SCHEME OF INSTRUCTION AND SYLLABI (R-20)

OF

B.TECH. I & VIII SEMESTERS

IN

BIOTECHNOLOGY

(For the batch admitted in 2020-21)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)
Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad- 500 075. Telangana
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

B.TECH. – BIOTECHNOLOGY

INSTITUTE VISION AND MISSION

Vision: To be centre of excellence in technical education and research

Mission: To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION

Vision: To excel in education, research and entrepreneurship in various fields of Biotechnology for contribution to the evolving needs of the society

Mission:

- To provide an excellent educational experience to the undergraduate students of Biotechnology through quality teaching and advanced curriculum with roots into the fundamentals, that enables students to become leaders in their chosen field of Biotechnology
- To provide vibrant learning and research environment that enables students to focus on lifelong learning to transform into entrepreneurs, and renowned researchers
- To instil the spirit of innovation and creativity in young minds through participation in International and National level conferences/hackathons combined with a deep awareness of ethical responsibilities to profession and society

PROGRAM EDUCATIONAL OBJECTIVES (PEOS):

The Biotechnology department is dedicated to graduating engineers who,

- will demonstrate successful careers in industry through scientific thinking, interpreting, analysing experimental results and purse higher education and research in reputed national and international institutes.
- will demonstrate leadership and initiative to advance professional and organizational goals with commitment to ethical standards of profession, teamwork and respect for diverse cultural background
- will be involved in lifelong /self-learning to keep abreast with the constantly evolving technologies for establishing start-ups and becoming successful entrepreneurs.
- will be committed to creative practice of engineering and other professions in a responsible manner contributing to the socio-economic development of the society.

PROGRAM SPECIFIC OUTCOMES (PSOS):

Student should be able to

- Apply the concepts of Biotechnology in the fields of health care, agriculture, biofuels, food industry and other relevant areas
- Demonstrate adequate proficiency of good lab practices by adopting standard operating protocols and illustrate independent, safe and accurate handling of the biotechnology lab equipment

ABOUT THE DEPARTMENT:

The Department of Biotechnology is offering undergraduate program for students with an intake of 60. The department has grown in leaps and bounds, since its inception in the year 2005.The department has spawned brilliant chemical engineers, scientists and biotechnologists. Department keeps churning out talent on a regular basis, with its well designed curriculum and exceptionally qualified faculty catering the various needs viz. Research, Higher studies and Entrepreneurship of graduating students. The present curriculum being practised from current academic year 2020-21 is adopted from AICTE model curriculum prescribed for Biotechnology by AICTE in 2019. Inputs from stakeholders' viz. Alumni, Industry personnel are taken into consideration for including the thrust areas/topics that are required for the student to be industry ready.

With effect from Academic Year 2020-21

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of I Semester of B.Tech. – Biotechnology as per AICTE Model Curriculum 2020-21

DEPARTMENT OF BIOTECHNOLOGY

SEMESTER–I

S.No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
3 WEEKS COMPULSORY INDUCTION PROGRAM									
	THEORY								
1	20MT C21/ 20BT C01	Mathematics-I/ Basics of Biology-1	3	1	-	3	40	60	4
2	20EGC01	English	2	-	-	3	40	60	2
3	20PY C02	Physics	3	–	-	3	40	60	3
4	20CS C01	Programming for Problem Solving	2	1	-	3	40	60	3
	PRACTICALS								
5	20PY C04	Physics lab	-	-	4	3	50	50	2
6	20EG C02	English lab	-	-	2	3	50	50	1
7	20CS C02	Programming for Problem Solving lab	-	-	4	3	50	50	2
8	20ME C01	CAD & Drafting	-	1	3	3	50	50	2.5
9	20MBC02	Community Engagement	30 field + 2P/W			-	50	-	1.5
Total			**10**	**3**	**13**	24	**410**	**440**	**21**
Clock Hours Per Week –28									

L: Lecture **T: Tutorial** **P: Practical**

CIE- Continuous Internal Evaluation **SEE- Semester End Examination**

20MT C21

MATHEMATICS– I
(Bio Tech- BiPC Stream)

Instruction:	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES:

1. To discuss elementary transformations of trigonometric functions.
2. To explain basics of limit and continuity of the functions.
3. To explain differentiation of the basic functions
4. To discuss matrix methods to solve system of linear equations.
5. To discuss the exact roots of Cubic and Bi-quadratic equations.

COURSE OUT COMES: Upon completing this course, students will be able to:

1. Calculate the elementary transformations of trigonometric functions.
2. Evaluate the limit and Continuity of the functions
3. Calculate the differentiation of functions.
4. Apply the matrix methods to solve the system of linear equations.
5. Solve the Cubic and Bi-quadratic equations.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1					1	1		1	1	1	
CO2	2	2	1					1	1		1	1	1	
CO3	2	2						1	1			1	1	
CO4	2	2						1	1			1	1	
CO5	2	3						1	1			1	1	

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Trigonometry: Review of basics of Trigonometry, Compound angles and multiple and sub multiple angles, Transformations-sum and product rules, Hyperbolic and Inverse Hyperbolic functions.

UNIT-II

Function, Limits and Continuity: Functions ($Sin\,x, Cos\,x\ e^x, logx$) Intervals and neighbor hoods, limits and concept of a limit. Standard limits and related problems.

UNIT-III

Differentiation: Derivatives of a function, Elementary properties. Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic and inverse Hyperbolic functions, Methods of differentiation, second and higher order derivatives.

UNIT-IV

Matrices: Types of matrices, multiplication of matrices, scalar multiplication, Inverse of matrix-determinant, singular, non-singular, minor, cofactors, adjoint, Rank-Echelon form, consistency and inconsistency Solutions of simultaneous linear equations.

UNIT-V:

Theory of Equations: Relation between roots and the co-efficient in an equation, solution of the equation when two or more of its roots are connected by certain relations.

TEXT BOOKS:

1. Shanti Narayanand Mittal P.K.," Differential Calculus" , 30th edition, S Chand publishers,2005.
2. A.R.Vasistha, "Matrices", 43rd edition, Krishna Prakashan Media (P) Ltd.2014.
3. Hall and Knight " Higher Algebra" Arihant Publications,2016.

