sequence, series and the tool of power series and fourier series for learning advanced Engineering Mathematics.	30
3	To compute directional derivative, maximum or minimum rate of change and optimum value of functions of several variables.	20
4	To compute the areas and volumes using multiple integral techniques.	20
5	To perform matrix computation in a comprehensive manner.	15

List of Open Source Software/learning website:

Scilab, MIT Opencourseware.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110015

SUBJECT NAME: Mathematics-2

1st Year

Type of course: Basic Science Course

Prerequisite: Calculus, fourier series

Rationale: To compute line integrals, solution techniques of higher order ordinary differential equations, fourier integral representation.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	2	0	5	70	30	0	0	100

Sr. No.	Content	Total Hrs	% Weightage
01	Vector Calculus: Parametrization of curves, Arc length of curve in space, Line Integrals, Vector fields and applications as Work, Circulation and Flux, Path independence, potential function, piecewise smooth, connected domain, simply connected domain, fundamental theorem of line integrals, Conservative fields, component test for conservative fields, exact differential forms, Div, Curl, Green's theorem in the plane (without proof).	9	20
02	Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, ODEs, Unit Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, ODEs with Variable Coefficients, Systems of ODEs.	7	20
03	Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral.	02	
04	First order ordinary differential equations, Exact, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	6	14
05	Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler-Cauchy Equations, Existence and Uniqueness of Solutions, Linear Dependence and Independence of Solutions, Wronskian, Nonhomogeneous ODEs, Method of Undetermined Coefficients, Solution by Variation of Parameters.	10	26
06	Series Solutions of ODEs, Special Functions, Power Series Method, Legendre's Equation, Legendre Polynomials, Frobenius Method, Bessel's Equation, Bessel functions of the first kind and their properties.	8	20



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3110015

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	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)

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) Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.
- (5) Howard Anton, Irl Bivens, Stephens Davis, Calculus, 10e, Wiley, 2016.

Course Outcomes:

The objective of this course is to familiarize the prospective engineers with techniques in vector calculus, ordinary differential equations, fourier integrals and laplace transform. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Sr. No.	Course Outcomes	Weightage in %
1	To apply mathematical tools needed in evaluating vector calculus and their usage like Work, Circulation and Flux.	20
2	To apply the laplace transform as tools which are used to solve differential equations and fourier integral representation.	20
3	To apply effective mathematical tools for the solutions of first order ordinary differential equations.	14
4	To apply effective mathematical methods for the solutions of higher order ordinary differential equations.	26
5	To use series solution methods and special functions like Bessels' functions.	20

List of Open Source Software/learning website:

Scilab, MIT Opencourseware.



GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3110016
BASIC ELECTRONICS
1st Year

Type of course: Engineering Science

Prerequisite: High School Education & Physics

Rationale: Electronics is playing a key role in all engineering applications. All engineers should have basic knowledge of electronics. Purpose of this subject is make students familiar with basic electronics concepts. Students will be able to operate electronic test and measurement equipment like multi-meter, CRO, DC power supply and function generator.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Diode theory and applications Basic idea about forward bias, reverse bias and VI characteristics, ideal diode, second and third approximation, surface mount diodes, Zener diode, Testing of diode with multi-meter, half wave rectifier, full wave rectifier, bridge rectifier, RC and LC filters, Design of un-regulated DC power supply, Clipping circuit, Clamping circuit, voltage multiplier circuit, Reading datasheet of semiconductor diode.	10	20%
2	Bipolar junction transistors and its biasing BJT operation, BJT voltages and currents, CE, CB and CC characteristics, DC load line and bias point, base bias, emitter feedback bias, collector feedback bias, voltage divider bias, Thermal stability, biasing BJT switching circuits, transistor power dissipation and switching time, Testing of bipolar junction transistor with multi-meter, Reading datasheet of BJT.	10	20%
3	Special purpose diodes and transistors Light emitting diode (LED). Zener diode, Zener diode circuit for voltage regulation, Photo diode, Solar cell, PIN diode, Varactor, Schottky diode, Varistors, Tunnel diode, Seven Segment display, Sixteen segment display, Identify segments on pin using multi-meter, Dot-matrix LED display, Photo transistor, Opto-coupler, Reading datasheet of opto-electronics devices	4	10%



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4	AC Analysis of BJT circuits and small signal amplifier Coupling and bypass capacitors, AC load lines, Transistor models and parameters, Common emitter circuit analysis, common base circuit analysis, common collector circuit analysis, Comparison of CE, CB and CC circuits, Transistor as a switch	10	20%
5	Field effect transistors (FET) and its biasing Junction field effect transistors(JFET), Comparison of BJT and FET, JFET characteristics, FET, Biasing in ohmic region and active region, Transconductance, amplification and switching, MOSFETs (D-type and E-type MOSFET), CMOS introduction, E-MOSFET amplifier. MOSFET testing, Reading datasheet for FET and MOSFET.	10	20%
6	Digital Circuits Basic gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Building AND, OR Gate with diodes, Digital logic families RTL, DTL, TTL, CMOS, Comparison of logic families	4	10%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30 %	30%	40%	0	0	0

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

Reference Books:

- [1] David A. Bell, "Electronic Devices and Circuits", Oxford University Press, Fifth edition
- [2] Albert Malvino & David, "Electronic Principles", Tata McGraw-Hill, Seventh edition
- [3] R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education
- [4] Jacob Millman, Chritos Halkias, Chetan D Parikh, "Integrated Electronics", Tata McGraw-Hill, Second edition
- [5] Albert Malvino & David, "Problems and Solutions in Basic Electronics, McGraw Hill Education

Course Outcomes:

Sr. No.	CO statement	% weightage
CO-1	Analyze the general – and special-Purpose diode circuits	30
CO-2	Design biasing circuits for BJT	20
CO-3	Analyze BJT Circuits in small-signal domain	20
CO-4	Analyze basic FET Circuits	20
CO-5	Verify the functionalities of basic digital gates and logic families	10
CO-6	Construct and test circuit using basic electronic devices in a group	From Lab work



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List of Experiments:

(General guidelines. Institute may change list of experiments)

- To measure DC voltage and current, AC voltage and current with multi-meter
- To observe waveforms on oscilloscope, measure basic parameters amplitude and frequency of sine wave and square wave.
- Obtain VI characteristics of semiconductor rectifier diode, LED, Photo-diode
- To observe waveform at the output of half wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To observe waveform at the output of full wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To observe waveform at the output of bridge rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
- To construct clamper circuits on breadboard and To observe waveforms at the output of clamper circuits
- To construct clipper circuits on breadboard and To observe waveforms at the output of clipper circuits
- Construct AND gate & OR gate with help of diode and verify truth table
- To obtain common emitter characteristics of NPN transistor
- To obtain common base characteristics of NPN transistor
- To obtain common collector characteristics of NPN transistor
- To design common emitter amplifier and construct circuit on breadboard. Measure gain at different frequencies and plot frequency response
- To understand working of transistor as a switch. To draw DC load line for given circuit.
- To observe input-output waveforms of common collector (CC) amplifier. To measure gain of amplifier at different frequencies and plot frequency response
- To obtain characteristics of field effect transistor (FET)
- To measure gain of FET common source (CS) amplifier
- Verify truth table of basic digital logic gates OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR
- To test individual circuit prepared by the student (Get circuit from the faculty, build it, draw circuit diagram and test it in the laboratory. Write test results in this practical)

