Scheme of Instruction, Evaluation

and

Syllabi of

B.E. BIOMEDICAL ENGINEERING

SEMESTER - I

With effect from Academic Year 2026-27

DEPARTMENT OF BIOMEDICAL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Estd. 1917 **Estd. 1929**

Osmania University

Hyderabad – 500 007, TS, INDIA

SCHEME OF INSTRUCTION AND EVALUATION
B.E. (BIOMEDICAL ENGINEERING)

SEMESTER - I

Sl.No	Course Code	Course Name	Contact hours per week		Scheme of Evaluation		Credits
			L	P	CIE	SEE	
THEORY							
1.	MC 100 HS	Induction Program	Three Weeks				
2.	BS 101 PH	Engineering Physics	3	-	40	60	3
3.	BS 102 CH	Applied Chemistry	3	-	40	60	3
4.	HS 101 EG	Communicative English	3	-	40	60	3
5.	PC 101 BM	Fundamentals of BME	3	-	40	60	3
PRACTICALS							
6.	BS 151 PH	Engineering Physics Lab	-	3	25	50	1.5
7.	BS 152 CH	Applied Chemistry Lab	-	3	25	50	1.5
8.	ES 151 BM	EC & IT Workshop	-	3	25	50	1.5
9.	ES 152 ME	Workshop Practice	-	6	25	50	3
TOTAL			**12**	**15**	**260**	**440**	**19.5**
BRIDGE COURSES FOR BI. P. C STUDENTS							
11.	BC 101 MT	**Basic Mathematics I**	3	-	40	60	-
12.	BC 102 MT	**Basic Mathematics II**	3	-	40	60	-
		TOTAL	**18**	**15**	**340**	**560**	**19.5**

BS 101 PH	**ENGINEERING PHYSICS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student:	
1	To understand the fundamental laws of electromagnetism and how they lead static and time-varying electric and magnetic fields and to apply wave theory to optical phenomena, such as interference, diffraction, and polarization
2	To appraise significance of stimulated emission and laser light production. Subsequently propagation of light through optical fibers.
3	To make student understand the formation of energy bands and classification of the solids based on the band theory and to sensitize the students towards nanomaterials.
4	To understand the different types Magnetic materials and Dielectric materials with their origin of evolution.
5	To understand Schrodinger's wave equation and its applications and to understand the concept of superconductors.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	know how electric and magnetic fields lead the behavior of electromagnetic wave. It bridges classical physics and modern optics, empowering learners to analyze complex electromagnetic systems and waves optics.
CO-2	understand the construction and working of different laser systems and apply them to propagate light through optical fiber cable as cutting edge application.
CO-3	understand the semiconducting materials and their properties, operating electronic devices, and applying them in circuits and also equips students with the fundamental principles, how materials behave at the nanoscale and how these unique physical, chemical, and biological properties differ from bulk materials.
CO-4	understand the fundamental physics behind how materials interact with electric and magnetic fields.
CO-5	enrich and understand the implications of matter waves in quantum mechanics evolution and to equip students with the theoretical skills to analyze, and apply materials that conduct electricity with zero resistance and expel magnetic fields.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**2**	**1**	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**3**
CO2	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**
CO3	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**
CO4	**3**	**2**	**1**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**3**
CO5	**3**	**2**	**3**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Unit – I
Modern Optics: Interference – Newton's Rings by reflected light – Experimental arrangement – Types of diffraction – Diffraction due to single slit - Diffraction due to double slit (qualitative)-diffraction grating (Conditions of maxima and minima) – Polarization – Malus law – Double refraction – Nicol's Prism. – Optical activity and polarimeter. **Electro Magnetic Theory**: Basic laws of electricity and magnetism – Derivation of Maxwell's equations in integral and differential forms - Conduction and displacement current – modification of Ampere's law - Equation of plane wave in free space – Poynting theorem.

Unit – II
Lasers: Characteristics of lasers – Absorption of radiation, spontaneous and stimulated **Lasers:** Characteristics of lasers – Absorption of radiation, spontaneous and stimulated emission of radiation - Einstein's coefficients and their relation - Population inversion– Types of lasers - Ruby laser, Helium-Neon laser and semiconductor laser – state of art applications of lasers. **Fiber Optics:** Construction of an optical fiber – Propagation of light through an optical fiber - Acceptance angle - Numerical aperture – Types of optical fibers (Based on number of modes and refractive index profile) – Fiber drawing process (double crucible method) - Applications of optical fibers.

Unit – III
Quantum Mechanics: Schrödinger's time independent and time dependent wave equation – Physical significance of wave function – Particle in 1-D box – Wave function, Probability function – Quantum states – Introduction to quantum technology and applications. **Semiconductor Physics:** Classification of materials based on band theory - Kronig-Penney model (qualitative treatment) - Energy band formation in solids - Intrinsic and Extrinsic semiconductors - Concept of a hole - Carrier concentration and conductivity in intrinsic semiconductors – Formation of P-N junction diode, Light Emitting Diode and their I-V characteristics – Thermistor and its characteristics - Hall effect and its applications.

Unit – IV
Dielectric Materials: Dielectrics - Types of polarizations – Electronic, Ionic, Orientational and Space charge polarizations – Expression for Electronic polarizability - Frequency and temperature dependence of dielectric polarizations - Determination of dielectric constant by capacitance Bridge method - Ferro electricity - Barium Titanate – Piezo electricity – Super capacitor. **Nanomaterials:** Introduction - Properties of materials at reduced size - Surface to volume ratio – Quantum confinement effect – Classification of nanomaterials - Preparation of nanomaterials: bottom–up methods (e.g., Sol Gel method and Chemical Vapor Deposition

method), Top-down methods (e.g., Ball milling method) - Basic ideas of carbon nanotubes – Applications of nanomaterials and their health hazards.

Unit –V
Magnetic Materials: Origin of magnetism (Orbital and Spin magnetic moments) - Classification of magnetic materials: dia, para, ferro, antiferro and ferrimagnetic materials – Weiss molecular field theory of ferromagnetism - Magnetic domains - Hysteresis curve - Soft and hard magnetic materials – Ferrites: Applications of ferrites. **Superconductivity:** Introduction - General properties of super conductors - Meissner effect - Type I and Type II superconductors - BCS theory (qualitative) – Introduction to High T_c superconductors - Applications of superconductors.

Suggested Reading:

1	M.S. Avadhanulu and P.G. Kshirasagar - Engg. Physics, S.Chand& Co.
2	C.M. Srivastava and C. Srinivasan - Science of Engg. Materials, New Age International.
3	R.K. Gour and S.L. Gupta – Engg. Physics, Dhanpat Rai Publications
4	B.K. Pandey and S.Chaturvedi – Engineering Physics, Cengage Learning.
5	A.K Bhandhopadhya - Nano Materials, New Age International.

BS 102 CH	**APPLIED CHEMISTRY**					
	(BME)					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student:	
1	To understand the mechanism involved in organic reactions and its applications in medicinal chemistry
2	To have an insight in the advanced techniques involved in analytical methods and application of dialysis , plasmolysis , electrodialysis, and membrane technology
3	Interpret various spectroscopic data for structural elucidation of molecules, and analysis of Fragment ions by Mass Spectroscopy in determining the molecular weight of the Compound.
4	To gain information in knowing the conductance of electrolytes and determining the P^H using different electrodes.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Study the basic reaction mechanism of organic chemistry and synthesis of drugs.
CO-2	Learning separation methods by contemporary advanced analytical techniques and and applications of Dialysis, Electro dialysis, Plasmolysis and Ultrafiltration.
CO-3	Gain knowledge in the concept of determination of structure of molecules by spectroscopic techniques.
CO-4	Analyze and interpret mass spectra to identify the structure of molecules by using mass spectrometry.
CO-5	It is possible to estimate the amounts of substances present in the given solution from the measurement of conductance, emf and P^H of the solution.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	-	-	-	-	-	-	-	-	2	1	-
CO 2	3	2	-	3	-	-	-	-	-	-	-	2	2	-
CO 3	3	3	-	2	-	-	-	-	-	-	-	2	2	-
CO 4	3	3	-	2	-	-	-	-	-	-	-	2	2	-
CO 5	2	3	2	1	-	-	-	-	-	-	-	2	2	-

Correlation rating: Low / Medium / High : 1 / 2 / 3 respectively.