SUGGESTED READING:

1. N P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", 9thEdition, Laxmi publishers, 2016.
2. Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers, 2016.
3. KantiB.Datta,"MathematicalMethodsofScienceandEngineering",CENGAGELearningpublishersWith effect from the Academic Year 2020-21.

20BT C01

BASICS OF BIOLOGY - I
(for MPC Stream of Bio-Tech)

Instruction:	3 L+1T Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	4

COURSE OBJECTIVES:

1. To give understanding of fundamentals of origin of life and various theories of evolution.
2. To give an insight of plant cell and its organelles
3. To provide a knowledge on classification of plants and their propagation mode.
4. To give the students an understanding of knowledge on microbes and their economic importance.
5. To impart theoretical knowledge on various physiological aspects of plants.

COURSE OUTCOMES: At the end of the course student will be able to

1. Explain the theories behind the origin of life and evolution studies (BL2).
2. Describe the structure and functions of plant cell and its organelles (BL1)
3. Relate the plants based on the habit and habitat and mechanism of seed development in plants (BL1).
4. Explain the different classification, mode of reproduction, economic importance of microbes (BL2)
5. Describe the basic physiological processes in plants and various methods of crop improvement (BL1).

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1		1	1		1	1	0	2	1	1
CO2	2	2	1	1	1	2	2		1	1	0	2	2	3
CO3	2	2	1	1	1	2	2		1	2	0	2	2	3
CO4	2	2	3	2	2	3	3	1	2	2	1	3	3	3
CO5	2	2	2	2	2	3	3	1	2	2	1	3	3	2

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

History of Life and Evolution: History of earth, evolutionary concepts of origin of life. Experimental verification of chemical origin of life - Miller's Experiment. Darwinism, Natural selection, Sexual selection, Artificial selection, Mendelism, Hugo de Vries mutation theory, Neo-Darwinism.

UNIT-II

Cell Structure and Internal Organization of Plants: Cell as basic unit of life, overview of the plant cell, cell cycle, cell division, mitosis and meiosis. Concept of Growth, meristems (apical, intercalary and lateral) their functions. Simple tissue (parenchyma, collenchyma and sclerenchyma), complex tissues (xylem and phloem). Tissue systems (epidermal, ground and vascular)

UNIT-III

Plant Systematic and Reproduction: Plant kingdom, salient features of classification. Alternation of generation of the plants. Type studies of Algae (Spirogyra), Fungi (Rhizopus), Bryophytes (Pteris), Gymnosperms (Cycas) and general characteristics and life cycle of Angiosperms. Overview of modes of reproduction-Asexual: vegetative propagation, budding, sporulation, binary fission; Sexual reproduction: pollination, fertilization, development of embryo, endosperm, fruit and seed formation. Apomixes, parthenocarpy, polyembryony type of reproduction.

UNIT-IV

Introduction to Microbial World: Introduction and importance of classification-five kingdoms (Protista, Fungi, Plantae and Animalia). General account of prokaryotes. Concept of species and strains. Sterilization and media compositions. Bacterial viruses - T4, plant viruses – TMV, animal viruses – HIV. Reproduction in bacteria (asexual
- binary fission and sexual - conjugation) and viruses (lytic and lysogenic). Economic importance of beneficial bacteria (agriculture, industry, medicine and biotechnology).

UNIT-V

Plant Physiology and Concepts in Plant Biotechnology: Absorption of water – soil water, water potential, diffusion, imbibitions, osmosis, plasmolysis, absorption of water, ascent of sap, transportation. Crop improvement - Heterosis and mutation breeding. Plant tissue culture techniques and their applications. Plant growth regulators.

TEXT BOOKS:

1. Ray F. Evert, Susan E. Eichhorn "Raven Biology of Plants": W. H. Freeman 2012. Tata McGraw Hill Publishing Co. Pvt. Ltd 9th edition, (2010).
2. Campbell, N.A., Reece, J.B., Urry, Lisa, Cain, ML, Wasserman, S.A., Minorsky, P.V., Jackson, R.B. "Biology: A Global Approach", 11th edition, Pearson Education Ltd. (2017).

SUGGESTED READING:

1. Willey, J. M., Sherwood, L., Woolverton, C. J., Prescott, L. M., & Willey, J. M. "Prescott's microbiology". New York: McGraw-Hill. 6th Edition (2011).

20EGC01

ENGLISH

Instruction	2LHours per Week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic knowledge of English grammar and vocabulary.

COURSE OBJECTIVES: This course will introduce the students:

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal Emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

COURSE OUTCOMES:
After successful completion of the course the students will be able to:

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques.

CO-PO ARTICULATION MATRIX

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						1		2	3		2	1	2	
CO2								3	3		1	1	2	
CO3						1	2	3	3	1	2	1	2	
CO4			1			1		2	3	2	1	2	2	
CO5								2	3	2	2	1	1	

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Understanding Communication in English: Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I: Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III

Developing Writing Skills II: Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response.

Vocabulary and Grammar: Subject-verb agreement.

Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV

Developing Writing Skills III: Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.

Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V

Developing Reading Skills: The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

Vocabulary and Grammar: Words often Confused; Use of standard abbreviations.

TEXT BOOKS:

1. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.
2. Swan Michael, "Practical English Usage",OUP, 1995.

SUGGESTED READINGS:

1. Wood F.T, "Remedial English Grammar", Macmillan, 2007.
2. Zinsser William, "On Writing Well", Harper Resource Book, 2001.
3. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, 2011.

With effect from Academic Year 2020-21

20PY C02

PHYSICS

Instruction:	3 L Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

The objectives of the course is to make the student

1. Learn the basic concepts of wave nature of light
2. Know about the properties of magnetic and dielectric materials
3. Understand the basics of nanomaterials
4. Familiarize with fundamental ideas of quantum mechanics

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. Analyse the wave nature of the light by correlating theoretical concepts with experimental results.
2. Categorize lasers and optical fibres for real time applications..
3. Identify magnetic and dielectric materials for engineering applications.
4. Make use of properties of nanomaterials for technological applications.
5. Interpret the dual nature of light and its quantum effects.

