Scheme of Instruction, Evaluation

and

Syllabi of

B.E. BIOMEDICAL ENGINEERING

SEMESTER - I

With effect from Academic Year 2022-23

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 - 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	Two Week		-	-	-
2.	BS 101 PH	Applied 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	Applied 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	-	2	25	50	1
9.	ES 151 ME	Workshop Practice	-	6	25	50	3
TOTAL			**12**	**14**	**260**	**440**	**19**
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**	**14**	**340**	**560**	**19**

BS 101 PH	**APPLIED PHYSICS**					
	(Common to BME, CSE, ECE and AIML)					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Understand the basic concepts of matter waves and experimental implications. To understand Schrodinger's wave equation and its implications.
2	Appraise significance of stimulated emission and laser light production. subsequently propagation of laser light through waveguides.
3	Understand the formation of energy bands and classification of the solids based on the band theory. To understand the concept of superconductors.
4	Understand implications of basic laws of electricity and magnetism to know the significance of techniques of Modern Optics.
5	Sensitize towards nanomaterial and appraise the various characterization techniques.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Enrich and ***understand*** concepts and real time applications of mater waves and implications of matter waves as quantum mechanics evolution.
CO-2	Understand construction and working of the laser systems and ***apply*** them to propagate through fiber optical cable as cutting edge application.
CO-3	***Analyze*** and semiconducting materials, superconducting materials, basics laws of electricity and magnetism to know the significance of techniques of Modern Optics.
CO-4	***Evaluate*** the different material characterization techniques .
CO-5	Appreciate significance of nanomaterials and ***create*** desired properties by using various methods of synthesis processes.

	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	2	1		-	1	3	-	3	-	-
CO 2	3		2	2	1	2		-	1	3	-	3	-	-
CO 3	3	1		2	3	2		-	1	3	-	3	-	-
CO 4	3		3	1	2	1	1	-	1	3	-	3	-	-
CO 5	3	2	1	2	3	3		-	1	3	-	3	-	-

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

Unit – I
Matter waves: de-Broglie hypothesis – properties of Matter Waves – Davison and Germer's experiment – G.P. Thomson experiment – Uncertainty principle. **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, energy levels.

Unit – II
Electromagnetic 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 - Relation between Displacement Current (D), Electric Intensity (E) and Polarization (P) - Equation of plane wave in free space – Poynting theorem. **Modern Optics:** Interference – Newton's Rings by reflected light – Experimental arrangement – Types of diffraction – diffraction grating (Conditions of maxima and minima) – Resolving power of grating –Types of polarized light – Polarization by reflection – Malus law – Double refraction – Nicol's Prism. – Optical activity and polarimeter.

Unit – III
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 – Applications of lasers. **Fibre 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) – Fibre drawing process (double crucible method) - Applications of optical fibers

Unit – IV
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, Zener diode, Light Emitting Diode and their I-V characteristics – Thermistor and its characteristics - Hall effect and its applications. **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.

Unit –V
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. **Techniques for Characterization:** Morphological studies of materials – X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM). Spectroscopic studies of materials – Fourier Transform Infrared (FTIR), Beer's law, UV-Visible and Raman spectroscopy.

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.
6	S.K. Sharma, et al., Hand book of Material Characterization - Springer

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

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Gain knowledge in the utility of electrodes and their chemical reactions which are useful in finding the PH value of solutions.
2	Appreciate the integration of study of Engineering Chemistry and Medicinal Chemistry to gain knowledge in interdisciplinary in BME course.
3	Learn and understand the major reactions of natural products involved in biological systems.
4	Give an insight of knowing permeability of solutes and solvents between membranes and the use of alloys in the manufacture of medical equipments.
5	Grasp the significance of understanding the basic reaction mechanism of organic compounds and the synthesis involved in the preparation of commonly used drugs.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	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.
CO-2	Gain knowledge in the concept of medicinal chemistry which is the need of today.
CO-3	Study of natural products in living organism.
CO-4	Predict the behavior of solvent molecules across a membrane and also understand the rules of Hume-Rothery behind mechanical behavior of different alloys.
CO-5	Apply the knowledge of reaction mechanisms of addition, substitution and elimination etc as they have significance in the making of chemical molecules and synthesize the drug molecules.