Unit – I: Stereochemistry, Organic reactions and synthesis of drug molecules
Stereo Chemistry: Chirality, optical activity, Enantiomers and Diastereomers R,S configuration, E and Z system of nomenclature with Examples. **Organic Reactions:** Introduction to Addition, Substitution and Elimination reactions. Addition to C=C and C=O, Nucleophilic substitution in aliphatic system: SN^1 and SN^2 mechanism, Elimination reactions: E^1 and E^2 mechanism. **Drugs:** Definition and classification. Preparation and uses of commonly used drugs- Paracetamol, Aspirin and Ibuprofen.

Unit – II: Analytical Techniques & Osmosis
Chromatography: - Introduction, principles of chromatographic separations, Classification of chromatographic techniques. **TLC (Thin Layer Chromatography): -**Technique, sample applications, development of TLC plates, R_f values in TLC, principles, reverse phase TLC and applications of TLC. **Column Chromatography:** Principles of column separation, Column packing-wet & Dry column packing, stationery phase materials (Alumina, Silica gel), Nature of adsorption forces, mobile phase, solvent systems. **Gas Liquid chromatography**: Introduction, apparatus – Supply of carrier gas, sample injection, column detectors- Thermal conductive detectors, Flame ionization detectors. **High Performance Liquid Chromatography: (HPLC)**-Instrumentation, classification of stationary phase -polar phase, bonded phase & non polar phase. Mobile phase – gradient elution isocratic elution, difference between normal and reverse phase HPLC and Chiral HPLC. **Osmosis:** Colligative properties, osmosis and osmotic pressure, Berkeley-Hartley method for determination of osmotic pressure, isotonic, hypotonic & hypertonic solutions. Plasmolysis, Dialysis, Electrodialysis and Ultrafiltration.

Unit - III: Spectroscopy
Description of Electromagnetic radiation: **Principles of UV-Visible Spectroscopy**: Statement of Beer-Lambert Law. Chromophores and Auxochromes. Absorption and intensity shifts: Bathochromic, Hypsochromic, Hyper chromic and Hypo chromic shifts with one example each. Principle and applications of UV –Visible Sensors.

IR Spectroscopy: Principle of IR Spectroscopy. IR active and IR inactive molecules (two examples each). Types of vibrational bands, Degrees of Freedom for linear and nonlinear molecule, Principle and applications of IR Sensors.

NMR Spectroscopy: Principle of ^{1}H-NMR Spectroscopy. Chemical Shift, Multiplicity, Example - Ethyl chloride, Principle and Applications of MRI.

Unit - IV: Mass Spectroscopy

Mass Spectroscopy- Mass spectrometry–Origin of mass sprectrometry -Instrumentation - principle of EI & ESI in mass spectrometry. Types of fragments- electron, neutral & charged species-even electron rule, nitrogen rule, Isotopic peak with relative % of Natural abundance of isotope of elements, determination of molecular formula by mass spectral data Example Ethyl chloride. Fragmentation pattern or ionization sites-α cleavage (2,2 –di methyl butane) Mclafferty rearrangement (octane-2-one).

Unit - V: Electrochemistry

Electrolytic conductors-conductance, specific conductance, equivalent conductance and molar conductance. Cell constant. Effect of dilution on various conductivities. Kohlrausch law and its applications – determination of $\wedge_{\infty}$ of weak electrolytes and degree of dissociation. Principle and applications of conductometric titrations. Numerical problems.

Electrolytic and galvanic cells, cell notation, concept of electrode potential, single electrode potential and its determination. Electrochemical series and emf calculations. Types of electrodes- Hydrogen, Calomel, Quinhydrone and Glass electrode. Nernst equation and its applications. Determination of pH by using Quinhydrone and Glass electrodes.

Suggested Reading:

1	Jain & Jain, Engineering chemistry, Dhanpat Rai publishing Co., 17th Edition.
2	Arun Bahl and BS Bahl, *A text book of Organic Chemistry*, S. Chand Co. Ltd., S. Chand Publishing, 2017.
3	Robert Silverstein spectrometric identifications of organic compounds, Journal of Chemical Education, ACS Publications.
4	L.D.S. Yadav, Organic Spectroscopy. Springer nature-2005
5	Vogel's text Book of Quantitative Chemical Analysis. Longman Scientific & Technical,Wiley.
6	Fundamentals of analytical chemistry by Skoog and West. ACS Publications.
7	Y.R. Sharma Elementary organic spectroscopy, S.Chand Publications.
8	G L Krupadanam & et.al. Analytical Chemistry, Universities Press.

HS 101 EG	**COMMUNICATIVE ENGLISH**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To develop students' listening, speaking, reading, and writing (LSRW) skills for academic and professional communication.
2	To enhance vocabulary, grammar, and language accuracy for effective expression.
3	To improve comprehension and critical thinking through prose, poetry, biographies, and professional ethics.
4	To equip students with technical and professional writing skills such as report writing, email writing, presentations, and resume writing.
5	To enable students to communicate confidently and ethically in professional and social environments.

Course Outcomes :	
After successful completion of the course, students will be able to:	
CO-1	Demonstrate effective listening, speaking, reading, and writing skills in academic and professional contexts.
CO-2	Apply appropriate vocabulary, grammar, and language structures to communicate accurately and fluently.
CO-3	Analyze literary and non-literary texts to develop comprehension, critical thinking, and interpretation skills.
CO-4	Prepare professional documents such as reports, emails, letters, resumes, and presentations using appropriate formats and conventions.
CO-5	Demonstrate ethical communication practices and interpersonal skills required for teamwork and professional success.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	-	-	-	-	-	-	3	3	-	2
CO 2	3	2	-	-	-	-	-	-	2	3	-	2
CO 3	2	3	-	-	-	-	-	2	2	2	-	3
CO 4	2	2	-	-	1	-	-	-	2	3	-	2
CO 5	-	2	-	-	-	2	-	3	3	3	-	2

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Unit - I
Prose: Silent Crisis | *Martha C Nussbaum* ***Listening***: What is Listening; Process of Listening; Importance of Listening ***Speaking***: Importance of Communication, Types of Communication (Non-verbal and Verbal)

Reading: Importance of Reading ***Writing***: Features of Writing Composition: Cohesions, Coherence, Precision and Clarity ***Vocabulary and Grammar***: Homonyms; Homophones; Homographs; Punctuation; Sentence Structure (Simple, Compound, Complex)

Unit - II
Poem: Where the Mind is Without Fear | *Rabrindranath Tagore* ***Listening***: Types of Listening; Non-Verbal and Verbal Signs of Active Listening ***Speaking***: Types of Communication (Oral, Written, Visual) ***Reading***: Reading Skills: Skimming, Scanning ***Writing***: Discourse Markers and Linking Words; Paragraph Writing; Précis Writing ***Vocabulary and Grammar:*** Root Words: Prefix, Suffix; Synonyms; Antonyms; Idioms and Phrasal Verbs; Concord

Unit - III
Biography: Homi J. Bhabha | *Enakshi Chatterji* ***Listening***: Active Listening; Barriers to Effective Listening ***Speaking***: Channels of Communication (Vertical, Horizontal, Diagonal, Grapevine) ***Reading***: SQ3R Method ***Writing***: Essay Writing; Report Writing; Letter Writing; Resume Writing; Email Writing; Etiquette ***Vocabulary and Grammar:*** One Word Substitutes; Active and Passive; Reported Speech

Unit - IV
Listening: Word Made by Atom | *Maples and Technique* ***Speaking***: Styles of Communication; Johari Window ***Reading***: Intensive and Extensive Reading ***Writing***: Essay Writing; Report Writing; Letter Writing; Resume Writing; Email Writing; Etiquette ***Vocabulary and Grammar:*** Commonly Misspelt Words; Often Confused; Tenses

Unit - V
Prose: Professional Ethics ***Listening***: Note-Taking; Critical Listening Exercises ***Speaking***: Speaking To Communicate Effectively; Proverb Expansion through JAM ***Reading***: Critical and Inferential Reading Passages ***Writing***: Creating Writing ***Vocabulary and Grammar:*** Technical Vocabulary; Common Errors in English; Correct Use of Prepositions and Articles; Avoiding Ambiguity; Misplaced Modifiers; Avoiding Redundancy

Suggested Reading:

1	Ashraf, M. Rizvi. *Effective Technical Communication*. Tata McGraw-Hill, 2006.
2	*Language and Life: A Skills Approach*. Orient Blackswan, 2018.