CO-PO/PSO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	1	2	2	1	1	2	1	2	0	1
CO2	3	1	2	1	2	2	2	1	2	2	2	2	1	1
CO3	2	2	1	1	1	1	1	1	1	2	1	2	1	0
CO4	3	2	2	2	2	2	2	1	1	2	1	2	0	1
CO5	3	2	2	2	2	1	1	2	1	2	1	2	1	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Wave Optics: Huygens' principle – Superposition of waves – Interference of light by splitting of wavefront and amplitude – Fresnel's biprism – Interference in thin films (reflected light) – Newton's rings – Fraunhofer diffraction from a single slit – Double slit diffraction – Concept of N-slits – Diffraction grating and its resolving power. Polarization: Introduction – Malus's law – Double refraction – Nicol's prism – Quarter-wave plate and half-wave plate – Optical activity – Laurent's half shade polarimeter.

UNIT-II

Lasers: Characteristics of lasers – Einstein's coefficients – Amplification of light by population inversion – Ruby laser – He-Ne laser – Semiconductor laser – Applications of lasers in engineering and medicine.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle – Step-index and graded-index fibers – Pulse dispersion – Fiber losses – Fiber optic communication system – Applications.

UNIT-III

Dielectric Materials: Introduction – Dielectric polarization – Types of dielectric polarization: electronic &ionic polarizations (quantitative); orientation & space-charge polarizations (qualitative) – Frequency and temperature dependence of dielectric polarization – Determination of dielectric constant (Schering bridge method) – Ferroelectricity – Barium titanate – Applications of ferroelectrics.

Magnetic Materials: Origin of magnetism – Magnetic moment - Bohr magneton – Classification of magnetic materials: dia, para, ferro, anti-ferro and ferrimagnetic materials – Weiss molecular field theory – Domain theory – Hysteresis curve – Soft and hard magnetic materials – Applications.

Nanomaterials: Properties of materials at reduced size – Surface to volume ratio – Quantum confinement – Preparation of nanomaterials: bottom-up approach (sol-gel method) and top-down approach (ball milling method) – Elementary ideas of carbon nanotubes – Applications of nanomaterials.

UNIT-V

Quantum Mechanics: Introduction – Planck's' law of black body radiation – Wien's law and Rayleigh-Jean's law from Planck's law – Photoelectric effect – Compton effect – de-Broglie hypothesis – Wave-particle duality – Physical significance of ψ – Born's interpretation of the wave function – Verification of matter waves by Davisson-Germer's experiment – Uncertainty principle – Schrodinger wave equation (time-dependent and time-independent) – Particle in infinite square well potential.

TEXT BOOKS:

1. B.K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, *A Text BookEngineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTED READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, McGahill Education Publications, 2013.
3. P.K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

20CS C01

PROGRAMMING FOR PROBLEM SOLVING
(Common to All Programs)

Instruction:	2L+1T Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

The objectives of this course are

1. Identification of computer components, Operating environments, IDEs.
2. Understanding the steps in problem solving and formulation of algorithms to problems.
3. Develop programming skillsasameans of implementing an algorithmic solution with appropriate control and data structures.
4. Develop intuition to enable students to come up with creative approaches to problems.
5. Manipulation of text data using files.

COURSE OUTCOMES:

On Successful completion of the course, students will be able to:

1. Identify and understand the computing environments for scientific and mathematical problems.
2. Formulate solutions to problems with alternate approaches and represent them using algorithms / Flowcharts.
3. Choose data types and control structures to solve mathematical and scientific problem.
4. Decompose a problem into modules and use functions to implement the modules.
5. Apply arrays, pointers, structures, and unions to solve mathematical and scientific problems.
6. Develop applications using file I/O.

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	2							1	1	2		
CO2	3	3	3	2			1			1	1	2		
CO3	2	2	2	1	1					1		2		
CO4	3	3	3	2	3					1	1	2		
CO5	3	2	2	1	2					1		2		
CO6	3	3			3					3		3		

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Introduction to computers and Problem Solving: Components of a computer, Operating System, Compilers, Program Development Environments, steps to solve problems, Algorithm, Flowchart / Pseudo code with examples.

Introduction to programming: Programming languages and generations, categorization of high-level languages.

Introduction to C: Introduction, structure of C program, keywords, identifiers, Variables, constants, I/O statements, operators, precedence, and associativity.

UNIT–II

Introduction to decision control statements: Selective, looping and nested statements.

Functions:Introduction,usesoffunctions,Functiondefinition,declaration,passing parameters to functions, recursion, scope of variables and storage classes,

Case study using functions and control statements.

UNIT–III

Arrays: Introduction, declaration of arrays, accessing and storage of array elements, 1-dimensional array, Searching (linear and binary search algorithms) and sorting (Selection and Bubble) algorithms, 2-D arrays, matrix operations.

Strings: Introduction, strings representation, string operations with examples.

Case study using arrays.

UNIT–IV

Pointers: Understanding computer's memory, introduction to pointers, declaration pointer variables, pointer arithmetic, pointers and strings, array of pointers, dynamic memory allocation, advantages, and drawbacks of pointers.

Structures: Structure definition, initialization and accessing the members of a structure, nested structures, structures and functions, self- referential structures, unions, and enumerated data types.

UNIT-V

Files: Introduction to files, file operations, reading data from files, writing data to files, error handing during file operations.

Pre-processor Directives: Types of pre-processor directives, examples.

SUGGESTED READING:

1. M.T. Somashekar "Problem Solving with C", 2nd Edition, Prentice Hall India Learning Private Limited 2018
2. AK Sharma "Computer Fundamentals and Programming", 2nd Edition, University Press, 2018
3. Pradeep Deyand Manas Ghosh, "Programming in C", Oxford Press, 2nd Edition, 2017

REFERENCES:

1. Byron Gottfried, Schaum's "Outline of Programming with C", McGraw- Hill.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
3. E. Balaguruswamy, Programming in ANSIC, Tata McGraw-Hill.
4. Reema Tharaja "Introduction to C Programming", Second Edition, OXFORD Press, 2015.
5. https://www.tutorialspoint.com/cprogramming/index.htm.
6. https://onlinecourses.nptel.ac.in/noc18-cs10/preview.