	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	2	2	3	-	1	3	-	3	-	-
CO 2	3	1	1	1	2	2	3	-	1	3	-	3	-	-
CO 3	3	2	2	2	2	2	3	-	1	3	-	3	-	-
CO 4	3	2	2	2	1	-	3	-	1	3	-	3	-	-
CO 5	3	2	2	2	1	-	3	-	1	3	-	3	-	-

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

Unit - I: ELECTROCHEMISTRY:
ELECTROCHEMISTRY:(10L) Electrolytic conductors-conductance, specific conductance, equivalent conductance and molar conductance. Cell constant, measurement of electrolytic conductance. Effect of dilution on various conductivities. Kohlrausch law and its applications – determination of Λ_∞ of weak electrolytes, solubility product 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. Principle and applications of Potentiometric titrations.Numerical problems.

Unit - II: ENGINEERING MATERIALS: (10)
Drug design and Discovery: Lead molecules- structure activity relationship(SAR)- QSAR-Physicochemical parameters, hydrophobicity, electronic effects, steric factors: Molar refractivity, Verloop steric factor and other Physicochemical parameters.
Methods used in QSAR studies- Correlation of biological activity with physicochemical parameters-Applications of Hammett equation, Hansch analysis, significance of slope and intercepts in Hansch analysis in QSAR 2D. Principles of drug design- SBDD and LBDD. ADME properties of drug molecules.

Unit - III: Carbohydrates and Proteins:(8L)
Carbohydrates and Proteins: Classification of carbohydrates – mono, oligo, poly saccharides. General properties of monosaccharides, aldoses and ketoses. Reactions of glucose and fructose. Establishment of open chain structure (Configuration not necessary)Di-saccharides: Sucrose, Maltose and their reactions. Reducing/non reducing sugars. Polysaccharides: starch, cellulose, importance of acetate, xanthate.
Amino acids and Proteins: Classification of amino acids, neutral, acidic, basic and essential amino acids. Nomenclature, methods of preparation- Streckers synthesis, Gabriel pthalimide synthesis and properties. Zwitter ion and iso-electric point. Peptide, peptide linkage, proteins, importance, Classification of 1^o 2^o & 3^o proteins-helices, sheets and loops. General properties and colour tests of proteins.

Unit - IV: Osmosis & Alloys:(6L)
Osmosis & Alloys: Colligative properties, osmosis and osmotic pressure, Berkeley-Hartley method for determination of osmotic pressure, isotonic, hypotonic & hypertonic solutions. Plasmolysis, Dialysis, Electrodialysis and Ultrafiltration.
Alloys: Solid solution, interstitial alloys, intermetallic compounds .Hume- Rothery rules. Composition, properties and uses of copper alloys, stainless steel, titanium and tantalum alloys.

Unit - V: Organic reactions and synthesis of drug molecules (8L)
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.

Suggested Reading:

1	PL Soni, OP Dhrmara, Text book of Physical Chemistry, Sultan Chand & Co, 22nd Edition(2001).
2	Arun Bahl and BS Bahl, A text book of Organic Chemistry, S.Chand Co. Ltd., 16th Edison(2002).
3	Ashuthoshkar, Medicinal Chemistry.
4	Graham Patrick, Medicinal Chemistry.
	Mount, DW, Sequence and genome CSHL press.