3	Raman, Meenakshi, and Sangeetha Sharma. *Technical Communication: Principles and Practice*. 2nd ed., Oxford University Press, 2011.
4	Swan, Michael. *Practical English Usage*. Oxford University Press, 1995.
5	Vijaya, B. *Communicative English and Employability Skills*. Orient Blackswan, 2026.

PC 101 BM	**FUNDAMENTALS OF BIOMEDICAL ENGINEERING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To make the students learn the basics of Biomedical Engineering.
2	To make the students comprehend the concepts of excitable cells and organ systems.
3	To make the students understand the applications of basic medical devices and medical technology advancements.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Identify the major roles of biomedical engineer.
CO-2	Gain knowledge of bioelectricity.
CO-3	Get familiarized with major organ systems and their functions.
CO-4	Describe the functions of medical instruments.
CO-5	Understand the advancements of medical technology.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	1	1	1	0	0	0	0	1	0	1	1	0
CO 2	1	2	2	1	1	1	0	0	0	1	0	1	1	0
CO 3	1	2	2	2	1	1	2	1	0	2	0	2	2	0
CO 4	1	1	3	3	3	2	3	3	2	3	3	3	3	3
CO 5	1	1	3	3	3	2	2	3	2	3	2	3	3	2

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Unit – I: Biomedical Engineering: A Historical Perspective and Ethical Issues:
Modern health care system. Areas of biomedical engineering. Roles of biomedical engineers. Clinical Engineering: Professional Societies. Human experimentation. Regulation of medical device innovation. Ethical issues in Feasibility, emergency, and treatment. Role of biomedical engineer in the FDA process.

Unit – II Bioelectricity:
Cellular organization, Excitable cells, Resting potential, Action potential, Nerve Action potential, , Stimulus characteristics, Strength-Duration Curve, Relative and Absolute refractory periods, Accommodation, Propagation of impulses in myelinated and unmyelinated nerves, Cardiac action potentials.

Unit – III Major Organ Systems:
Basic structure and functions of major organ systems. Cardiovascular System - Heart, major blood vessels, heart valves. Respiratory system- conduction and respiratory zones and respiratory cycle. Nervous system- Central and peripheral nervous systems. Muscular system-types of muscles-skeletal, smooth and cardiac. Skeletal system- types of bones and joints. Excretory system- Nephron, parts of the Kidney. Homeostasis.

Unit – IV Basic Medical devices/ Instruments:
Building blocks of a medical instrumentation system. Categories of medical instruments based on parameter, organ system. Functions and components of Pacemaker, Ventilator, Nerve-Muscle Stimulators, Artificial joints, and Dialyzers.

Unit – V Applications of Medical Technology Advancements:
Healthcare information and communication. Biotelemetry. Applications of computers in medicine. Telemedicine- Need and components. Medical applications of BCI.

Suggested Reading:

1	Sawhney, G. S. (2007). Fundamentals of biomedical engineering. New Age International Publishers.
2	Leslie Cromwell, Fred J. Weibell & Erich A. Pfeiffer, Biomedical Instrumentation and Measurements PHI Learning Pvt Ltd.
3	Enderle, J. D., & Bronzino, J. D. (2012). Introduction to biomedical engineering (Third ed.) Elsevier.

BS 151 PH	**APPLIED PHYSICS LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Demonstrate an ability to make physical measurements and understand the limits of precision in measurements.
2	Demonstrate the ability to use experimental statistics to determine the precision of a series of measurements.
3	Demonstrate the ability to prepare a valid laboratory notebook.
4	Demonstrate the ability to understand the construction and working of different experiments

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Recognize the transformation concepts into practicals.
CO-2	Use a best fit to create a graph from a series of data points. Students can extrapolate and interpolate.
CO-3	Appreciate the mathematical abilities to meaningful physical conclusions.
CO-4	Develop skills to impart practical knowledge in real time solution and learn to design new instruments with practical knowledge.
CO-5	Understand the link between theory and practicals.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3		-	-	-	3	_	1	3	-	3	_	_
CO 2	3	3	1	-	-	-	3	_	1	3	_	3	_	_
CO 3	3	3	3	-	-	-	3	_	1	3	_	3	_	_
CO 4	3	3	2	1	3	1	3	_	1	3	_	3	_	_
CO 5	3	1	-	-	-	-	3	_	1	3	_	3	_	_

Correlation rating: Low / Medium / High : 1 / 2 / 3 respectively.

Experiment - I
To calculate the Numerical aperture (NA), acceptance angle of a given optical fibre.

Experiment - II
Determination of wavelength of LASER using diffraction grating.

Experiment - III
Verification of Beer's law.

Experiment - IV
To determine specific rotatory power of a given solution by using Laurent's Half shade polarimeter.

Experiment - V
To Estimate Radius of curvature of given lens by forming Newton's rings.

Experiment - VI
To determine resolving power of plane grating.

Experiment - VII
Determination of carrier concentration, Mobility and Hall Coefficient of Ge Crystal using Hall Effect Experiment.

Experiment - VIII
To draw the I-V Characteristics of P-N Junction diode and to evaluate the value of potential barrier of the diode.

Experiment - IX
To find the values of Electrical conductivity and energy gap of Ge crystal by Four probe method.

Experiment – X
To determine the constants of A, B and α of given Thermistor.

Experiment - XI
To study V-I characteristics of Light Emitting Diode.

Experiment - XII
To draw the I-V characteristics of Zenor diode.

BS 152 CH	**APPLIED CHEMISTRY LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Synthesis and Application of various mechanisms in organic chemistry.
2	Application of photochemical reaction.
3	To identify functional groups in various organic compounds.
4	Structural elucidation by Spectral methods.
5	Apply electrochemical principles in conductivity and Electrode potentials.

Course Outcomes :	
The chemistry laboratory course use consists of experiments illustrating the principle of chemistry relevant to the study of science and engineering. The students will learn to:	
CO-1	Prepare small molecules relevant to different reactions in organic chemistry.
CO-2	Photochemical reaction through blueprinting.
CO-3	Qualitative analysis of Functional groups.
CO-4	Spectral analysis of organic compounds.
CO-5	Measurement of conductance of solutions and electrode potentials.

CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**		
CO2	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**		
CO3	**2**	**2**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**		
CO4	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**2**		
CO5	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**1**		

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

1. Preparation and spectral analysis of organic compound:

1) Aspirin

2) Benzylidene aniline

3) Spectral interpretation-Ethyl Chloride.

2. Photosensitization and Light energy.

4) Chemistry of Blue printing

3. Identification and derivatization of the functional group in the given organic compound by qualitative test: 5) Carboxylic acids 6) Phenols 7) Amines 8) Aldehydes and ketones 9) Carbohydrate
4. Acid-base titrations using the following instruments: 10) Conductivity meter 11) Potentiometer

Suggested Reading:

1	*PG Mann, BC Saunder ,Practical Organic Chemistry, Orient Longman Ltd, 4th Edition. (1999).*
2	BD Khosla, A. Gulati, Senior Practicla Physical Chemistry ,VC Garg, Chand & Co, 10th Edition(2001).
3	Vogel' s Text Took of quantitative chemical Analysis.