Major Equipment:

1. CRO
2. Function generator
3. DC Power Supply
4. Bread board and discrete electronics components

List of Open Source Software/learning website:

- <http://nptel.ac.in/syllabus/117103063/>
- <https://swayam.gov.in/course/3595-basic-electronics>
- eSIM available on FOSSEE website: <https://fossee.in/>

Induction Program

Preamble:

The goal of engineering education is to train engineering graduates well in branch of admission, have a holistic personality and must have desire to serve society and nation. It is expected that an engineering graduate work for solving the problems of society using the modern technologies and practices. That needs the broad understanding of the society and relationships. It is needed to cultivate the human values in engineering graduates to fulfil his responsibilities as an engineer, a citizen and a human being.

Considering the various social backgrounds and whether a student comes from the urban or rural areas they differ in many of the life skills and their abilities and thinking. Their branch of admission may be due to rush; their interest in subject is question. They are facing the issues like hostel and settlements, pressures from peers and many related issues. To overcome such issues, it is necessary to create an environment for students so that they feel comfortable, find their interest and explore their inner beings, create bonding with other students, establish relation with teachers, work for excellence, get a broader view of life and practice human values to build characters. The Induction Program covers the various activities which enables them to overcome all such issues and motivates them to perform well in their chosen branch of admission.

Scheme:

Sr No	Phase and Activities Heads	Weightage
1.	Initial Phase	1 day (6 Hrs)
2	Regular Phase	13 Days
a)	Physical activity	24 Hours
b)	Creative Arts	12 Hours
c)	Universal Human Values	12 Hours
d)	Literary	12 Hours
e)	Proficiency Modules	6 Hours
f)	Lectures by Eminent People	3 Hours: 3 Expert Lectures, One per Week
g)	Visits to local Areas or Industry	1 Day
h)	Innovations	3 Hours
3	Closing Phase	1 Day (6 Hrs)
Total		90 Hours

Phases, Modules, Activities and Guidelines:

The activity during Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The initial and closing phases would be one day each. The following is the guidelines indicating the possible activities under each phase of the Induction Program.

Initial Phase (First Day)		
Following are the activities to be carried on the first day: ● Orientation Programme ● Know your Department/Institute ● Know your university ● Know hostel and other amenities ● Information about Student Diary and Induction Program		
Regular phase (13 Days)		
The Regular Phase consists of 13 days, each day is of 6 hours. It covers all the 8 different activity modules. For each module, the objectives, suggested activities and guidelines are provided herewith. Institute can use additional relevant activities in addition in suggested activities for each of the phases.		
Module Name	Objectives	Suggested Activities
1. Physical Activity (24 hours)	1. Improve bone health 2. Improve cardio respiratory and muscular fitness 3. Understand the anatomy, basic biomechanical principles and terminology. 4. Examine the effect of nutrition, rest and other lifestyle factors that contribute to the better health.	1. Running/Jogging 2. Brisk Walk 3. Cycling 4. Heavy yard work 5. Swimming 6. Yoga/Pranayam 7. Aerobics 8. Outdoor Sports/Indoor Games (In addition to cricket, Volleyball, Badminton, Chess, Carom, Table Tennis, Other games like Critical Thinking, Math skill developing Games, Memory Games can be included.) 9. Calculate Body mass index of each students and explain their fitness level from it. 10. Tree Plantation 11. Gardening
Guidelines: ● Half an hour Yoga/Pranayam followed by physical activities including various games. ● Refer this link for Yoga/Pranayam https://s3-ap-southeast-1.amazonaws.com/ministry-		

Module Name	Objectives	Suggested Activities
2. Creative Arts (12 hours)	1. Develop creativity and imagination through a range of complex activities. 2. Improve the student's ability to control materials, tools and techniques. 3. Develop increasing confidence in the use of visual and tactile elements and materials.	1. Make a model of any physical object related to Engineering Design 2. Crafting 3. Painting 4. Sculpture 5. Pottery 6. Music 7. Dance
Guidelines: • Use any activities leading to creative thing and practice. • Show the video demonstrating the creative ideas and thinking. • Show the video demonstrating phenomenon performance using innovation in different areas of humanity and social science. • Demonstrate the story of leaders with the context of how with their creative vision, with all odds they achieved success.		
Module Name	Objectives	Suggested Activities
3. Universal Human Values (12 hours)	1. Impart universal human values in students. 2. Enable students to live in harmony within themselves, with family, with society and the nature 3. Initiate the process of self exploration and self investigation within themselves about their understanding of happiness.	1. Showing Motivational Movies. 2. Social Activities like visit of orphanage, old age home, blind peoples'school etc. 3. Swachchhata Mission Activities. 4. Awareness regarding environmental issues and remedies. 5. Spread awareness about blood donation, organ donation, precaution to avoid malaria in monsoon etc. 6. Discuss autobiography of legendary persons who practiced universal human values in their life and work. 7. Conduct universal human values group discussions.

Guidelines:

- Use the materials and activities covered in the FDP on Induction Program held at GTU organized by AICTE.
- The faculties trained from institute will take leadership role to rollout it at institute level.

Module Name	Objectives	Suggested Activities
4. Literary (12 hours)	1. Inculcate the habit of active (or interactive) consumption of the best content available in literature. 2. Develop thinking skills. 3. Improve reading abilities and attitude.	1. Digital literacy and use of Internet 2. Basic Mathematics for Solving Real World Problems 3. Use of Scientific Calculator in Engineering 4. General Knowledge Quiz Competition 5. Vedic Mathematics 6. Reading/writing/speaking/listening 7. Debating/Elocution 8. Enacting a play 9. Book review

Guidelines:

- Use the video lectures to literate students in different skills needed for day-to-day life and need.
- Motivate students to create the nature of inquiry and reading habits.
- Arrange the various competitions like Elocution, Essay writing, Storytelling, Book reviews etc.
- Writing the review of the well known books, movies etc and sharing.

Module Name	Objectives	Suggested Activities
5. Proficiency modules (6 hours)	1. Determining English proficiency level of students and mentoring accordingly. 2. Learn the mining vocabulary, idioms, and expressions and understand their meanings in context. 3. Develop ability to write a paragraph about general topics by using the English language correctly.	1. English general diagnostic test to determine student's English proficiency level. 2. Mentoring students to improve in English proficiency according to his/her proficiency level based on test.