20PY C04

PHYSICS LAB

Instruction:	4P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2

COURSE OBJECTIVES:

The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the physical properties of magnetic and dielectric materials
4. Familiarize with motion of electrons in electric and magnetic fields

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. Interpret the errors in the results of an experiment.
2. Demonstrate the wave nature of light experimentally
3. Utilize physical properties of magnetic and dielectric materials for various applications
4. Make use of lasers and optical fibers for engineering applications
5. Explain light induced phenomenon and motion of electrons in electric and magnetic fields

CO-PO/PSO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	3		1	1	2					2	1
CO2	3		2		1	2	2	2						
CO3	1	2	2	2		1	1						1	1
CO4	2	3	2	1	2	2	2						1	
CO5			2	2		2	2							

1 - Slightly, 2 - Moderately, 3 - Substantially

Experiments

1.	Error Analysis	:	Estimation of errors in the determination of time period of a torsional pendulum
2.	Fresnel's Biprism	:	Determination of wavelength of given monochromatic source
3.	Newton's Rings	:	Determination of wavelength of given monochromatic source
4.	Single Slit Diffraction	:	Determination of wavelength of given monochromatic source
5.	Diffraction Grating	:	Determination of wavelengths of two yellow lines of light of mercury lamp
6.	Malus's Law	:	Verification of Malus's law
7.	Double Refraction	:	Determination of refractive indices of O-ray and E-ray of given calcite crystal
8.	Polarimeter	:	Determination of specific rotation of glucose
9.	Laser	:	Determination of wavelength of given semiconductor laser
10.	Optical Fiber	:	Determination of numerical aperture and power losses of given optical fiber
11.	Dielectric constant	:	Determination of dielectric constant of given PZT sample
12.	M & H Values	:	Determination of magnetic moment M of a bar magnet and absolute value H of horizontal component of earth's magnetic field
13.	B-H curve	:	Determination of hysteresis loss of given specimen
14.	Planck's constant	:	Determination of Planck's constant using photo cell
15.	e/m of an Electron	:	Determination of specific charge of an electron by J.J. Thomson method

NOTE: A minimum of TWELVE experiments should be conducted

20EG
C02

ENGLISH LAB

(Common to all branches)

Instruction:	2P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	1

COURSE OBJECTIVES: This course will introduce the students:

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To IELTS and TOEFL material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behaviour while developing their ability to discuss in groups and making oral presentations.

COURSE OUTCOMES: After successful completion of the course the students will be able to:

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze IELTS and TOEFL listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO/PSO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1								1	1	2	1	3		
CO2						1		1	2	2	1	3		1
CO3						1		1	2	1	1	2	1	2
CO4	1	1	1	1	1	2		1	2	3	1	3	1	2
CO5		1	1	1	1	2		2	3	3	1	3	1	2

1 - Slightly, 2 - Moderately, 3 - Substantially

Exercises

1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English:** Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm &Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** — Practice with IELTS and TOEFL material
6. **Public speaking** — Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** — weaving an imaginative story around a given picture.
9. **Information Gap Activity** — Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation** — Theme, poster preparation, team work and presentation.

Suggested Reading

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt. Ltd., 2011
4. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016

20CS C02

PROGRAMMING FOR PROBLEM SOLVING LAB
(Common to All Programs)

Instruction:	4P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2

COURSE OBJECTIVES:

The objectives of this course are

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate C programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in a modular fashion.
6. Manage data using files.

COURSE OUTCOMES:

On Successful completion of the course students will be able to:

1. Identify and setup program development environment.
2. Design and test programs to solve mathematical and scientific problems.
3. Identify and rectify the syntax errors and debug program for semantic errors
4. Implement modular programs using functions.
5. Represent data in arrays, pointers, structures and manipulate them through a program.
6. Create, read, and write to and from simple text files.

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2	1	1	1		1	1	1	1	1		
CO2	3	2	3	2	2	1		1	2	1	1	2		
CO3	3	2	2	3	2				1	2		2		
CO4	3	2	3	2	2				1	1	2	3		
CO5	3	2	2	1	2					1		1		
CO6	3	3			3					3	1	3		

1 - Slightly, 2 - Moderately, 3 - Substantially

Lab experiments

1. Familiarization with programming environment.
2. Simple computational problems using arithmetic expressions.
3. Problems involving if-then-else structures.
4. Iterative problems e.g., sum of series.
5. 1D Array manipulation.
6. 2D arrays and strings.
7. Matrix problems, String operations.
8. Simple functions.
9. Recursive functions.
10. Pointers and structures.
11. Dynamic memory allocation and error handling.
12. File handling:

Design the experiments in such a way that the students will be able to end up the solution for a real world problem that uses most of the concepts of C programming language. For example: A banking application where it uses the concepts of operators, control structures, switch case for menu, structures, functions, error handling, files etc.

SUGGESTED READING:

1. Pradeep Deyand Manas Ghosh,"Programming in C", Oxford Press, 2nd Edition, 2017.
2. Reema Tharaja "Introduction to C Programming", Second Edition, OXFORD Press, 2015.

REFERENCES:

1. https://www.tutorialspoint.com/cprogramming/index.htm
2. https://www.w3resource.com/c-programming/programming-in-c.php
3. https://www.w3schools.in/c-tutorial/

With effect from the Academic Year 2020-21

20ME C01

CAD AND DRAFTING

Instruction:	1T + 3P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2.5

COURSE OBJECTIVES:

1. To get exposure to a cad package and its utility
2. Understanding orthographic projections
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice

COURSE OUTCOMES:

At the end of the course, the Students are able to

1. Become conversant with appropriate use of CAD software for drafting
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO ARTICULATION MATRIX

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	1	2	2	2	1	2	3	1	3	2	2
CO2	3	2	2	1	2	2	2	1	2	2	1	2	2	2
CO3	3	3	2	1	2	2	2	1	2	2	1	2	3	2
CO4	3	3	3	2	2	2	2	1	2	2	1	2	3	2
CO5	3	2	2	1	2	2	2	1	2	2	1	2	3	2

1 - Slightly, 2 - Moderately, 3 - Substantially

List of exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice versa.