HS 101 EG	**COMMUNICATIVE ENGLISH**					
Pre-requisites	English proficiency above B1 level as per the CEFR (Common European Framework of Reference) for languages		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Communicate clearly, accurately and appropriately using correct grammar and vocabulary
2	Write effective paragraphs and essay using devices of coherence & cohesion
3	Write business letters and emails
4	Demonstrate the ability to employ a range of critical to inferential reading.
5	Employ active and passive voice in engineering and scientific contexts to compile technical reports

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Heighten the awareness of correct usage of English grammar and vocabulary in writing and speaking besides improving their fluency and comprehensibility
CO-2	Develop their ability as critical readers and writers and will produce paragraphs independently on any context with coherence
CO-3	Draft effective business letters and emails
CO-4	Exercise critical reading skills by enhancing the quality of life and to support lifelong learning.
CO-5	Will produce short reports using the drafting process

	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
Importance of listening, Importance of reading, Importance of communication, types of communication, Discourse markers & linking words, Homonyms, Homophones, Homographs , Concord

Unit - II
Types of listening, Reading skills-skimming, scanning, intensive and extensive reading, Communication barriers, Paragraph & Precise writing, One word substitutes, Tenses

Unit - III
Dos and don'ts of listening, Types of comprehension questions, Styles of communication Essay writing, Root words, Active and Passive voice

Unit - IV
Listening for specific purposes, Critical reading passages, Proverb expansion through JAM, Letter writing, Email writing, Synonyms, Antonyms, Common errors-I

Unit - V
Listening to various texts –contd…in language laboratory, Inferential reading passages, Effective presentations, Report writing , Idioms & Phrases, Common Errors-II

Suggested Reading:

1	Ashraf, M Rizvi. Effective Technical Communication. Tata McGraw-Hill, 2006
2	Languageand LifeASkillsApproach,OrientBlackSwan,2018
3	MichaelSwan, PracticalEnglishUsage. OUP,1995.
4	Meenakshi Raman and Sangeetha Sharma. Technical Communication: Principles and Practice 2nd Edition, Oxford University Press, 2011
5	Singer F L. (1975). *Engineering Mechanics Statics and Dynamics*, 3rd Edition, HarperCollins International Edition.

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

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 10**	**PO 11**	**PO 12**	**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 Marks	**CIE**		25 Marks	

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 Marks	**CIE**		25 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Identifications of functional groups in the given organic compounds by qualitative analysis.
2	Synthesis of organic compounds.
3	Verification of Beers law and estimation of glucose by colorimetry.
4	Estimation of HCL by conductometry and Potentiometry.

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	Know the procedure for the preparation of organic compounds.
CO-2	Identify the functional groups and also able to prepare the derivatives of unknown organic compounds.
CO-3	Estimate the strength of acids and ions present in unknown solutions by conductometry and potentiometry.
CO-4	Estimate the concentration of ions present in unknown solutions from the absorbance by colorimetric analysis.
CO-5	Estimate the strength of acids and ions present in unknown solutions by conductometry.

	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	2	2	-	-	-	-	-	1	3	1
CO 2	3	1	1	1	2	2	-	-	-	-	-	1	3	1
CO 3	3	2	2	2	2	2	-	-	-	-	-	1	3	2
CO 4	3	2	2	2	1	-	-	-	-	-	-	1	3	2
CO 5	3	2	2	2	1	-	-	-	-	-	-	1	3	2

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

Experiment - I
Identification of the functional group in the given Carboxylic Acid compound by qualitative test.
Experiment – II
Identification of the functional group in the given Phenol compound by qualitative test.
Experiment – III Identification of the functional group in the given Amines compound by qualitative test.
Experiment - IV
Identification of the functional group in the given Aldehyde and Ketones compounds by qualitative test.
Experiment – V
Identification of the functional group in the given Carbohydrates compound by qualitative test.
Experiment – VI
Verification of Beer's law.and Estimation of Glucose by colorimetry.
Experiment - VII
Preparation of the following Organic Compounds: i) Acetanilide ii) Aspirin
Experiment - VIII
Preparation of the following Organic Compounds: iii) Azo-dye iv) Benzyalidene aniline
Experiment - IX
Estimation of HCL by Conductometry.
Experiment – X
Estimation of HCL by Potentiometry.

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).

ES 151 BM	**ELECTRONIC COMPONENTS AND INFORMATION TECHNOLOGY WORKSHOP**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

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

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To learn about different tools used in workshop.
2	To understand the different manufacturing processes.
3	To learn about fabrication of components using different materials

Course Outcomes :	
Upon successful completion of this laboratory course, the students shall be able to	
CO-1	Study and practice on tools and their operations of different trades.
CO-2	Practice on manufacturing of components using workshop trades including carpentry, fitting, foundry, smithy, sheet metal &welding
CO-3	Select suitable tools for machining process including facing, turning& knurling
CO-4	Attain basic electrical knowledge for house wiring practice

	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	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.