	4. Realize the importance of English language as a global business language.	
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Guidelines:

- An MCQ test of **45 minutes** should be conducted covering basic grammar and vocabulary.
- Group the students in three groups based on test result in three proficiency levels:
 - Unsatisfactory
 - Satisfactory
 - Good
- Following activities are to be used to uplift proficiency levels of students.
 - Motivational movies, documentary
 - Language games
 - Essay/story writing
 - Ice breaking games.
- Separate set of activities from suggested list should be used for different groups.

Module Name	Objectives	Suggested Activities
6. Lectures by Eminent people (3 hours)	1. Motivation through knowing experience of successful person. 2. Meet and interact with eminent personalities of different fields.	1. To conduct lecture by eminent people. 2. Interaction with leaders, experts, entrepreneurs, contributors and successful personalities

Guidelines:

- 3 expert lectures each of 1 hour per week.
- Multiple divisions can be combined in an expert lecture.
- External expert should be invited.
- Expert can be from academic, industry, research organization, social organization etc.
- An individual successful person in any of the field can be invited.
- The aspect to be addressed may be social / economical / engineering / entrepreneurship/ spiritual/ humanity science.

Module Name	Objectives	Suggested Activities
7. Visit to Local Area and Industry (1 Full day)	1. To familiarize students with the local area. 2. Sensitise with the different aspects of the life including social services and heritage	1. A full day visit covering at least 2 or 3 places. 2. List of possible places A. Centre of excellence B. Elite Academic Institutes C. Research institute

		D. Hospitals E. Industry visit F. Heritage places
Guideline and References: - Institute can arrange visit to public, social or specifies places to give insight of the activities and overall socio-economic contribution of such places. - The uniqueness or impact of such visits should be highlighted.		
Module Name	Objectives	Suggested Activities
8. Innovation (3 hours)	1. Introduce the student about innovation in different fields 2. Make students aware about innovative and modern practices and products in their own branch 3. Create awareness about support available for start-up and innovation	1. Lectures by senior faculties. 2. Showing videos demonstrating innovation. 3. Introducing innovative technology/products. 4. Awareness regarding SSIP Scheme of Government of Gujarat 5. Awareness about Government initiatives in areas of innovations and supports for start-up, Incubation, Entrepreneurship etc.
Guideline: - Video lectures from leaders and innovators. - TeDx Talks. - Government Policy documents for different schemes.		
Closing Phase (Last Day)		
The closing phase is the last day of the Induction Program and covering conclusion and summary of the Induction Program. Conclusion and summary: - Guiding students for preparation of student report about Induction Program. - Instruct students regarding submission and examination of the Induction Program. - Address by HODs/Senior faculties regarding branch/discipline and career option in respective branch. - Introduce about the engineering and its importance in life and their responsibilities towards the society.		

General Regulations:

- Every student has to maintain a daily diary. Format of the diary is already given.
- After completion of the Induction program student has to prepare a report based on activities performed during the Induction program. Diary will be attached as Appendix in Report.
- 75% Attendance is require during Induction Program.

- d) This program will be noncredit subject but it will reflect in 1st Semester Marksheet as PASS or FAIL.
- e) Institute should appoint a mentor for a group of 20 to 30 students. Mentor can take help of senior students.
- f) If student gets admission transfer in other college during Induction Program the diary will be continued from previous college to new college.
- g) If student gets admission in middle of the Induction Program or student gets admission after Induction Program, it is responsibility of the institute to fulfill the criteria of the Induction Program.
- h) If student fails in the Induction program the student has to clear the same during subsequent Semester

Evaluation Pattern:

1. Induction Program is Mandatory course for each branch of Engineering.
2. It is mandatory for each student to clear Induction Program with PASS grade.
3. Grades for Induction Program are either PASS or FAIL and have no credits. Evaluation for Induction Program is based on the Induction Program Report prepared by a student from Student diary and student will be declared PASS or FAIL.
4. Student has to submit the Induction Program Report at the end of first semester dully approved by Mentor and HOD.
5. Evaluation of Induction Program will be done along with first Semester Term-Work Submission.
6. The evaluation is carried out by Internal Examiner from institute itself. The entry on the GTU portal will be PASS or FAIL, not marks.
7. The students who will FAIL have to reappear again after every 6 months as remedial exam.

Guidelines for Program Report:

- 1) Report should have minimum 20 pages.
- 2) Report must have One Photograph per Activity.
- 3) Report consists of Certificate, Index and Diary as Appendix.
- 4) Report should be dully signed by Mentor and HOD.
- 5) Index will have following sequence:

1.	Initial Phase
2	Regular Phase
a)	Physical activity
b)	Creative Arts
c)	Universal Human Values
d)	Literary
e)	Proficiency Modules
f)	Lectures by Eminent People
g)	Visits to local Areas or Industry
h)	Innovations
3	Closing Phase

Format of Diary

Enrolment/Roll No:

Name of Student:

Day		Date:
Hour	Activities Done	Learning Outcomes
1		
2		
3		
4		
5		
6		
Signature of the Student		Signature of Mentor



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Subject Code: 3110018

PHYSICS

1st YEAR

(For Group II Branches)

Type of course: Type of course: Basic Science (Physics)

Prerequisite: Basic understanding of Math's, Physics and chemistry

Rationale: The basic science physics program is to prepare students for careers in engineering where physics principles can be applied to the advancement of technology. This education at the intersection of engineering and physics will enable students to seek employment in engineering upon graduation while, at the same time, provide a firm foundation for the pursuit of graduate studies in engineering.

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)	
3	0	2	4	70	30	30	20	150

Content:

SrNo	Topic	Teaching Hrs.	Module Weightage
1	MODULE 1: ELECTRONIC MATERIALS - Free electron theory - Density of states and energy band diagrams, - Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, - E-k diagram, Direct and indirect bandgaps, - Types of electronic materials: metals, semiconductors, and insulators, - Density of states, Occupation probability, - Fermi level, Effective mass, Phonons.	8	22%
2	MODULE 2: SEMICONDUCTORS (10) - Intrinsic and extrinsic semiconductors - Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics) - Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, - Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices	10	27%



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3	MODULE 3: LIGHT-SEMICONDUCTOR INTERACTION - Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; - Joint density of states - Density of states for photons, - Transition rates (Fermi's golden rule) - Optical loss and gain; Photovoltaic effect, Exciton - Drude model.	6	17%
4	Module 4: Measurements - Four-point probe and Van Der Pauw measurements for carrier density, - Resistivity and hall mobility - Hot-point probe measurement, capacitance-voltage measurements, - Parameter extraction from diode I-V characteristics, DLTS, - band gap by UV-Vis spectroscopy, absorption/transmission.	6	17%
5	Module 5: Superconductivity - Introduction of Superconductivity - Properties of superconductor - Effect of magnetic field - Meissner effect - Pressure effect - Impurity effect - Isotopic mass effect - Mechanism of Superconductivity : BCS Theory - Penetration depth : Magnetic field - Josephson's junction and its application Application of superconductors	6	17%

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	40	30	0	0	0

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

References:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications,



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Oxford

5. University Press, New York (2007).
6. 5. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
7. Engineering Physics by Dattu R Joshi, McGraw hill Publications.