TEXT BOOKS:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L.Narayana and P.K.Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

20MBC02

COMMUNITY ENGAGEMENT

Instruction	3 Hours per week (30 hours field work & 2 Practical hours per week)
SEE	Nil
CIE	50 Marks
Credits	1.5 Credits

COURSE OBJECTIVES: The main Objectives of this Course are to:

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

COURSE OUTCOMES: After the completion of this Course, Student will be able to:

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

CO-PO/PSO ARTICULATION MATRIX

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	2	2		3	3	1	2			2	2	
CO2		1	2	2		2	2		2	1		1	1	
CO3		1	1	2		3	3	1	3	1	2	1	1	
CO4	2	2	3	2		2	2	1	2	2	1			
CO5	1	2	2	1		2	2		1		1	1	1	

1 - Slightly, 2 - Moderately, 3 - Substantially

Module I Appreciation of Rural Society

Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood

Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions

Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes

History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

TEXT BOOKS:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

JOURNALS:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

With effect from Academic Year 2020-21

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of II Semester of B.Tech. - Biotechnology as per AICTE Model Curriculum 2020-21

B.TECH. - BIOTECHNOLOGY

SEMESTER–II

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1	20MT C22/ 20BT C02	Mathematics –II/ Basics Of Biology-II	3	1	-	3	40	60	4
2	20CY C01	Chemistry	3	0	-	3	40	60	3
3	20EE C01	Basic Electrical Engineering	3	-	-	3	40	60	3
4	20BT C03	Process Principles and Reaction Engineering	3	-	-	3	40	60	3
	PRACTICALS								
5	20CY C02	Chemistry lab	-	-	4	3	50	50	2
6	20EE C02	Basic Electrical Engineering lab	-	-	2	3	50	50	1
7	20ME C02	Workshop/Manufacturing Practices	-	-	5	3	50	50	2.5
8	20ME C03	Engineering Exploration	90 Hours / 4P			-	50	-	1.5
		Total	**12**	**1**	**15**	**21**	**360**	**390**	**20**
Clock Hours Per Week 26									

L: Lecture **T: Tutorial** **P: Practical**

CIE-Continuous Internal Evaluation **SEE-Semester End Examination**

20MTC22

MATHEMATICS–II
(Bio-Tech BiPC Stream)

Instruction:	3 L+1T Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES:

1. To discuss the basic operations in Vector Algebra.
2. To discuss Physical interpretations on Scalars and vector functions.
3. To explain various methods of partial fractions.
4. To explain various techniques of integration.
5. To discuss the solutions of first order differential equations.

COURSE OUTCOMES:

Upon completing this course, students will be able to:

1. Apply the basic operations on Scalar and Vectors.
2. Apply the vector differential operators to Scalars and Vector functions.
3. Solve partial fractions by various methods.
4. Evaluate definite and indefinite Integral.
5. Solve the first order ordinary differential equations.

CO-PO ARTICULATION MATIRX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1					1	1		1	1		
CO2	3	2	1					1	1		1	1		
CO3	3	2						1	1			1		
CO4	3	2	1					1	1			1		
CO5	3	2	1					1	1			1		

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I: Vector Algebra

Addition of vectors, scalar multiplication, angle between two non-zero vectors, linear combination of vectors, component of vectors in three dimensions, scalar product geometrical interpretations, orthogonal projections, properties of dot product, angle between two vectors, vector product of two vectors and properties, scalar triple product, vector triple product.

UNIT-II: Vector Calculus

Definitions, scalar and vector point functions, vector differential operator, Gradient, Divergence and Curl, Solenoidal and Irrotational vectors, properties of gradient, divergence and curl (vector identities)

UNIT- III

Partial Fractions: Resolving $f(x)/g(x)$ in to partial fractions, $g(x)$ contains non repeated linear factors, $g(x)$ contains repeated and non-repeated linear factors, $g(x)$ contains non repeated irreducible factors, $g(x)$ contains repeated and not repeated irreducible factors.

UNIT - IV

Integration: Simple integrations of algebraic, trigonometric and exponential. Methods of integration, integration by parts, integration of rational, irrational and Trigonometric functions, definite integrals.

UNIT- V

Differential Equations: Formation of Differential equations, Solutions of First order and first degree differential Equations, Variable Separable, Homogeneous, Linear, Bernoulli and Exact differential Equations.

TEXT BOOKS:

1. Shanti Narayan"vector Calculus", S. Chand publishers,2003.
2. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, KhannaPublishers, 2014.

SUGGESTED READING:

1. William E. Boyce /Richard C.Dip, "Elementary differential equations", 9th Edition, Wiley publishers,2008.
2. Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers, 2016.

20BTC02

BASICS OF BIOLOGY - II
(for MPC Stream of Bio-Tech)

Instruction:	3 L +1T Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	4

COURSE OBJECTIVES:

1. To impart theoretical knowledge on animal cell, tissues their types and level organization
2. To provide knowledge on basic concepts of Biology and basis of animal kingdom classification.
3. To provide knowledge on various parasites, lifecycle and diseases caused by them.
4. To impart knowledge on ecology, environment and biotic interactions in nature
5. To give an insight on genes, chromosome, blood grouping system, and gene expression

COURSE OUTCOMES:

By the end of the course students be able to

1. Identify the basic structure, function of various animal cell organelles, level of organization and types of tissues in animals (BL4).
2. Explain the criteria for classification of various organisms in animal kingdom (BL2).
3. Explain the lifecycles, diseases and preventive measures of human pathogens (BL2)
4. Outline various biotic and abiotic interactions in nature (BL1).
5. Explain the basic information on gene, alleles and its inheritance (BL2).