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

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			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To introduce the concept of functions
2	To introduce the concept of the trigonometric functions
3	To introduction the theory of equations
4	To introduce Partial Fractions
5	To study co-ordinate geometry and vectors

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	To know when algebraic equation has an algebraic solution
CO-4	Partial fractions used to decompose rational expressions into simpler partial fractions
CO-5	Apply techniques from multivariable analysis to set up and solve mathematical models

	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
Definition of set, domain, co-domain, range of function. Types of functions, some standard functions and their properties, graphical representation, [polynomial function, modulus function, signum function, Greatest integer functions, fractional past function, exponential, logarithmic, trigonometric function] With example problems, odd and even functions.

Unit - II: Trigonometry
Trigonometric ratios with their graphical representation,compound angles, multiple and sub multiple angles, transformations, periodicity, inverse trigonometricfunction's hyperbolic function with some example problems.

Unit – III: Theory of equations
Definition of roots/zeros of polynomial equations, relation between the roots and coefficients. Problems on quotients and remainders division algorithms formation of polynomial when roots are given transformation of equation. Some standard method to find the roots of equation.

Unit – IV: Partial Fractions
Partial fractions of rational functions, decomposition of partial fractions, partial fractions of improper functions, Optional Binomial theory.

Unit – V: Co-Ordinate Geometry and Vectors
Cartesian co-ordinate system, quadrants/octants, locus, distance between two points, section formal in two three dimensional space. Definition of vector and scalar, types of vectors, additions, difference, dot or scalar product, cross product of vectors/vector product, and their properties, linear combination of vectors, linearly independent and dependent vectors angle between two vectors.

Suggested Reading:

1	H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand.
2	B.S.Grewal , "Higher Engineering Mathematics", 44th edition, Khanna Publishers
3	B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hills Education.
4	Shanti Narayan, "Vector Calculus", S.Chand Publisher.
5	Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers.

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

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To study matrix algebra
2	To study about the complex numbers
3	To study about differentiation and integration
4	To introduce 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	Recognize a unique complex number x+iy associated with the point p(x,y) in the argand plane and vice-versa
CO-3	To find maxima and minimum possible values of any function
CO-4	Solve certain first order ordinary differential equations

	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
Introduction of matrix theory, order matrix, types of matrices, [Row, Column, singleton, zero, Rectangular, square, Triangular, Diagonal, Scalar, identity matrices] definitions with example. Addition, difference, multiplication of matrices with example problems, determinant, trace, inverse of matrix, definition of special type matrices [symmetry, skew symmetry, hermitian, skew hermitian, idempotent, unitary, orthogonal] with example Applications: solution of linear equations, by matrix inverse method, Cramer's rule

Unit - II Complex numbers
Introduction of complex numbers, addition, difference, multiplication and division of complex numbers, conjugate modulus of complex numbers, principle argument of complex number, Argand plane and polar representation, Demoivre's theorem, n^{th} roots of unity.

Unit – III Differential Calculus
Definition of intervals, and neighborhoods, concept of limits, left and right hand limits, existence of limit, indeterminate forms, standard limits, definition of continuity with examples and discontinuity ,Geometrical Meaning of derivative of the addition, difference, product and division of two functions.

Unit – IV Integration
Definition standard integrals, integration by the method of substitution, integration by parts, integration of sum and difference, multiplication of two functions,geometrical interpretation of definite integration, general properties of definite integral, integration of even odd functions, integration of form of f (a-x) ,f(a+b-x), Leibnitz formula.