Extra Study Material

1. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL
2. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL

Course Outcome:

Sr. No.	CO statement	% weightage
CO-1	The student will gain knowledge of basic theoretical and mathematical concept of electronic materials.	22%
CO-2	The student will demonstrate understanding of basic principles, properties and applications associated with semiconducting materials.	27%
CO-3	The student will demonstrate understanding of basic theory and properties associated with optoelectronic materials.	17%
CO-4	The student will gain knowledge of the different measurements techniques to characterize various semiconducting, electrical and optoelectrical materials and devices.	17%
CO-5	The student will demonstrate understanding of basic theory, properties and applications of Superconductivity.	17%

List of Experiments:

1. To measure the dielectric constant of a material
2. To study the Hall-Effect.
3. To study the I-V Characteristic of Silicon diode.
4. To study the I-V Characteristic of Zener diode.
5. To study the I-V Characteristic of LED.
6. To determine the efficiency of given solar cell.
7. To measure the Resistivity & Band gap of Germanium Crystal (N-type) by Four Probe Method.
8. To measure the numerical aperture of optical fiber.
9. To Study of propagation & bending loss in optical fiber.
10. P-N Junction diode as Bridge Rectifier.
11. Energy gap of Semiconductor
12. Study of cathode ray oscilloscope
13. Time constant of an R-C circuit.
14. L-C-R Circuit.
15. Logic Gates
16. Virtual Laser Optics Lab
17. Virtual Solid-State Physics Lab
18. Virtual Harmonic Motion & Waves Lab
19. Virtual Optics Lab
20. Virtual Modern Physics Lab
21. Virtual Physical Sciences Lab



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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
L	T	P	C	Theory Marks		Practical Marks		
				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%



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	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



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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%



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Subject Code: 3130006

Semester – III

Subject Name: Probability and Statistics

Type of course: Basic Science Course

Prerequisite: Probability basics

Rationale: Systematic study of uncertainty (randomness) by probability - statistics and curve fitting by numerical methods

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				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	Basic Probability: Experiment, definition of probability, conditional probability, independent events, Bayes' rule, Bernoulli trials, Random variables, discrete random variable, probability mass function, continuous random variable, probability density function, cumulative distribution function, properties of cumulative distribution function, Two dimensional random variables and their distribution functions, Marginal probability function, Independent random variables.	08	20 %
02	Some special Probability Distributions: Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Normal, Exponential and Gamma densities, Evaluation of statistical parameters for these distributions.	10	25 %
03	Basic Statistics: Measure of central tendency: Moments, Expectation, dispersion, skewness, kurtosis, expected value of two dimensional random variable, Linear Correlation, correlation coefficient, rank correlation coefficient, Regression, Bounds on probability, Chebyshev's Inequality	10	20%
04	Applied Statistics: Formation of Hypothesis, Test of significance: Large sample test for single proportion, Difference of proportions, Single mean, Difference of means, and Difference of standard deviations. Test of significance for Small samples: t- Test for single mean, difference of means, t-test for correlation coefficients, F- test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	10	25 %
05	Curve fitting by the numerical method: Curve fitting by of method of least squares, fitting of straight lines, second degree parabola and more general curves.	04	10 %



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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) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
- (2) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
- (3) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
- (4) D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
- (5) J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning.

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	understand the terminologies of basic probability, two types of random variables and their probability functions	20 %
CO-2	observe and analyze the behavior of various discrete and continuous probability distributions	25 %
CO-3	understand the central tendency, correlation and correlation coefficient and also regression	20%
CO-4	apply the statistics for testing the significance of the given large and small sample data by using t- test, F- test and Chi-square test	25 %
CO-5	understand the fitting of various curves by method of least square	10 %

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	
L	T	P		C	Theory Marks		Practical Marks		
					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 Responsibilities.	30%
CO-3	Create Awareness of their Surroundings, Society, Social problems and their sutable 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%



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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
L	T	P	C	Theory Marks		Practical Marks		
				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.



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Subject Code: 3130008

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	○ 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.
		○ Immerse via Role Playing	



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		○ 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



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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:

- 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.)
- Preparation of canvases based on different phase of Design Thinking
- Feedback analysis with the user shall be clearly included in the report
- Summary of findings of Prior Art Search on purpose/project theme (2 summary papers per student)
- Summary of the learning from Design Thinking
- Summary on validation process and refinement in the rough prototype
- Any other important aspects you feel should be included



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- 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.



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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



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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: 3130702
Semester – III
Subject Name: Data Structures

Type of course: Compulsory

Prerequisite: Computer Programming & utilization

Rationale: Data structure is a subject of primary importance in Information and Communication Technology. Organizing or structuring data is important for implementation of efficient algorithms and program development. Efficient problem solving needs the application of appropriate data structure during program development.

Understanding of data structures is essential and this facilitates the understanding of the language. The practice and assimilation of data structure techniques is essential for programming. The knowledge of „C“ language and data structures will be reinforced by practical exercises during the course of study. The course will help students to develop the capability of selecting a particular data structure.

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)		
3	0	4	5	70	30	30	20	150	

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	INTRODUCTION TO DATA STRUCTURE: Data Management concepts, Data types – primitive and non-primitive, Performance Analysis and Measurement (Time and space analysis of algorithms-Average, best and worst case analysis), Types of Data Structures- Linear & Non Linear Data Structures.	04	10
2	LINEAR DATA STRUCTURE Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation, Recursion, Tower of Hanoi Queue: Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue Linked List: Singly Linked List, Doubly Linked list, Circular linked list ,Linked implementation of Stack, Linked implementation of Queue, Applications of linked list.	13	30
3	NONLINEAR DATA STRUCTURE : Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (Inorder, postorder, preorder), Threaded binary tree, Binary search trees, Conversion of	13	30



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Subject Code: 3130702

	General Trees To Binary Trees, Applications Of Trees- Some balanced tree mechanism, eg. AVL trees, 2-3 trees, Height Balanced, Weight Balance, Graph-Matrix Representation Of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)		
4	HASHING AND FILE STRUCTURES : Hashing: The symbol table, Hashing Functions, Collision-Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, hashing for direct files, Multi-Key file organization and access methods.	06	15
5	Sorting & Searching: Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search and Binary Search	06	15

Reference Books:

1. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
2. Data Structures using C & C++ -By Ten Baum Publisher – Prentice-Hall International.
3. Fundamentals of Computer Algorithms by Horowitz, Sahni, Galgotia Pub. 2001 ed.
4. Fundamentals of Data Structures in C++-By Sartaj Sahani.
5. Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher-Thomson Learning.