ES 151 BM	**ELECTRONIC COMPONENTS AND INFORMATION TECHNOLOGY WORKSHOP**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To introduce the students to different electronic components and devices
2	To introduce the students to working and usage of different measuring equipment
3	To introduce the students to identification and usage of IT components
4	To introduce the students to working and usage of basic engineering equipment

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Identify, use and test the basic electronic components
CO-2	Use different testing and measuring equipment
CO-3	Identify different IT hardware components
CO-4	Installation of OS and network configuration
CO-5	Use different soldering techniques

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 2	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 3	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 5	-	-	-	-	-	-	-	-	1	3	-	3	-	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

LIST OF EXPERIMENTS	
1	Identification, operation and testing of
	a. Resistors
	b. Capacitors
	c. Inductors
	d. Semiconductor components- Diodes, Zener Diodes, Transistors
	e. Switches- toggle switches, rotary switches, and cables etc
	f. Types of fuses and fuse holders, circuit breakers and protectors
	g. Transformers, Motors, Electromagnetic Relays
2	Practice the usage of Voltmeter, Ammeter, Multimeter (Analog and Digital), D.C Regulated Power
3	Practice the usage of Analog and Digital Storage Oscilloscope, and function generator
4	IT Hardware:
	a. Identification of Switching Mode Power Supply (SMPS), Hard disk, RAM, Mother Board b. Assembly and disassembly
5	Installation of Windows and Linux Operating Systems
6	Network Configuration- LAN-based and Wi-Fi-based
7	Study and usage of Basic Engineering tools: Pliers, Cutters, Wrenches/Spanners, Screw drivers, Nut drivers, Hacksaw, Drills, Files and other workshop tools
8	Soldering procedure and Techniques
	a. Usage of Soldering tools – soldering iron, strippers, bending tools, heat sinks b. Practice of Soldering and De-soldering

Suggested Reading:

1	R.S.Khandpur., “Troubleshooting Electronic Equipment”, Second Edition 2003, McGraw Hill Tab publishers.

ES 152 ME	**WORKSHOP PRACTICE**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	6	3
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To train students for identifying, selecting and use proper tools
2	To Impart practical, hands-on skills in basic manufacturing processes and fabrication across multiple trades.
3	To Instill a safety-first mindset regarding shop floor operations in an industrial environment
4	To learn the fundamentals of house wiring which is used in daily life
5	To Measure mechanical dimensions accurately using standard instruments like Vernier calipers etc.

Course Outcomes :	
Upon successful completion of this laboratory course, the students shall be able to	
CO-1	Identify and select tools appropriate for specific manufacturing, assembly, and fabrication tasks across various engineering trades
CO-2	Fabricate physical products by applying hands-on skills in basic manufacturing and fabrication processes like carpentry, fitting, welding, foundry and other trades
CO-3	Practice industrial safety by adhering to shop floor regulations, recognizing potential hazards, and using personal protective equipment.
CO-4	Understand how individual trades work together to manufacture and assemble a complete engineering product.
CO-5	Perform precise measurements on machined or fabricated components using standard metrology instruments like Vernier calipers and gauges.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	2	-	-	-	2	-	-	-	2	1	-	2	1	-
CO 2	2	-	2	-	2	-	-	-	3	1	-	2	1	-
CO 3	1	-	-	-	-	3	2	2	2	1	-	2	1	-
CO 4	2	1	2	-	2	-	1	-	3	2	1	2	1	-

CO 5	2	1	-	2	3	-	-	-	2	1	-	1	1	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Experiment - I : Carpentry shop
• Making of Cross lap joint with Wood • Making of End Lap/Tee Lap Joint with wood

Experiment - II : Fitting shop
• Making of Step cut with Mild Steel flat • Making of semi circular and V-cut with Mild Steel flat

Experiment - III : Sheet metal shop
• Making of Funnel with GI Sheet • Making of Rectangular box with GI Sheet

Experiment - IV : House wiring
• Making of Cleat wiring • Making of casing wiring

Experiment - V : Welding shop
• Making of Butt joint using Arc Welding • Making of Lap Joint using Arc Welding

Experiment - VI : Machine shop
• Making of Step turning on MS cylindrical rod • Making of Taper turning on MS cylindrical rod

Experiment - VII : Foundry shop
• Preparation of casting using single piece pattern • Preparation of casting using core pattern

Experiment - VIII : Smithy shop
• Forging of square shape peg from cylindrical work piece • Forging of square shape L- bend peg from cylindrical work piece

Note: Minimum six trades should be conducted

Suggested Reading:

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.

BC 101 MT	**BASIC MATHEMATICS-I**					
	(Bridge Course for Bi. P. C. Students)					
Pre-requisites SSC/CBSE/ICSE Mathematics			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To study the concept of the Functions, Domain and Range.
2	To introduce the concept of the Trigonometric Functions, Trigonometric Functions Ratio's and Angles.
3	To introduce the concepts of Vectors, Scalars, Addition, Multiplication, Angle between Vectors.
4	To introduce Partial Fractions, Repeated and Non – Repeated Factors.
5	To introduce the Statistical Methods.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO 1	Sketch the graph of given curves.
CO 2	Know and apply identities involving the Trigonometric Functions.
CO 3	Apply techniques of dot Product and Cross Product and its properties.
CO 4	Use Partial Fractions to decompose rational expressions into simpler Partial Fractions
CO 5	Apply Measure of Central Tendency, Measure of Dispersion, Coefficient of Variation, Moments, Skewnes, Kurtosis, Correlation and Lines of Regression.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 2	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 3	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 5	-	-	-	-	-	-	-	-	1	3	-	3	-	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT - I
Functions: Types of functions – Definitions, Inverse functions and Theorems (Without Proof), Domain, Range, Inverse of real valued Functions.

UNIT - II
Trigonometry: Trigonometric ratios – variation - Graphs and Periodicity, Trigonometric ratios and Compound angles, Trigonometric ratios of multiple and sub-multiple angles, Sum and Product Transformations, Graphs and Properties of Inverse Trigonometric Functions, Hyperbolic Functions.

UNIT - III
Vectors: Addition of vectors, Scalar multiplication, Angle between two non- zero vectors, Linear combination of vectors, Component of a vector in three dimensions, Scalar Product of two vectors - Geometrical Interpretations orthogonal projections, Properties of dot product, Expression for scalar (dot) product, Angle between two vectors, Vector product of two vectors and properties, Vector product in i, j, k system, Scalar Triple Product.

UNIT - IV
Partial Fractions: Partial fractions of $f(x)/g(x)$ when $g(x)$ contains non – repeated linear factors, Partial fractions of $f(x)/g(x)$ when $g(x)$ contains repeated and/or non-repeated linear factors, Partial fractions of $f(x)/g(x)$ when $g(x)$ contains irreducible factors only.

UNIT - V
Statistical Methods: Introduction, Measures of Central Tendency, Measures of Dispersion, Coefficient of Variation, Moments, Skewness, Kurtosis, Correlation, Lines of Regression.

Suggested Reading:

1	Text Book For Intermediate First Year Mathematics Paper IA & Paper IB Telugu Akademi, Hyderabad, Telangana
2	Text Book For Intermediate First Year Mathematics Paper IIA & Paper IIB Telugu Akademi, Hyderabad, Telangana
3	Mathematics Text Book for Class XI & XII, Part I & II, NCERT, New Delhi
4	Shanti Narayan, "Vector Calculus", S. Chand Publisher.
5	B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 45th Edition, 2024 (Reprint 2025).
e-resources: https://onlinecourses.swayam2.ac.in/e-learning/preview/nce24_sc47 https://onlinecourses.swayam2.ac.in/e-learning/preview/nce25_sc19	

BC 102 MT	**BASIC MATHEMATICS – II**					
	(Bridge Course for Bi. P. C. Students)					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To study the concepts of Matrix Algebra.
2	To study the concepts of Limits, Continuity and Differentiation.
3	To study the concepts of Integration.
4	To study the applications of Differentiation and Integration.
5	To study formation of Ordinary Differential Equations.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO 1	Solve systems of Linear Equations using Multiple Methods.
CO 2	Find Limit, Continuity and Differentiation of a Function.
CO 3	Evaluate the Integration of Functions.
CO 4	Apply the Differentiation and Integration.
CO 5	Solve Differential Equations by using Variable and Separable Methods.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 2	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 3	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 5	-	-	-	-	-	-	-	-	1	3	-	3	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

Unit – I
Matrices: Types of Matrices, Scalar Multiple of a Matrix and Multiplication of Matrices, Transpose of a Matrix, Determinants, Adjoint and Inverse of a Matrix.

Unit - II
Limits, Continuity and Differentiation: Intervals and Neighborhoods, Limits, Standard Limits, Continuity, Derivative of a function, Elementary Properties, Trigonometric, Inverse Trigonometric, Hyperbolic Inverse Hyperbolic Function Derivatives, Second Order and higher Order Derivatives, Definition of Partial derivative.