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2					2	2	2	2	2		2	2	1
CO2	2					2	2	2	2	2		2	2	
CO3	2					2	2	2	2	2		2	2	1
CO4	2					2	2	2	2	2		2	2	
CO5	2					2	2	2	2	2		2	2	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Animal Cell, Tissues and Level of Organization: Structure of animal cell and its organelles. Differences between plant and animal cell. Level of organization, multicellularity, diploblastic and triploblastic conditions. Asymmetry, symmetry: radial symmetry and bilateral symmetry. Acoelomates, pseudocoelomates and coelomates in brief. Animal tissues structure and functions. Different types of animal tissues and their functions. Epithelial, Connective, Muscular and Nervous tissues in brief

UNIT-II

Animal Kingdom Classification: Classification of animal kingdom. Phylogeny of invertebrate and vertebrate phyla. Salient features of non-chordates up to phyla, and chordates up to class level. Binomial and trinomial nomenclature. Concept of species and genus.

UNIT-III

Parasitology: Parasitism and Parasitic Adaptation: Health and disease: introduction, life cycle, pathogenicity, treatment and prevention; Entamoeba histolytica, Plasmodium vivax, Ascarislum bricoides and Wuchereria bancrofti. Brief account of pathogenicity, treatment and prevention of typhoid, pneumonia, common cold and ring worm.

UNIT-IV

Ecology and Environment: Organism and environment, habitat and niche. Population and ecological adaptations, population interactions. Abiotic environmental factors – light, temperature, water and radiation. Biotic environmental factors –neutralism, competition, mutualism, commensalism, parasitism, predation. Attributes, growth, birth rate and death rate, age distributions.

UNIT–V

Genetics: Structure and Functions of chromosome. Concept of gene and alleles, multiple alleles, ABO blood groups. Sex chromosomes, Sex determination, Sex linked inheritance, gene expression and regulation in prokaryotes and eukaryotes.

TEXT BOOKS:

1. Campbell, N.A., Reece, J.B., Urry, Lisa, Cain, ML., Wasserman, S.A., Minorsky, P.V., Jackson, R.B. "Biology: A Global Approach", 11th edition, Pearson Education Ltd. (2017)
2. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1st edition, 1983.

SUGGESTED READING:

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer "The Invertebrates: A New Synthesis".III Edition, Blackwell Science(2002)
2. K Vaidhyanath, K Pratap Reddy and K Sathya Prasad, "Introduction to Applied Biology and Biotechnology". BS Publications, India, 2004.

20CY C01

CHEMISTRY
(Common to all branches)

Instruction:	3 L Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

COURSE OUTCOMES: At the end of the course student will be able to:

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2			2						2	1	1
CO2	3	2	2			2						2	2	2
CO3	3	2	3			2						2	3	2
CO4	3	2	3			2						2	3	2
CO5	3	2	2			2						2	3	2

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2, He_2^+, N_2, O_2, O_2^-, CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, – Reference electrodes (NHE, SCE)-electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel

UNIT- III Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides)

Cyclization (Diels - Alder reaction)

UNIT–IV Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process),ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Mali, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7thedition (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla ,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C. Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8thedition (2006).

20EEC01

BASIC ELECTRICAL ENGINEERING

Instruction:	3 L Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To understand the basic principle of operation of AC and DC machines
3. To know about different types of electrical wires and cables, domestic and industrial wiring. safety rules and methods of earthing

COURSE OUTCOMES:

After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and to apply them in superposition, Thevenin's and Norton's theorems to get the solution of simple dc circuits
2. Obtain the steady state response of RLC circuits with AC input and to acquire the basics, relationship between voltage and current in three phase circuits.
3. Understand the principle of operation, the emf and torque equations and classification of AC and DC machines
4. Explain various tests and speed control methods to determine the characteristic of DC and AC machines.
5. Acquire the knowledge of electrical wiring, types of wires, cables used and Electrical safety precautions to be followed in electrical installations.
6. Recognize importance of earthing, methods of earthing and various low-tension switchgear used in electrical installations

CO-PO ARTICULATION MATRIX

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2						1	2		3		
CO2	3	3	2						1	2		3		
CO3	3	3	2	1					1	2		3		
CO4	2	1							1	2		3		
CO5	2		2						1	2		3		

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltagelaws, analysis of simple circuits with dc excitation, Superposition, Thevenin and Norton Theorems, Time-domain analysis of first-order RL and RC circuits.

UNIT-II

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power,reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Transformers: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalentcircuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification,Characteristics of shunt, series and compound generators.

DC Motors: Classification, Torque equation, Characteristics, Efficiency, Speed Control of Series and Shunt Motors.
Three - Phase Induction Motors: Principle of operation, Applications,

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handlingelectrical appliances, electric shock, first aid for electric shock, safety rules.

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

TEXT BOOKS:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill,2009
4. P.V. Prasad, S. sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

20BT C03

PROCESS PRINCIPLES AND REACTION ENGINEERING

Instruction:	3 L Hours per week
Duration of SEE:	3 Hours
SEE:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

1. The aim of the course is to impart knowledge of the basic chemical engineering principles and techniques used in analyzing a biochemical process.
2. The course aims to provide the students an understanding of how to represent experimental data in graphical form.
3. This course also aims to enable the students to evaluate material balances in different units.
4. The course aims at enabling the students to learn calculations regarding enthalpy and heat of reactions
5. The aim of the course is to impart knowledge of biochemical reactors and enhance skill to formulate and analyze different types of reactors used in biochemical engineering

COURSE OUTCOMES:

At the end of the course student are able to

1. To analyze, interpret and solve the problems encountered in the preparation of material and energy balances of different processes.
2. To analyze and present experimental data in the form of graphs.
3. To calculate Material balances and analyze the applications of transport phenomena in Bioprocess.
4. To calculate enthalpy changes associated during various processes
5. To compute and compare the basic design calculations of various reactors.
6. To predict growth kinetics and analyze substrate utilization and product formation.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2			1		2	2	3	3	3
CO2	3	3	2	3	1	2	2	2	1	3	1	3	3	2
CO3	3	3		1		2	2	3				3	3	
CO4	3	3	2	2		2	2	2				3	3	2
CO5	3	3	2	2	2			3		1		3	3	2

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Dimensions And System Of Units: Fundamental quantities, derived quantities and conversions; SI and MKS system of Units; Basic Chemical Engineering calculations-Atomic, Molecular and Equivalent weights, molar concept, Concentration units for pure components, Vapor pressures, Moles, Mixers and solutions, Morality, Molality, Normality and Partial pressures; Definition of Stochiometry; Composition of mixers and solutions; Weight fraction; Mole fraction; Volumetric composition; Density and Specific gravity, Ideal gas law; Ideal mixtures and solution;

UNIT-II

Presentation and Analysis of data: Presentation and Analysis of Data, Errors in Data and Calculations, Significant Figures, Types of Error, Statistical Analysis, Presentation of Experimental Data, Data Analysis, Graph Paper With Logarithmic Coordinates, General Procedures For Plotting Data

UNIT-III

Operations In Bioprocesses and Material balances: Application of principles of unit operations and unit processes in biotech Industries, Application of principles of transport phenomenon (momentum, mass and heat transfer) in bioprocessing. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets.