Course Outcomes:

Sr. No.	CO Statement	Marks % weightage
CO-1	Define and classify various data structures, storage structures and common operations on them	10
CO-2	Create various linear data structures with their representation and perform different operations on them	20
CO-3	Create various nonlinear data structures with their representation and perform different operations on them	20
CO-4	Apply various searching sorting techniques on data set	30
CO-5	Solve the given a problem using an appropriate data structure to achieve optimal performance and compare its performance with other possible data structures	20

List of Practical:

At least 10 practical should be performed by students using programming language.

1. Introduction to pointers. Call by Value and Call by reference.
2. Introduction to Dynamic Memory Allocation. DMA functions malloc(), calloc(), free() etc.
3. Implement a program for stack that performs following operations using array.



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(a) PUSH (b) POP (c) PEEP (d) CHANGE (e) DISPLAY

4. Implement a program to convert infix notation to postfix notation using stack.
5. Write a program to implement QUEUE using arrays that performs following operations (a) INSERT (b) DELETE (c) DISPLAY
5. Write a program to implement Circular Queue using arrays that performs following operations. (a) INSERT (b) DELETE (c) DISPLAY
6. Write a menu driven program to implement following operations on the singly linked list.
 - (a) Insert a node at the front of the linked list.
 - (b) Insert a node at the end of the linked list.
 - (c) Insert a node such that linked list is in ascending order.(according to info. Field)
 - (d) Delete a first node of the linked list.
 - (e) Delete a node before specified position.
 - (f) Delete a node after specified position.
7. Write a program to implement stack using linked list.
8. Write a program to implement queue using linked list.
9. Write a program to implement following operations on the doubly linked list.
 - (a) Insert a node at the front of the linked list.
 - (b) Insert a node at the end of the linked list.
 - (c) Delete a last node of the linked list.
 - (d) Delete a node before specified position.
10. Write a program to implement following operations on the circular linked list.
 - (a) Insert a node at the end of the linked list.
 - (b) Insert a node before specified position.
 - (c) Delete a first node of the linked list.
 - (d) Delete a node after specified position.
10. Write a program which create binary search tree.
11. Implement recursive and non-recursive tree traversing methods inorder, preorder and post-order traversal.
12. Write a program to implement Queue Sort
13. Write a program to implement Merge Sort
14. Write a program to implement Bubble Sort
15. Write a program to implement Binary Search.



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3130703

Semester – III

Subject Name: Database Management Systems

Type of course: Core

Prerequisite: Basic knowledge of Computer Programming

Rationale:

Database is an integral part of real life application system. The course will enable student understand the different issues involved in the design and implementation of a database system. Student will learn the physical and logical database designs, database modeling, relational, hierarchical, and network models. Student will learn to use data manipulation language to query, update, and manage a database. Student will understand essential DBMS concepts such as: database security, integrity, concurrency, storage strategies etc. The students will get the hands on practice of using SQL and PL/SQL concepts.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		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	% Weightage
1	Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).	03	05
2	Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	06	12
3	Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.	04	08
4	Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.	05	10
5	Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization	06	10



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	algorithms.		
6	Storage strategies: Indices, B-trees, hashing.	04	07
7	Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	06	15
8	Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	04	07
9	SQL Concepts : Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints – Primary key, foreign key, unique, not null, check, IN operator, aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, join, Exist, Any, All , view and its types., transaction control commands.	10	18
10	PL/SQL Concepts : Cursors, Stored Procedures, Stored Function, Database Triggers	04	08

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
15	15	15	10	10	05

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. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. "Fundamentals of Database Systems", 7th Edition by R. Elmasri and S. Navathe, Pearson
3. "An introduction to Database Systems", C J Date, Pearson.
4. "Modern Database Management", Hoffer , Ramesh, Topi, Pearson.
5. "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.



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Bachelor of Engineering

Subject Code: 3130703

6. “Understanding SQL”, Martin Gruber, BPB
7. “SQL- PL/SQL”, Ivan bayross

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Recognize the various elements of Database Management Systems	10
CO-2	Given a problem statement, identify the entities and their relations and draw an E-R diagram and design database applying normalization	20
CO-3	Solve the given problem using Relational Algebra, Relational Calculus, SQL and PL/SQL	40
CO-4	Apply and relate the concepts of transaction, concurrency control, recovery and security in database	20
CO-5	Recognize the purpose of query processing, optimization and demonstrate the SQL query evaluation	10

List of Experiments:

1. To study DDL-create and DML-insert commands
2. Create table and insert sample data in tables.
3. Perform queries involving predicates LIKE, BETWEEN, IN etc.
4. To Perform various data manipulation commands, aggregate functions and sorting concept on all created tables.
5. To study Single-row functions.
6. Displaying data from Multiple Tables (join)
7. To apply the concept of Aggregating Data using Group functions.
8. To solve queries using the concept of sub query.
9. To apply the concept of security and privileges
10. To study Transaction control commands
11. Write Cursor
12. Write Trigger

Major Equipment:

Computer system with DBMS system

List of Open Source Software/learning website:

1. <https://www.tutorialspoint.com/dbms/>
2. <https://www.w3schools.com/sql/>
3. <https://www.codecademy.com/learn/learn-sql>
4. <https://in.udacity.com/>



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3130704
Semester – III
Subject Name: Digital Fundamentals

Type of course: Core

Prerequisite: Basic Electronics and Number Systems

Rationale:

The students need to learn basic concepts of digital circuits and system which leads to design of complex digital system such as microprocessors. The students need to know combinational and sequential circuits using digital logic fundamentals. This is the first course by which students get exposure to digital electronics world.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Module 1 : Fundamentals of Digital Systems and logic families Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	07	20
2	Module 2: Combinational Digital Circuits Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	08	20



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3	Module 3: Sequential circuits and systems A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters	08	20
4	Module 4: A/D and D/A Converters Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	08	20
5	Module 5: Semiconductor memories and Programmable logic devices. Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	08	20

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
15	15	15	10	10	05

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.