UNIT - III
Integration: Integration as the inverse process of Differentiation - Standard forms and Properties of integrals, Method of substitution - integration of Algebraic, Exponential, Logarithmic, Trigonometric and Inverse trigonometric functions. Integration by parts, Integration- Partial fractions method, Definite Integral as the limit of sum, Fundamental theorem of Integral Calculus, Properties.

Unit – IV Integration
Applications of Differentiation and Integration: Geometrical interpretation of a derivative, Equations of Tangent and Normal to a curve, Increasing and Decreasing functions, Maxima and Minima, Application of Definite integral to areas.

Unit – V Applications of differentiation, integration and Differential equations
Differential Equations: Formation of differential equation - Degree and order of an ordinary differential equation, Solving differential equation by Variables Separable Method, Homogeneous Differential Equation.

Suggested Reading:

1	Text Book For Intermediate First Year Mathematics Paper IA & Paper IB Telugu Academy, Hyderabad, Telangana.
2	Text Book For Intermediate First Year Mathematics Paper IIA & Paper IIB Telugu Academy, Hyderabad, Telangana.
3	Mathematics Text Book for Class *XI & XII, Part I* & II , NCERT, New Delhi
4	Shanti Narayan, "Vector Calculus", S. Chand Publisher, New Delhi
e-resources: https://onlinecourses.swayam2.ac.in/e-learning/preview/nce24_sc47 https://onlinecourses.swayam2.ac.in/e-learning/preview/nce25_sc19	

Scheme of Instruction, Evaluation

and

Syllabi of

B.E. BIOMEDICAL ENGINEERING

SEMESTER - II

With effect from Academic Year 2026-27

DEPARTMENT OF BIOMEDICAL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500 007, TS, INDIA

Estd. 1917 **Estd. 1929**

SCHEME OF INSTRUCTION AND EVALUATION
B.E. (BIOMEDICAL ENGINEERING)

SEMESTER - II

Sl.No	Course Code	Course Name	Contact hours per week		Scheme of Examination		Credits
			L	P	CIE	SEE	
THEORY							
1.	BS 201 MT	Matrices and Calculus	3	-	40	60	3
2.	ES 201 BM	Electronic Devices and Circuits	3	-	40	60	3
3.	ES 201 CS	Programming for Problem Solving	3	-	40	60	3
4.	ES 201 EE	Basic Electrical Engineering	3	-	40	60	3
5.	ES 211 CE	Applied Mechanics	3	-	40	60	3
PRACTICALS							
6.	ES 251 BM	Electronic Devices and Circuits Lab	-	3	25	50	1.5
7.	ES 251 CS	Programming for Problem Solving Lab	-	3	25	50	1.5
8.	ES 251 EE	Basic Electrical Engineering Lab	-	3	25	50	1.5
9.	ES 252 BM	Computer Aided Engineering Lab	-	3	25	50	1.5
10	HS 251 EG	Communicative English Lab	-	3	25	50	1.5
		TOTAL	**15**	**15**	**325**	**550**	**22.5**

BS 201 MT	**MATRICES AND CALCULUS**					
Pre-requisites	Mathematical Knowledge of 12th/ Intermediate level		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To study Matrices as vector spaces, subspaces, linear transformation and its use in solving system of linear equations.
2	To study Eigenvalue problems, Diagonalizable Matrices and Quadratic Forms.
3	To introduce the concepts of Functions of Several Variables and its Applications.
4	To introduce the concepts of Multiple Integrals and its Applications.
5	To study Vector Differential and Integral Calculus.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Find vector spaces and subspaces and solutions of system of linear equations.
CO-2	Solve Eigenvalue problems, Similar & Diagonalizable Matrices and Canonical Form of Quadratic Forms
CO-3	Find the maximum and minimum values of multiple variable functions.
CO-4	Use the knowledge of Multiple Integrals in finding the area and volume of any region bounded by given curves
CO-5	Apply the knowledge of Vector Calculus to find line, surface and volume integrals.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	2	2	1	1	1	-	-	1	-	-	2	-	-
CO 2	3	2	1	2	2	2	-	-	1	-	-	2	-	-
CO 3	3	2	2	3	2	2	-	-	1	-	-	2	-	-
CO 4	3	2	1	1	1	2	-	-	1	-	-	2	-	-
CO 5	3	2	2	3	1	2	-	-	1	-	-	2	-	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT - I
Matrices and Vector Spaces: Vector Spaces, Subspaces, Linear Independence of Vectors, Dimension and Basis, Linear Transformation, Solution of General linear System of Equations, Elementary row and Column Operations, Echelon form of a Matrix, Gauss Elimination Method for Non – Homogeneous Systems, Homogeneous System of Linear Equations.

UNIT - II
Eigenvalue Problems: Eigenvalues and Eigenvectors, Cayley - Hamilton theorem (without Proof), Similar and Diagonalizable Matrices, Special Matrices, Quadratic Forms, Canonical Form of a Quadratic Form.

UNIT - III
Functions of Several Real Variables: Introduction, Functions of Two Variables, Limits, Continuity, Partial Derivatives, Total Differential and Differentiability, Derivatives of Composite and Implicit functions, Higher Order Partial Derivatives, Homogeneous functions, Taylor's Theorem (without Proof), Maximum and Minimum Values of Function, Lagrange's method of Multipliers.

UNIT - IV
Multiple Integrals: Double Integrals, Evaluation of double integrals by two successive integrations, Application of double integrals, Triple Integrals, Application of triple integrals, Evaluation of triple integrals Change of Variables in Integrals.

UNIT - V
Vector Differential and Integral Calculus: Gradient of a Scalar Field and Directional Derivative, Divergence and Curl of a Vector Field, Line Integrals, line Integrals Independent of the Path and Green's theorem (without Proof), Surface Integral, Divergence Theorem of Gauss and Stoke's Theorem (without Proof).

Suggested Reading:

1	R. K. Jain & S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition 2016 (Fifteenth Reprint 2026).
2	Erwin Kreyszi, Advanced Engineering Mathematics, John Wiley, 11thEdition, 2025.
3	B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 45rd Edition, 2024(Reprint 2025).
4	N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications, 11th Edition 2025.
5	H. K. Dass and Er. Rajnish Varma, Higher Engineering Mathematics, S. Chand Technical 3rd Revised Edition 2014(Reprint 2025).
e-resources: https://onlinecourses.nptel.ac.in/e-learning/noc26_ma133	

ES 201 BM	**ELECTRONIC DEVICES AND CIRCUITS**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	The course facilitates the students to study the basic concepts and characteristics of electronic devices.
2	To develop the ability of analyzing actual electronic circuits that implements the basic circuits.
3	The students also learn about BJTs, MOSFETs and feedback Amplifiers.

Course Outcomes :	
CO-1	Understand various diodes and their applications
CO-2	Outline transistor characteristics and Design the biasing circuits like self-biasing.
CO-3	Analyze small signal low frequency amplifier circuits using h-parameters
CO-4	Illustrate the construction, operation and characteristics of JFET and MOSFET, which can be used in the design of amplifiers.
CO-5	Access feedback concept and various topologies

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	2	3	3	-	3	3	3	-	3	2	3
CO 2	3	3	3	2	3	3	-	3	3	3	-	3	2	3
CO 3	3	3	3	2	3	3	-	3	3	3	2	3	3	3
CO 4	3	3	3	2	3	3	-	2	-	3	2	3	3	3
CO 5	3	3	3	3	3	3	-	2	-	3	2	3	3	3

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Unit - I: Semiconductors & Diodes:
Energy bands, Intrinsic and Extrinsic Semiconductors, Band structure of PN Junction, Quantitative Theory of PN Diode, Volt - Amp Characteristics, Temperature Dependence,

Transition and Diffusion Capacitance of PN Junction, Zener Diode, Tunnel Diode, LED, Varactor Diode, Photo Diode.
Diode circuits: Diode as a rectifier: Half-wave, Full-wave and Bridge Rectifiers, Types of Filters, Capacitor and Inductor filter, Zener diode as a voltage regulator, Ripple Factor and Regulation Characteristics.