Steady state and Equilibrium, Laws of conservation of mass, Types of material balances, General procedure for solving material balances, Material and energy balances for nonreactive systems; Recycle, bypass and purge processes

UNIT-IV

Energy Balances: Basic Energy concepts, General energy balance equations, Enthalpy calculation procures, Enthalpy Change in Non-Reactive Processes, Procedure for Energy-Balance Calculations, Enthalpy Change Due to Reaction, Heat of Reaction for Processes with Biomass Production, Energy-Balance Equation For Cell Culture

UNIT-V

Introduction To Bioreaction Engineering: - Rate law, zero and first order kinetics; Batch, fed-batch and continuous processes; Growth Kinetics: Batch growth quantifying cell concentration, substrate utilization and product formation; Structured and unstructured models , Chemostat growth, Differences and similarities between chemical and bioreactors; Classification of bioreactors and Reactor configurations; Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor, Ideal reactors - batch, mixed flow and plug flow; diffusion effects - Thiele modulus, effectiveness factor, Damkoehler number

TEXT BOOKS:

1. Pauline M.Doran, 2013,Bio-process Engineering Principles, 2nd Edition, Academic press
2. Hougen and Watson K M and Ragatz R A,1959, Chemical Process Principles, 2nd Edition ,Wiley.
3. Bhatt B I and S M Vora, Stoichiometry**,** 2006, 4thEdition ,Tata McGraw Hill.
4. Chemical Reaction Engineering , Octave Leven Spiel, 3rd Edition ,Wiley.

SUGGESTED READING:

1. David M. Himmelblau, James B. Riggs, “Basic Principles and Calculations in Chemical Engineering”, 8/e, Prentice Hall, 2012.
2. James E Bailey, David F Ollis, “Biochemical Engineering Fundamentals: Solutions Manual” McGraw-Hill Education, 1979.
3. Harvey W Blanch, Douglas S Clark “Biochemical Engineering”, 1st Edition, 1997

20CYC02

CHEMISTRY LAB

(Common to all branches)

Instruction:	4P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2

COURSE OBJECTIVES:

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: At the end of the course student will be able to:

1. Identify the basic chemical methods to analyse the substances quantitatively and qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2			2	2					2	2	2
CO2	3	2	1			2	2					2	2	2
CO3	3	2	3			2	2					2	2	2
CO4	3	2	2			2	2					2	2	2
CO5	3	2	3			2	2					2	2	2

1 - Slightly, 2 - Moderately, 3 - Substantially

List of Laboratory Experiments/Demonstrations:

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2}& Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

Text Books

1. J. Mendham and Thomas,"Vogel' s text book of quantitative chemical analysis", Pearson education Pvt. Ltd. New Delhi, 6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, A.Ghulati, V.C.Garg; R.Chand and CD New Delhi

Suggested Readings

1. Dr.Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara, "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

20EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction:	2P Hours per week
Duration of SEE:	3 Hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	1

COURSE OBJECTIVES:

1. To acquire the knowledge of different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power &energy.
3. To determine the characteristics of Transformers, dc, ac machines and switchgear components

COURSE OUTCOMES:

At the end of the course, the students are expected to

1. Get an exposure to common electrical components, their ratings and basic electrical measuring equipment.
2. Make electrical connections by wires of appropriate ratings and able to measure electric power and energy.
3. Comprehend the circuit analysis techniques using various circuital laws and theorems.
4. Determine the parameters of the given coil and calculate the time response of RL & RC series circuits.
5. Recognize the basic characteristics of transformer and components of switchgear.
6. Understand the basic characteristics of dc and ac machine by conducting different types of tests on them.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2			2	2					2		
CO2	3	2	1			2	2					2		
CO3	3	2	3			2	2					2		
CO4	3	2	2			2	2					2		
CO5	3	2	3			2	2					2		

1 - Slightly, 2 - Moderately, 3 - Substantially

List of Laboratory Experiments/Demonstrations:

1. Demonstration of Measuring Instruments and Electrical Lab components.
2. Verification of KCL and KVL.
3. Time response of RL and RC series circuits.
4. Determination of parameters of a choke or coil by Wattmeter Method
5. Verification of Thevenin's and Norton's theorems
6. Turns ratio /voltage ratio verification of single phase Transformers
7. Open Circuit and Short Circuit tests on a given single phase Transformer
8. Observation of Excitation Phenomenon in Transformer
9. Measurement of three phase power in a balanced system using two Wattmeter method.
10. Measurement of 3-Ph Energy by an Energy Meter (Demonstration of Principle)
11. Load test on DC Shunt motor
12. Speed control of DC Shunt motor
13. Demonstration of Low Tension Switchgear Equipment/Components
14. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

20ME C02

WORKSHOP / MANUFACTURING PRACTICES

Instruction:	5P Hours per week
Duration of SEE:	3 hours
SEE:	50 Marks
CIE:	50 Marks
Credits:	2.5

COURSE OBJECTIVES:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive & team work attitude to get things right the first time.
3. To provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. To advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES:

At the end of the course, the students are able to

1. Understand safety measures to be followed in workshop to avoid accidents
2. Identify various tools used in fitting, carpentry, tin smithy, house wiring, welding, casting and machining processes
3. Make a given model by using workshop trades including fitting, carpentry, tin smithy and House wiring.
4. Perform various operations in welding, machining and casting processes
5. Conceptualize and produce simple device/mechanism oftheir choice

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1				1				1		
CO2	1		1									1		2
CO3	1		1			1	1					1	2	2
CO4	1		1			1	1					1	2	2
CO5	2	2	2	1	3	1	1	1	1	2		2	3	3

1 - Slightly, 2 - Moderately, 3 - Substantially

List of Exercises

CYCLE 1

Exercises in Carpentry

1. To plane the given wooden piece to required size
2. To make a lap joint on the given wooden piece according to the given dimensions.
3. To make a dove tail-joint on the given wooden piece according to the given dimensions.