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Reference Books:

1. "Digital logic and Computer design", M. M. Mano, Pearson Education India, 2016.
2. "Fundamentals of Digital Circuits", A. Kumar, Prentice Hall India, 2016.
3. "Digital Principles and Applications" Malvino & Leach, McGraw-Hill Education
4. "Modern Digital Electronics", R. P. Jain, McGraw Hill Education, 2009.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Solve the given problem using fundamentals of Number systems and Boolean algebra	10
CO-2	Analyze working of logic families and logic gates and design the simple circuits using various gates for a given problem	10
CO-3	Design and implement Combinational and Sequential logic circuits and verify its working	40
CO-4	Examine the process of Analog to Digital conversion and Digital to Analog conversion	20
CO-5	Implement PLDs for the given logical problem	20

List of Experiments:

1. Getting familiar with various digital integrated circuits of different logic families. Study of data sheet of these circuits and see how to test these circuits using Digital IC Tester.
2. Configure diodes and transistor as logic gates and Digital ICs for verification of truth table of logic gates.
3. Configuring NAND and NOR logic gates as universal gates.
4. Implementation of Boolean Logic Functions using logic gates and combinational circuits. Measure digital logic gate specifications such as propagation delay, noise margin, fan in and fan out.
5. Study and configure of various digital circuits such as adder, subtractor, decoder, encoder, code converters.
6. Study and configurations of multiplexer and demultiplexer circuits.
7. Study and configure of flip-flop, registers and counters using digital ICs. Design digital system using these circuits.
8. Perform an experiment which demonstrates function of 4 bit or 8 bit ALU.
9. Study and configuration of A to D and D to A converter.

Design based Problems (DP)/Open Ended Problem:

1. Design of combinational lock circuits with varying number of bits (For example 4, 8)
2. Design of various types of counters.



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3. Design of Arithmetic and Logic Unit using digital integrated circuits.
4. Design project for example digital clock, digital event counter, timers, and various multi-vibrator Circuits, small processor, ports or scrolling display. A student and faculty may choose any other such problem which includes the concept used in the course.

Major Equipment:

1. Digital Storage Oscilloscopes
2. Digital Integrated Circuits Tester.
3. Complete Bread Board Systems, switches and I/O indicators, multimeters, pulse, square wave generators and display facility.
4. Digital Electronics Trainer kit.

List of Open Source Software/learning website:

1. LogiSim software
2. Xcircuit and Scilab
3. NPTEL website and IITs virtual laboratory

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Course Abstract for
DESIGN ENGINEERING – 1B
(4TH SEMESTER)

Course Initiated by:
Centre for Industrial Design
(OPEN DESIGN SCHOOL)

For any query, please write us at: design@gtu.edu.in

Post-graduate Research Centre for Industrial Design

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Design Engineering – 1B (3140005) (4th Semester)

Module 2: Applying Design Thinking

Name of the Discipline & the Programme: **Every discipline of the Engineering**

Course category: **Compulsory/Core - Intermediate**

Examination Pattern: **Internal evaluation/viva at the end of semester**

Prerequisites: **Design Engineering – 1A**

				Credit				Marks				
Subject code	Subject Name	Category	Sem.	L	T	P	Total	E	M	I	V	Total
3140005	DE - 1B	Project Work	4	0	0	2	1	0	0	20	80	100

*L=lectures, T=tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External, OJT=On Job Training is equivalent to Practical

Relevance

This is a revision course designed for those who have undergone the fundamentals of Design Thinking process in 3rd semester.

Objective: Applying Design Thinking

The course aims to validate the learnings from the understanding design thinking course by translating the concepts into exercises. Here branch specific topics need to be selected by students, apply reverse engineering, modify existing solutions and refine their learning for Design Thinking phases.

Course Contents

In the 3rd semester, students have learnt the basic Design Thinking methodology in DE-1A and undergone the phases of the same with necessary tools and techniques and worked upon general topic/domain irrespective of their branch. Now in 4th semester, they need to select **branch specific existing artefact/solution, apply Reverse Engineering (RE) and modify/redesign** it as per the User's needs using Design Thinking. There are three core objectives of introducing RE and integrating Design Thinking with it: (1) Students will learn some basic concepts from their branch and relate all stages/phases of Design Engineering with their regular core subjects of particular branch in current or further semester/s as one of the key objectives of Design Engineering subject is to imbibe Design Thinking approach into core engineering subject for practical learning, (2) they will use Design Thinking process again to refine their learning and (3) some of the existing solutions will be modified/redesigned through

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DE projects which can be helpful to user/society. In this module also whole Design Thinking process will be used by students, but more emphasis on Ideation and initial Product Development phases. The content is divided into week-wise activities to better understand the course and to give enough time to all the learning aspects, but depending upon the type and nature of projects, students and guide may allocate more/less time to the activities.

Students in 4th semester need to follow week-wise activities as mentioned below to complete course requirements.

Design Thinking Process – with Tools & Techniques			
Module 2 (DE-1B): Applying Design Thinking			
Broad segment	Week	Description	Operational need
Domain/Topic Selection	1	- Branch Specific existing topic selection for Reverse Engineering (This topic must be different from 3rd sem topic) - Team Selection (you may change your team member here in 4th sem)	- Brief lecture/exercise - In this semester, student will use Design Thinking process learnt in 3rd semester to modify the selected RE topic
Reverse Engineering (RE)	2, 3	- Reverse Engineering – Detailed study for Branch Specific topic - Dissemble the existing selected artefact/product/component/process/system to study technical aspects and design detail involved - Identify issues related to existing solutions	- Brief lecture/exercise - Hands-on practice sessions with cases /examples - Reverse engineering document link is given in General Guidelines document
Empathization Phase	4, 5	Observation: Through AEIOU framework and other Ethnography tools available Immerse via Role Playing Interview: ✓ Formal and Informal interview ✓ Students may use Stanford	- Students need to visit their domain/place where they can interact with user for getting insights. - Here, observation can be of direct user of the selected solutions, manufacturer and dealer or from point of view