Unit - II: Bipolar Junction Transistor:

NPN and PNP junction Transistors, Transistor current components, CB, CE and CC Configurations and their Characteristics, Saturation, Cutoff and Active Regions, Comparison of CE, CB and CC Configurations, Maximum voltage rating, The operating point, Fixed-bias, Emitter stabilized bias circuits, Voltage-divider bias, DC bias with voltage feedback, Stabilization, Bias compensation, Thermal Runaway, Thermal Stability, High frequency model of a Transistor.

Unit - III: Small Signal - Low Frequency Transistor amplifier Circuits:

Transistor as an Amplifier, Simplified CE and CC hybrid models. The h parameters of the three transistor configurations, Analysis of Transistor Amplifier circuits using h-parameters. Linear analysis of a Transistor circuit, BJT transistor modeling parameters: Zi, Zo, Av, Ai. The CE amplifier with emitter resistance, Darlington pair, Analysis of Single Stage Amplifiers.

Unit - IV: Field Effect Transistors:

The Junction field effect transistor, Pinch off Voltage, Volt-ampere characteristics, Drain Saturation Current, Small Signal model of FET, MOSFET - Enhancement and Depletion Modes. The low frequency common source and common drain amplifiers, FET biasing.

Unit - V: Feedback Amplifiers:

Concept of Feedback Amplifiers - Effect of Negative feedback on the amplifier characteristics. Four Feedback Amplifier Topologies. Method of Analysis of Voltage Series, Current Series, Voltage Shunt and Current Shunt feedback amplifiers, Analysis of simple feedback amplifiers using BJT and FET, Design Considerations.

Suggested Reading:

1	*Integrated Electronics Analog and Digital Circuits and Systems*, Jacob Milliman and Christos C. Halkias, McGraw Hill, Edition, l988.
2	*Electronic Devices and Circuits Theory*- Robert L Boylestad and Louis Nashelsky, Pearson Education.9th, Pearson publications, 2009.
3	*Electronics Principles*, Albert Paul Malvino, Tata McGraw Hill Edition 2001.
4	J. B. Gupta, "*Electronic Devices and Circuits*" S.K. Kataria & Sons Publications, Reprint 2013.

ES 201 CS	**PROGRAMMING AND PROBLEM SOLVING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
1	To introduce the basic concepts of Computing environment, number systems and flowcharts
2	To familiarize the basic constructs of C language – data types , operators and expressions
3	To understand modular and structured programming constructs in C
4	To learn the usage of structured data types and memory management using pointers
5	To learn the concepts of data handling using files

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Explain various functional components in computing environment
CO-2	Develop algorithmic solutions to problems and draw the flow charts
CO-3	Explain and use basic constructs of C in writing simple programs
CO-4	Use standard library functions in C and develop modular programs using user defined functions and structured data types
CO-5	Use files and file handling for applications.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	1	-	_	1	_	_	_	1	-	1	-	_	_
CO 2	3	3	2	_	1	_	_	_	1	-	1	-	_	_
CO 3	3	2	2	_	2	_	_	_		-	1	-	_	_
CO 4	3	3	3	1	2	_	_	_	1	-	1	-	_	_
CO 5	2	2	3	1	3	_	_	_	1	-	1	-	_	_

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT – I

Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. **Number Systems**: Binary, Octal, Decimal, And Hexadecimal.
Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements
Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II

Conditional Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and Go to statements
Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. **Recursion-** Recursive Functions. **Storage Classes:** Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers

UNIT– III

Preprocessors: Preprocessor Commands. **Arrays** - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.

UNIT – IV

Pointers - Introduction, Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, L -value and R-value, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments. **Strings -** Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions

UNIT –V

Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self-Referential Structures, Unions, Type Definition (typedef), Enumerated Types. **Input and Output:** Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.

Suggested Reading:

1	B.A. Forouzan and R.F. Gilberg, "*A Structured Programming Approach in C"* , Cengage Learning, 2007
2	Kernighan BW and Ritchie DM, "*The C Programming Language"*, 2nd Edition, Prentice Hall of India, 2006.
3	Rajaraman V, "*The Fundamentals of Computer"*, 4th Edition, Prentice-Hall of India, 2006.
4	Dromey " *How to Solve it By Computer* , Pearson education, 2006

ES 201 EE	**BASIC ELECTRICAL ENGINEERING**					
	(BME, MINING, ME)					
Pre-requisites		**L**	**T**	**P**	**C**	
		3	-	-	3	
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To understand the fundamentals of DC electrical circuits.
2	To understand the fundamentals of AC electrical circuits
3	To understand the working principles of Transformers
4	To understand the working principles of DC motor and DC generator
5	To understand working principles of protection devices used in electrical circuits.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Analyze the performance of simple electrical circuits & Apply different theorems to solve complicated electrical circuits to obtain the current, voltage and power. and AC excitations.
CO-2	Analyze the performance of simple electrical circuits exciting with DC
CO-3	Understand the working principles of Transformers
CO-4	Understand the main components, characteristics, applications of different DC and AC electrical machines used in industry.
CO-5	Understand the importance of protective devices and their rating used in electrical circuits. Obtain the overall understanding of basic electrical circuits and appliances required for any industry.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO 2	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO 3	3	2	2	-	-	1	-	-	-	-	-	-	2	3
CO 4	3	2	2	-	-	2	-	-	-	-	-	-	2	3
CO 5	3	2	1	-	-	2	-	-	-	-	-	-	2	3

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

UNIT - I : DC Circuits
Electrical circuit elements (R, L and C), voltage and current sources, Ohm`s Law, KCL and KVL, series, parallel circuits, analysis of simple circuits with dc excitation. Thevenin`s, Norton`s & Superposition Theorems.

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, and RL, RC, RLC combinations (series only). Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT - III: Transformers
Transformers: Electromagnetic induction, Faradays laws, statically induced EMF, EMF equation, ideal and practical transformer, OC & SC tests, losses and efficiency, Auto-transformer and three-phase transformer connections. **AC Motors**: Induction Motors and BLDC Motors, Principle of operation ,Advantages and Applications.

UNIT IV: - DC Machines
DC Generators: Dynamically induced emf, construction and principle of operation of DC generator, EMF equation, Types of DC Generators, OCC characteristics, applications **DC Motors:** Principle of working, Torque expression**,** Types of DC Motors, characteristics, applications.

UNIT - V: Electrical Installations
Components of LT Switchgear: Switch, Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing & types of Earthing. Elementary calculations for energy consumption, power factor improvement by capacitors.

Suggested Reading:

1	J.B.Gupta, "*Fundamentals of Electrical Engineering and Electronics*" S.K.Kataria & Sons Publications, 2002.
2	J.B.Gupta, "*Utilization of Electric Power and Electric Traction*" S.K.Kataria & Sons Publications, 2010
3	V.N.Mittle,Aravind Mittal "Basic Electrical Engineering" *Tata Mc.Graw Hill Publicationss* second edition 2007
4	Hughes, *"Electrical Technology*", VII Edition, International Student -on, Addison Welsey Longman Inc., 1995.
5	Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, " *Basic Elactrical Engineering"* Tata McGraw Hill, Publications, 2009

ES 211 CE	**APPLIED MECHANICS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60	**CIE**		40	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Learn the concept of center of gravity and mass moment of inertia
2	Understand the concept of stress, strain and elastic behavior of materials
3	Know the shear force, bending moment and the bending stress distribution
4	Understand the concept of fluid flow in statics, Kinematic, dynamics conditions
5	Evaluate the flow properties in static and dynamic, compressible and incompressible flow

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Determine the center of gravity and mass moment of inertia of a solid
CO-2	Apply the fundamental concepts of stress and strain
CO-3	Analyze the structural members subjected to tension, compression, bending
CO-4	Analyze the fluid flow
CO-5	Competent to evaluate the fluid properties

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	1	-	1	-	-	-	-	-	-	1	-	-	-
CO 2	1	2	-	-	1	-	-	-	-	-	-	-	1	-
CO 3	2	-	1	-	-	-	1	-	-	-	-	-	1	-
CO 4	2	-	1	-	-	-	1	-	-	-	-	-	1	-
CO 5	1	2	-	-	1	-	-	-	-	1	-	-	-	1

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

PART-I SOLID MECHANICS

Unit – I

Resultant of coplanar concurrent forces, Components of force in space, Moment of force and its applications, couples and resultant of force systems, Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system. , Pappu's theorems and its applications, center of gravity and mass moment of inertia of solids and composite bodies, radius of gyration. Area moment of Inertia, Polar moment of Inertia.