Exercises in Tin Smithy

4. To make a rectangular box from the given sheet metal with base and top open. Solder the corners.
5. To make a scoop.
6. To make a pamphlet box.

Exercises in Fitting

7. To make a perfect rectangular MS flat and to do parallel cuts using Hack saw
8. To make male and female fitting using MS flats-Assembly1
9. To make male and female fitting using MS flats-Assembly2

Exercises in House Wiring

10. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bell push
11. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs.Wiring of two light points connected in parallel from two single pole switches and a three pin socket
12. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.

CYCLE 2

Exercises in Casting

1. Study of Sand casting process and its applications**.**
2. Green sand moulding practice for a single piece pattern
3. Green sand moulding practice for a split pattern with a horizontal core

Exercises in Welding

4. Study of gas welding equipment and process. Identification of flames, making of Butt joint with gas welding.
5. Study of Arc welding process, making Butt joint with DCSP, DCRP
6. Study of Arc welding process, making Lap joint with A.C

Exercises in Machine shop

7. Study of Machine Tools like Lathe, Drilling, Milling and Shaper.
8. Facing, Plain turning and Step turning operations on Lathe machine.
9. Knurling and Taper turning on Lathe machine

Open ended Exercise:

1. Student should produce a component /mechanism by applying the knowledge of any one trade or combination of trades.

TextBooks:

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. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I", Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

20ME C03

ENGINEERING EXPLORATION (PRACTICAL)

Instruction:	4P Hours per week
Duration of SEE:	Nil
SEE:	Nil
SEE:	50 Marks
Credits:	1.5

Prerequisites: Nil

COURSE OUTCOMES: At the end of the course, the students are able to

1. Understand the role of an engineer as a problem solver (BL-2)
2. Identify multi-disciplinary approaches in solving an engineering problem. (BL-4)
3. Build simple systems using engineering design process (BL-3)
4. Analyze engineering solutions from ethical and sustainability perspectives(BL-4)
5. Use basics of engineering project management skills in doing projects(BL-3)

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	1				1				1		
CO2	1		1									1		2
CO3	1		1			1	1					1	2	2
CO4	1		1			1	1					1	2	2
CO5	2	2	2	1	3	1	1	1	1	2		2	3	3

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT- I

Role of Engineers: Introduction, science, engineering, technology, engineer, scientist, role of engineer, various disciplines of engineering, misconception of engineering, expectations for the 21st century engineer and NBA graduate attributes.

Engineering problems and Design: Multidisciplinary facet of design, pair wise comparison chart, introduction to econometrics system, generation of multiple solution, Pugh chart, motor and battery sizing concepts, introduction to PCB design.

UNIT- II

Mechanisms: Basic components of a mechanism, degrees of freedom or mobility of a mechanism, 4-bar chain, crank rocker mechanism, slider crank mechanism, simple robotic arm building.

Platform-based development: Introduction to programming platforms (Arduino) and its essentials, sensors, transducers and actuators and their interfacing with Arduino.

UNIT- III

Data Acquisition and Analysis: Types of data, descriptive statistics techniques as applicable to different types of data, types of graphs and their applicability, usage of tools (MS-Office /Open Office/ Libre Office / Scilab) for descriptive statistics, data acquisition (temperature and humidity) using sensors interfaced with Arduino, exporting acquired data to spreadsheets, and analysis using representation.

UNIT- IV

Process Management: Introduction to Agile practice, significance of team work, importance of communication in engineering profession, project management tools, checklist, timeline, Gantt chart, significance of documentation.

UNIT -V

Engineering Ethics & Sustainability in Engineering: Identifying Engineering as a profession, significance of professional ethics, code of conduct for engineers, identifying ethical dimensions in different tasks of engineering, applying moral theories and codes of conduct for resolution of ethical dilemmas.

Sustainability in Engineering: Introduction, sustainability leadership, life cycle assessment, carbon foot print.

TEXT BOOKS:

1. Clive L. Dym, Patric Little, Elizabeth J Orwin, "Engineering Design: A project-based introduction", 4th edition, Willey.
2. Matthew Python, "Arduino programming for beginners", independently published, 2020.
3. Patrick F. Dunn, "Measurement and data Analysis for engineering and science" , third edition,2014.
4. Andrew Stellman, Jennifer Greene, "Head First Agile: A brain-friendly guide to Agile principles, ideas, and real-world practices", Kindle Edition.

SUGGESTED READING:

1. Charles B. Fleddermann, "Engineering ethics", fourth edition, Prentice Hall, 2012.
2. Rob Lawlor, "Engineering in society", second edition, Royal academy of engineering.
3. Richard Dodds, Roger Venables, "Engineering for sustainable development: Guiding principles", The Royal Academy of engineering, 2005.
4. Richard S. Paul, "Robot Manipulators: Mathematics, Programming, and Control", MIT Press.

ENGINEERING EXPLORATION ASSESSMENT SCHEME				
S. No	**Name of the module**	**Work Hours**	**Marks**	**Evaluation**
1	Role of Engineers	4	-	Evaluation - I
2	Engineering Design	16	5	
3	Mechanisms	6	3	
4	Engineering Ethics	2	2	
5	Platform-based Development	16	5	Evaluation -II
6	Data Acquisition and Analysis	6	4	Evaluation-III
7	Project Management	4	4	
8	Sustainability in Engineering	6	2	
9	Course Project Reviews	12	20	Final Evaluation
10	Code of conduct	-	5	
	Total	**72**	**50**	