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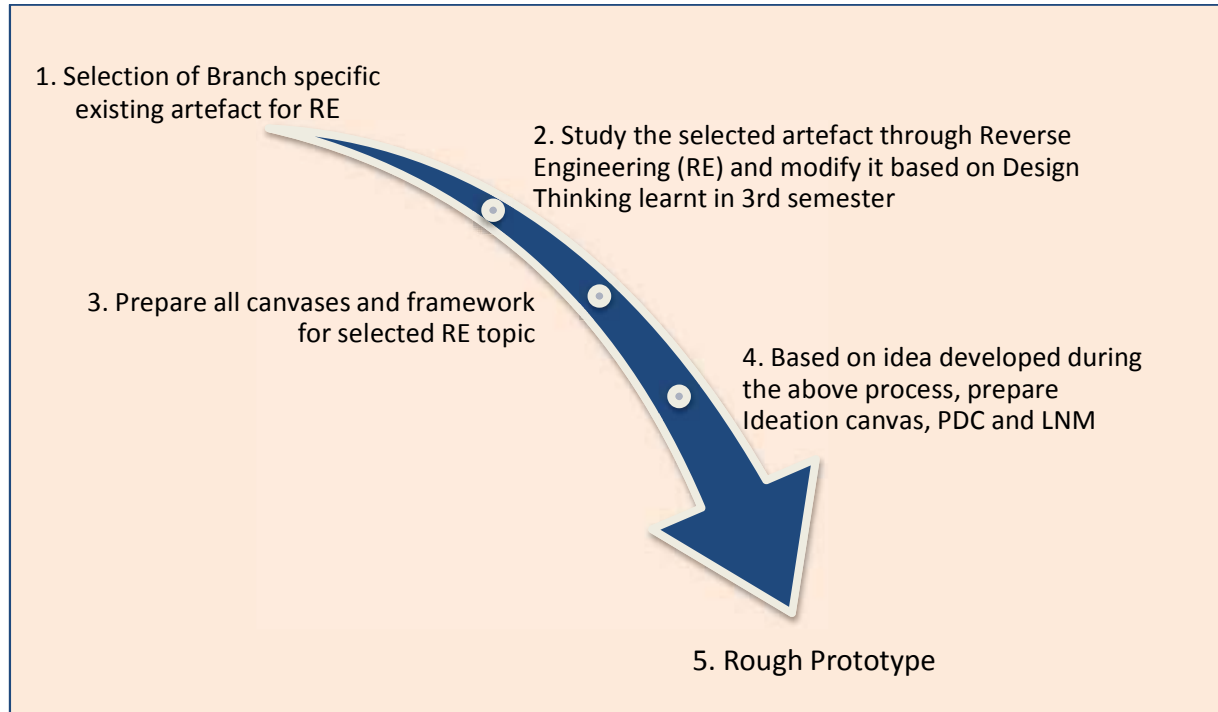
		methods given in below link - http://dschool.stanford.edu/wp-content/uploads/2013/10/METHO DCARDS-v3-slim.pdf ○ Modification for existing artefact/product/component/process/system based on User's need ○ Preparation of Mind Map, Empathy Map ○ Secondary research/Prior art search (prior art search is continuous 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	of repairer/maintenance person/services provider. Minimum 3-4 field trips will be required to get better insights on users' needs. ○ Based on User's need, students need to redesign/modify the selected existing artefact/product/component/process/system for RE
Note: For details of activities on various phases, students should consider the 3rd semester week-wise guideline, as Design Thinking process will be same with different projects.			
Ideation Phase	6, 7, 8	○ Preparation of Ideation canvas based on modification considered at Empathy phase ○ Learning Tools: ✓ Learning by analogy, artefactual, heuristic and gestalt model ○ Combination of Ideas from Ideation canvas ○ Sketching of rough ideas ○ Preparation of Ideation canvas	○ Students will work on their Ideation canvas ○ Ideation activities shall be performed in class with team members under guidance of teacher

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Product Development Phase	9, 10	○ Preparation of Product Development Canvas (PDC) to modify existing product ✓ Product Experience ✓ Product Functions ✓ Product Features ✓ Components ○ Discussion on PDC	○ Students will work on their PD canvas (min 3 hour continuous workshop) ○ Students team will discuss on their PDC with other groups and faculty guide and get the feedback ○ Refinement of PDC after discussion
	11	○ Customer/User Revalidation (Reject/Redesign/Retain) ○ Refinement	○ Till 12th week of course, student team will consult Users/Stakeholders for their inputs on concept and incorporate necessary changes
Pre-Design & Rough Prototype	12, 13	○ Learning Need Matrix (LNM) ○ Detail design and refinement ○ Prototype (Here strategy is to fail fast to succeed fast)	○ Building the solutions exercises ○ Iterate, Iterate, Iterate..... ○ LNM document link is given in General Guidelines document
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

Description of activities for DE – 1B (4th semester)



Reverse Engineering (Tear Down Lab approach)

Reverse Engineering, also called as *Back Engineering*, is the processes of extracting knowledge or design information from anything man-made and re-producing it or reproducing anything based on the extracted information. The process often involves disassembling something (a mechanical device, electronic component, computer program, or biological/chemical/organic matter) and analysing its components and workings in detail ^[1].

^[1] https://en.wikipedia.org/wiki/Reverse_engineering

Steps need to follow for Reverse Engineering (but not limited to, it may vary as per selected topic/project):

1. Select branch specific existing artefact/component/process/system/solution
2. Disassemble/Understand it for learning the technical/engineering aspects involved in it
3. Identify issues related to selected existing solution and try to modify it using Design Thinking approach
4. Apply Design Thinking approach to find out the Unmet needs of User related to selected artefact/component

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5. Follow phases of Observation, Empathy, Ideation and Product Development by preparing related canvases/frameworks
6. Modify/redesign the artefact/component to meet Users unmet needs

Activity 01 - Select Branch Specific artefact/component and disassemble it

Each group has to select one branch specific existing artefact/component/process/system/solution for reverse engineering activity for their DE-1B project and modify the same based on extracted information as per User's needs. This activity is to learn about some basic technical aspects involved in designing something related to particular branch.

After *Reverse Engineering study*, with extracted information from branch specific artefact/component, Students' team need to apply Design Thinking approach learnt in 3rd semester (all phases of 3rd semester DE-1A would repeat here) to modify/redesign that selected artefact/component based on User's unmet needs. Here one need to make all canvases and framework again as topic is different than 3rd semester.

Activity 02 – User Feedback based refinement and redesign (Using Design Thinking Process learnt in 3rd semester, for further refinement of learning)

After Reverse Engineering phase, Students must have to verify their identified problems of selected artefact/component with the user before investing their time and efforts further. This will help students to verify their concepts and help in clarifying the insights that they need for implementing their idea. Students will visit the domain/area of their selected artefact/component for reverse engineering and verify their modification approach taken up in the PD canvas with the user for functions, features and components. At this stage, one may find that one has to modify the prepared Canvases on the basis of feedback given by user.

After carrying out the feedback analysis, students are required to verify the important aspects, in line with the context of five principles, namely:

- i. Technological,
- ii. Aesthetic,
- iii. Ergonomics,
- iv. Environment, and
- v. Cost.

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For the design problem, each of their components, functions and features of the proposed solution will be checked using the above five principles. This verification may lead to modification and improving of the concept.

Activity 03 - Prior art search

Each student will search at least 2 most relevant research and development work through journals, patent databases, literature of similar products and any other resource, which can provide information related to their product/ idea/ concept. The students are expected to read thoroughly these documents and make a summary (2-3 pages) of the work described in the documents in their own words. *This exercise will ensure, to some extent, the novelty of the idea, as well as enable students to understand on-going works in the field, relevant to their project.*

Phase 2: Pre-Design

Now, after getting feedback from Users on the modification requirements and finalization on the concept, students need to work on Pre-Design phase. Basic Pre-design calculations which roughly decide size/shape/material requirements/manufacturing process/design specifications/applicable standards etc. needs to be identified. Students' need to work on identifying the learning needs in Phase 2 that would help to complete the projects further as well as in their professional career. These needs would be mostly industrial/practical needs which are not included in the regular BE syllabus and are important for the students' to learn these skillsets required by the industry.