Unit – II

Simple Stresses and Strains: Types of stresses and strains, stress-strain curve for ductile material, deformation of prismatic bars under axial loads. Poisson's ratio, volumetric strain, elastic constants, compound bars and temperature stresses.

Unit – III

Shear force and Bending Moment: Concepts of shear force and bending moment, shear force and bending moment diagram for cantilever, simply supported and overhanging beams subjected to concentrated and uniformly distributed loads, simple bending theory, bending stresses.

PART-II FLUID MECHANICS

Unit – IV

Fluid Properties: Density, Viscosity, compressibility, and surface tension, conservation of mass and momentum, Bernoulli's Equation, measurement of pressure, stream lines, path lines, streak lines. Flow stability and related characteristics (steady laminar flow, turbulent flow, flow development, viscous and turbulent shear stress), Boundary layer separation.

Unit – V

Capillary viscometer using Poiseuille's law, Rotating cylinder Viscometer (coaxial cylinder viscometer). Pressure – flow relationship for Non-Newtonian fluids, power law fluid, Bingham plastic, Casson's fluid. Hydrostatics in circulation, Application of Bernoulli's equation (Total v/s Hydrostatic pressure measurement).

Suggested Reading:

1	D.S. Prakash Rao, *Strength of Materials - A Practical Approach,* University Press, 1999.
2	S.B. lunarker, and R.I. Shah, *Applied Mechanics,* Charaotar Publishers, 2001.
3	G.H. Ryder, *Strength ofMaterials,* Macmill India Limited, Third Edition, 2002.
4	A. Pytel and F. I. Singer, *Strength of Materials,* Harper and RC, Fourth Edition, 1987.
5	Kishan B Chandran et.al. "Bio Fluid Mechanics- The Human Circulation", CRC Press, Taylor and Francis, New York, 2007
6	Clemant Kleinstreuer, "Bio-fluid Dynamics – Principles and Applications", CRC Press, Taylor and Francis, New York, 2006

ES 251 BM	**ELECTRONIC DEVICES AND CIRCUITS LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	The course facilitates the students to understand the basic concepts and characteristics of electronic devices.
2	To develop the ability of analyzing actual electronic circuits that implements the basic circuits.
3	The students learn about diodes, BJTs, FET and feedback Amplifiers.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand various components, test and measuring equipment along with their usage.
CO-2	Illustrate the characteristics of various Diodes, BJT and FET.
CO-3	Deduce rectifier circuits with and without filters.
CO-4	Interpret other applications of diodes.
CO-5	Demonstrate the characteristics of various feedback topologies.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	2	3	3	-	3	3	3	-	3	2	3
CO 2	3	3	3	2	3	3	-	3	3	3	-	3	2	3
CO 3	3	3	3	2	3	3	-	3	3	3	2	3	3	3
CO 4	3	3	3	2	3	3	-	2	-	3	2	3	3	3
CO 5	3	3	3	3	3	3	-	2	-	3	2	3	3	3

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Experiments:	
1.	Characteristics of Semi-conductor Diodes (Si, Ge and Zener)
2.	Static characteristics of Bipolar-junction Transistors CB configuration
3.	Static characteristics of Bipolar-junction Transistors CE configuration
4.	Characteristics of Field effect Transistors
5.	Half-wave Rectifier with and without filters
6.	Full-wave Rectifier with and without filters
7.	Regulators:
	Series and Shunt Regulators
	Regulator ICs
8.	Clipping and Clamping circuits using diodes
9.	Frequency response of Single stage amplifier
10.	Characteristics of Voltage series and Voltage shunt feedback amplifiers
11.	Characteristics of Current series and Current shunt feedback amplifiers

Suggested Reading:

1	Integrated Electronics Analog and Digital Circuits and Systems Jacob Millinan and Christos C. Halkias, McGraw Hill, Edition, l988.
2	Electronic Devices and Circuits Theory- Robert L Boylestad and Louis Nashelsky, Pearson Education.9th, Pearson publications, 2009.
3	Electronics Principles, Albert Paul Malvino, Tata McGraw Hill Edition 2001.

ES 251 CS	**PROGRAMMING AND PROBLEM SOLVING LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To use tools available under LINUX for C programming
2	To gain hands-on experience on basic constructs of C programming
3	To formulate problems and implement algorithmic solutions in C
4	To write modular programs in C using structure programming techniques and data files.
5	To gain hands-on experience in using Python Programming constructs

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	Write, compile and debug C programs in Linux environment
CO-2	Write simple programs using control structures, user defined functions and data manipulation using arrays
CO-3	Use standard C library functions to develop modular programs in C
CO-4	Write basic Python Programs, using conceptual understanding of Programming.
CO-5	Create Programs, solutions for any problem statements with Programmatic, logic based approach.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	2	1	2	-	3	-	-	-	-	-	1	1	-	-
CO 2	3	3	2	-	2	-	-	-	-	-	1	1	-	-
CO 3	3	2	3	-	2	1	-	-	-	-	1	2	-	-
CO 4	3	3	3	2	2	-	-	-	-	-	1	1	-	-
CO 5	3	3	3	2	2	-	-	-	-	-	1	2	-	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

	Programs
1.	Introducing to programming Environment(Linux commands, editing tools such as vi editor, sample program entry, compilation and execution)
2.	Write programs using arithmetic, logical, bitwise and ternary operators.
3.	Write programs simple control statements : Roots of a Quadratic Equation, extracting digits of integers, reversing digits ,finding sum of digit ,printing multiplication tables, Armstrong numbers, checking for prime, magic number,
4.	Sin x and Cos x values using series expansion
5.	Conversion of Binary to Decimal, Octal, Hexa and Vice versa
6.	Generating a Pascal triangle and Pyramid of numbers
7.	Recursion: Factorial, Fibonacci, GCD
8.	Finding the maximum, minimum, average and standard deviation of given set of numbers using arrays
9.	Reversing an array ,removal of duplicates from array
10.	Matrix addition , multiplication and transpose of a square matrix .using functions
11.	Bubble Sort, Selection Sort ,
12.	Programs on Linear Search and Binary Search using recursion and iteration
13.	Functions of string manipulation**:** inputting and outputting string , using string functions such as strlen( ),strcat( ),strcpy( )……etc
14.	Writing simple programs for strings without using string functions.
15.	Finding the No. of characters, words and lines of given text file
16.	File handling programs : student memo printing
17.	Create linked list, traverse a linked list, insert a node, delete a node, reversing list.
18.	Python Basics and Input/Output a) Print "Hello, Engineering Students!" b) Read two integers and display their sum, difference, product, quotient, and remainder. c) Calculate the area and circumference of a circle. d) Swap two numbers (with and without a temporary variable). e) Convert temperature from Celsius to Fahrenheit. f) Calculate simple and compound interest.
19.	Develop programs using conditional statements. a) Find the largest of three numbers. b) Check whether a year is a leap year. c) Determine whether a number is positive, negative, or zero. d) Check whether a number is even or odd. e) Display grades based on marks using if-elif ladder.

	f) Develop a menu-driven calculator using if-elif.
20.	Develop programs using loops a) Print multiplication table of a given number. b) Generate first N Fibonacci numbers. c) Find factorial of a number. d) Check whether a number is prime. e) Reverse a given integer. f) Display Armstrong numbers between 1 and 1000.
21.	Develop modular Python programs using functions. a) Write a function to find the maximum of two numbers. b) Write a function to calculate factorial using recursion. c) Write a function to check palindrome. d) Write a function to compute GCD of two numbers. e) Write a function to determine whether a number is prime. f) Create a menu-driven mathematical calculator using functions
22.	Lists & Tuples - Perform operations on Python collections. a) Read N numbers into a list and find the largest and smallest. b) Compute average and median of list elements. c) Remove duplicate elements from a list. d) Sort a list in ascending and descending order. e) Search an element using linear search. f) Count frequency of each element in a list.
23.	Develop programs using dictionaries. a) Create a student dictionary containing Roll Number, Name, Branch, and CGPA. b) Count frequency of characters in a string. c) Count frequency of words in a paragraph. d) Create a telephone directory using a dictionary. e) Implement a simple student record management system using dictionaries. Find the student with the highest marks

For online practice problems: https://projecteuler.net

ES 251 EE	**BASIC ELECTRICAL ENGINEERING LAB**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To understand the fundamentals of DC and AC electrical circuits.
2	To Analyze the balanced three phase circuits to obtain the current, voltage and power.
3	To understand the working principles of Transformers and three phase transformer connections
4	To understand the working and performance characteristics of DC Motors
5	To understand the Magnetization characteristics of DC Generators

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Get an exposure to common electrical components and their ratings.
CO-2	To Make electrical connections by wires of appropriate ratings.
CO-3	Understand the usage of common electrical measuring instruments.
CO-4	Analyze the performance of AC and DC circuits with appropriate operating conditions.
CO-5	Understand the basic operation ahd characteristics of transformers and electrical machines.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO 2	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO 3	3	2	2	-	-	-	-	-	-	-	-	-	2	3
CO 4	3	2	2	-	-	-	-	-	-	-	-	-	2	3
CO 5	3	2	2	-	-	-	-	-	-	-	-	-	3	3

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

Suggested List of Laboratory Experiments/Demonstrations:

I - Cycle	
	Demonstration: Basic safety and precautions - Introduction and use of measuring instruments, characteristics of machines: DC machine, and three phase transformer connections.
1.	Verification of Kirchhoff's Laws
2.	Verification of Thevenin's & Norton's Theorem
3.	Verification of superposition Theorem
4.	Sinusoidal steady state response of series R-L-C circuits-impedance calculation and verification
5.	Open Circuit &Short Circuit Test on single phase Transformer
6.	Steady-state & transient time-response of R-C circuit to a step change in voltage
7.	Load test on single phase transformer: Measurement of primary and secondary voltages, currents and power
8.	Three-phase Transformer: Star and Delta connections. Voltage and current relationship
9.	Performance Characteristics of DC-Shunt Moto
10.	Magnetization curve of a separately excited DC Generator

Suggested Reading:

1	J.B.Gupta, "Fundamentals of Electrical Engineering and Electronics" S.K.Kataria & Sons Publications, 2002.
2	J.B.Gupta, "Utilization of Electric Power and Electric Traction" S.K.Kataria & Sons Publications, 2010
3	Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda," Basic Elactrical Engineering Tata McGraw Hill, Publications, 2009
4	Hughes, "Electrical Technology", VII Edition, International Student -on, Addison Welsey Longman Inc., 1995.

ES 252 BM	**COMPUTER AIDED ENGINEERING LAB**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To make the students learn the basics of CAD.
2	To make the students understand the application of CAD as a tool for design, simulation and modeling)
3	To make the students develop the skills to formulate and solve engineering problems
4	Extend knowledge to understand the basics of CAD software designed for modeling and engineering drawings.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand the concept of computer aided design.
CO-2	Develop a model using computer aided software in manufacturing field.
CO-3	Develop solutions in the area of design and simulation.
CO-4	Gain knowledge on engineering drawings and understand the significance of 3D modeling
CO-5	Familiarize with the idea of data exchange programming as well as different strategies and methods of analysis.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 2	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 3	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	1	3	-	3	-	-
CO 5	-	-	-	-	-	-	-	-	1	3	-	3	-	-

Correlation rating : Low / Medium / High : 1 / 2 / 3 respectively.

LIST OF EXPERIMENTS	
1.	Introduction to CAD/CAM software, user interface, sketching, constraints, solid modeling, extrude, revolve, draft, mirror, patterns, sweeps, lofts, and viewing operations.
2.	Advanced modeling tools, transformations, measurements, material assignment, mass and geometric properties, engineering drawings, tolerances, annotations, and product data exchange formats (IGES, STEP, STL, DXF).
3.	Biomedical Implant Modeling – Heart Stent Design.
4.	Biomedical Scaffold and Honeycomb Structure Design.
5.	Orthopedic Implant Modeling.
6.	Prosthetic and Assistive Device Design.
7.	Assembly Modeling of Biomedical Devices: bottom-up and top-down assembly approaches, mating conditions, subassemblies, interference and motion analysis.
8.	Design and Modeling of a Biomedical Device/System – I based on given functional requirements and design specifications.
9.	Design and Modeling of a Biomedical Device/System – II based on given functional requirements and design specifications.
10.	Design and Modeling of a Biomedical Device/System – III based on given functional requirements and design specifications.
11.	Conceptual Design and Development of an Integrated Biomedical Device/System by combining functionalities of two or more biomedical devices/systems.
12.	Finite Element Structural Analysis of biomedical components and devices under specified loading conditions.
13.	Thermal Analysis of biomedical components and devices under specified operating conditions.
14.	Preparation of CAD Models for Additive Manufacturing: STL generation, model verification, and 3D printing workflow.

HS 251 EG	**COMMUNICATIVE ENGLISH LAB**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	3	1.5
Evaluation	**SEE**	50	**CIE**		25	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To develop learners' pronunciation skills through an understanding of the English sound system, stress, and intonation.
2	To enhance contextual and collaborative communication skills for academic, social, and workplace settings.
3	To improve fluency, confidence, and interpersonal communication through interactive language activities.
4	To develop employability skills required for interviews, group discussions, presentations, and professional interactions.
5	To foster effective communication, teamwork, and lifelong learning skills necessary for career growth.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Demonstrate correct pronunciation using the English sound system, stress patterns, and intonation in spoken communication.
CO-2	Communicate effectively in various contexts using appropriate verbal and non-verbal communication skills.
CO-3	Participate actively in collaborative communication activities, demonstrating teamwork and interpersonal skills.
CO-4	Apply employability communication skills in interviews, group discussions, presentations, and workplace interactions.
CO-5	Exhibit confidence, professionalism, and ethical communication practices for lifelong learning and career development.

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 1 0**	**PO 1 1**	**PO 1 2**	**PSO 1**	**PSO 2**
CO1	1	-	-	-	-	-	-	-	2	3	-	2	-	-
CO 2	-	1	-	-	-	-	-	1	2	3	-	2	-	-
CO 3	-	-	-	-	-	-	-	1	3	3	-	2	-	-
CO 4	-	1	-	-	-	1	-	2	2	3	-	2	-	-
CO 5	-	-	-	-	-	2	-	3	3	3	-	3	-	-

Correlation rating: Low / Medium / High : 1 / 2 / 3 respectively.

1. English Sound System

a. Sounds of English
b. Vowels
c. Consonants

d. Using Dictionary to Decode Phonetic Transcription
e. Transcription exercise with the help of CALL (Computer Aided Language Lab)

2. Stress and Intonation

a. Syllable
b. Word stress and its importance
c. Intonation-falling and rising tone
d. Listening comprehension: Listening to various accents & Listening practice and exercises

3. Contextual Conversation Skills

a. JAM
b. Picture perception
c. Public speaking
d. Role plays: Use of dialogues in various situations like Social, Formal, Academic and Professional contexts.

4. Collaborative Communication

a. Group discussion forms and techniques
b. Mock GDs
c. Factual GDs and Controversial GDs
d. Abstract GDs and Case Studies
e. Debate: Form, techniques, topics for mock debates in class

5. Employability Communication

a. Presentation Skills
b. Presentations with emphasis on visual aids and body language
c. Interview Skills: Techniques
d. Frequently asked Interview Questions
e. Mock interviews, Simulator Technique

Suggested Readings

1. Kumar, E. Suresh, and P. Sreehari. *A Handbook for English Language Laboratories*. Cambridge University Press, 2014.
2. Balasubramanian, T. *A Textbook of English Phonetics for Indian Students*. Macmillan, 2008.
3. Sethi, J., et al. *A Practical Course in English Pronunciation*. Prentice Hall of India, 2005.
4. Prasad, Hari Mohan. *How to Prepare for Group Discussions and Interviews*. Tata McGraw-Hill, 2006.
5. *English for Engineers and Technologists*. Combined ed., vols. 1–2, Orient Blackswan, 2010.
6. Vijaya, B. *Communicative English and Employability Skills*. Orient Blackswan, 2026

Suggested Software:

- Sky Pronunciation Suite
- K-van Software
- Study Skills
- English Pronunciation Dictionary –CALD