Activity 04 - Learning Need Matrix (LNM)

Learning Needs Matrix will help students to **identify the learning requirements that are much needed in industry or in their career** at an early stage along with *prioritization of specific learning*. Every students individually or in team, with the guidance of their Faculty Guide/Industry mentor, would identify the industrial skills for the generic learning. The learning requirements may depend upon and may be specific for the concept/idea for their solution **or** completely independent as per their choice and the field in which they wish to pursue their career. This will help students to do the research in a timely manner so that they are able to obtain the specific learning/ understanding, they would require for designing the product/solutions.

With understanding of the basic branch/ project related subjects, (after having discussions with and the guidance of their Faculty Guide) students will be able to identify *tools/ use of software/ applicable standards/ material / design specifications/ theories/ principles/ methods/ experiments* related needs to be acquired by them to complete their projects successfully or to

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succeed in their professional career after graduation. Students can maintain the same LNM sheet till final year (8th sem) and learn the specific skill sets that they want to pursue at each semester. As per change in requirements and learning needs at each semester, LNM may be refined and versions of it shall be prepared and present to examiners during final viva exam. The semester wise allocation for each skill sets need to be done by students and guide. Priority learning shall be taken up as per the core subject of each semester. Internal Guide will track and evaluate the learnings of students through LNM. Students may co-learn the skill sets with other students.

Students need to make LNM and include it in their report. LNM would include four major aspects as below:

1. Theories/ Methods/ Application Process Involved/ Mathematical Requirement
2. Applicable Standards and Design Specifications/ Principles & Experiments
3. Software/ Tools/ Simulation Methods/ Skill
4. Components Materials' & strengths criteria (Exploration- varieties/testing requirements)

Basic instructions for LNM:

- a) The requirements of the core discipline should be identified, may be in relation with the topic of projects or independently, to better correlate the learnings. At the same time the group has to work out the learning needs of the inter-disciplinary domains. The learning **responsibilities shall be distributed** equally among the group members. Also all learnings requirement to be brought on a mutually fixed **timeline**.
- b) Here do not concentrate only the requirements that are useful for current project, but aim for gaining practical learning/skillset that is required by industry and not included in the syllabus and try to learn gradually all the required skills before graduation.
- c) Students (along with faculties) shall identify practical limitations due to non-coverage in syllabus to develop their product and focus on the same from the early stages (i.e. Sem. 4) so that development (manufacturing level detailing) of their project, as desired, can be finished.
- d) Student must learn **at-least one** component in Sem. 4 which may be learnt in greater details in the rest of the semesters. The students, with the help of the Faculty Guide, will need to prioritize the learning needs and the level of understanding required. However, basis of interest, students may learn more than one components identified in LNM.
- e) The students may prepare a comprehensive LNM for the learning needs for their interest/idea/concept/projects. Ideally, students need to prepare timeline for all the stages of LNM by the end of the 4th semester with aim of learning at least one component by each group members.

Proof of Concept

This would be the very early stage of prototyping technique where the objective is “To succeed faster, you need to fail fast” to save on energy, time and money. So failure in projects shall be welcomed by students and faculty members to learn from it.

Activity 05 – Dirty Mock-ups/ Fast-prototype/ Schematic plan

The students shall be preparing the rough prototype/ schematic plan on the product/ concept they wish to develop. Here, the students need to show the very basic design calculations/ mathematical aspects (estimated) in the process report, involved in the product development, based on which the rough prototype/ schematic plan has been prepared. The students shall be expressing their concept/idea in a clear and understandable form through description, figures, calculations, drawings, model etc. They may also use animations, pictures, drama, skits or video-clips to explain the idea. By doing this students will learn and understand the technical and feasibility aspects of their concept.

Upon preparation of the fast-prototype/ schematic plan on the concept they wish to develop, it needs to be verified by involving some actual users. The students may take their rough prototype to the user and discuss their conceptual thoughts and verify whether the user's expectations are along with the anticipated lines. This interaction may require the inclusion of any missing or overlooked functions and/or features. Based on such discussions, students will further perform refinement in their design.

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Submissions by the end of 4th semester shall be:

- A. Process Report comprising:
 - a. Introduction (Reverse Engineering (RE) – Selection and disassembling of artefact/component)
 - b. Images of canvases using Design Thinking based on reverse engineering exercise
 - c. Feedback analysis with the user shall be clearly included in the report
 - d. Summary of findings of Prior Art Search on their purpose/project theme (2 summary papers per student)
 - e. Summary of the learning from Reverse Engineering activity
 - f. Basic Pre-design calculation which roughly decided size/shape/material requirement/manufacturing process/design specifications/applicable standards
 - g. Summary on validation process and refinement in the first-prototype
 - h. 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. Learning Needs Matrix (LNM)
 - a. Summary on learning needs by students in the 4th Semester shall be included in report with allocation of learning requirements among the members of the group
 - b. With timeline and semester specific learning by team members
- H. Rough prototype model/Conceptual Plan-Layout for process related branches
- I. Individual Log Book (duly signed by faculty guide)
- J. 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.

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Appendix 1: The END SEMESTER Evaluation Scheme for

Design Engineering – 1B (3140005) (4th Semester)

BE – II year – all branches

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.

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PROCESS OF EVALUATION: At the ensuing 4th semester examinations, the work of the students in Design Engineering – 1B 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 4th 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.	Phase 1: Reverse Engineering (RE) ✓ Selection of Branch specific component/product/artefact/program ✓ Disassembly/Analysis of the component/product/artefact/program and learning about the topic	15
2.	User Feedback based refinement and redesign of the RE topic based on 3rd semester learning ✓ Understanding of User's need for Reverse Engineering topic and preparation of canvases/framework for this topic (AEIOU, Mind Mapping, Empathy mapping, ideation, product development) ✓ Prior art search (Two Papers study and summary reports) ✓ Summary of the learning from Reverse Engineering activity	15
3.	Phase 2: Pre-Design ✓ Learning Need Matrix (LNM) and the skill set learnt in this semester so far ✓ Basic Pre-design calculation which roughly decide size/shape/material requirement/manufacturing process/design specifications/applicable standards	15
4.	Phase 3: Proof of Concept ✓ Dirty Mock-ups/ Fast-prototype/ Schematic plan	15
5.	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

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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.

For any query & suggestions, kindly contact course coordinator:

Mr. Karmjitsinh Bihola, Assistant Professor,

Centre for Industrial Design, GTU.

Email: design@gtu.edu.in

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