Unit – V Applications of differentiation, integration and Differential equations
Applications in differentiation: errors and approximations, increasing and decreasing functions, derivatives of a rate of change, maxima and minima, (single variable function) Application in integration: the area bounded by two curves, (standard curves) Differential equation: order and degree of a differential equation, formation of differential equation, various methods to find general solutions of first order and first degree differential equation [variable separable, homogeneous, non– homogeneous and Linear DE]

Suggested Reading:

1	H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand.
2	B.S.Grewal , "Higher Engineering Mathematics", 44^{th} edition, Khanna Publishers.
3	B.V.Ramana, "Higher Engineering Mathematics", Mc Graw Hills Education.
4	A.R.Vasistha, "Matrices", Krishna Prakashan Media(p)Ltd.
5	Joseph Edwards, "Differential Calculus For Beginners", Arihant publishers.
6	N.P.Bali ,Manish Goyal, "A Text Book Of Engineering Mathematics", Laxmi Publications(p) Ltd.

Scheme of Instruction, Evaluation

and

Syllabi of

B.E. BIOMEDICAL ENGINEERING

SEMESTER - II

With effect from Academic Year 2022-23

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	Engineering Mathematics-I	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	-	2	25	50	1
7.	ES 251 CS	Programming for Problem Solving Lab	-	2	25	50	1
8.	ES 251 EE	Basic Electrical Engineering Lab	-	2	25	50	1
9.	ES 252 BM	Computer Aided Engineering Lab	-	2	25	50	1
10	HS 251 EG	Communicative English Lab	-	2	25	50	1
		TOTAL	**15**	**10**	**325**	**550**	**20**

BS 201 MT	**ENGINEERING MATHEMATICS – I**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To introduce the concepts of sequences, series and their properties
2	To Study Fourier Series and its applications.
3	To introduce the concepts of functions of several variables and multiple integrals
4	To study vector differential and integral calculus

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Find the nature of sequences and series
CO-2	Expand functions as a Fourier series.
CO-3	Use the knowledge of multiple integrals in finding the area and volume of any region bounded by given curves
CO-4	Apply this knowledge to solve the curriculum problems

	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 Sequences and Series:
Sequences, Series, General properties of series, Series of positive terms, Comparison tests, tests of Convergence D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test, Logarithmic test, Alternating series, Series of positive and negative terms, Absolute convergence and Conditional convergence ; Fourier Series, Half range Sine and Cosine Series, Parseval's theorem.

Unit – II Calculus of one variable:
Rolle's theorem, Lagrange's , Cauchy's mean value theorems (without proof) Taylor's series, Curvature, Radius of curvature, Circle of curvature, Envelope of a family of curves, Evolutes and Involutes, Evaluation of definite and improper integrals, Beta, Gamma and Error functions.

Unit – III Multivariable Calculus (Differentiation):
Functions of two variables, Limits and continuity, Partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions (Chain rule), Change of variables, Jacobian , Higher order partial derivatives, Taylor's series of functions of two variables, Maximum and minimum values of functions two variables, Lagrange's method of multipliers.

Unit – IV Multivariable Calculus (Integration):
Double integrals, Change of order of integration, Triple integrals, Change of variables in integrals and applications-areas and volumes.

Unit –V Vector Calculus:
Scalar and vector fields, Gradient of a scalar field, Directional derivative, Divergence and Curl of a vector field, Line, Surface and Volume integrals , Green's theorem in a plane, Gauss's divergence theorem, Stoke's theorem (without proofs) and their verification.

Suggested Reading:

1	R.K.Jain & S.R.K Iyengar, *Advanced Engineering Mathematics*, Narosa Publications,4th Edition 2014.
2	Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley, 9th Edition, , 2012.
3	B.S.Grewal, *Higher Engineering Mathematics*, Khanna Publications, 43rd Edition, 2014.
4	G.B.Thomas , Maurice Weir and Joel Hass, *Thomas' Calculus* , Peterson, 12th Edition, 2010.
5	B.V. Ramana, *Higher Engineering Mathematics*, 23rd reprint, 2015.
6	N.P.Bali and M. Goyal, A text book of *Engineering Mathematics*, Laxmi Publications 2010.
7	H.K. Dass, Er. Rajnish Varma, *Higher Engineering Mathematics*, Schand Technical Third Edition.

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

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 :	
The concepts developed in this course will help in quantification of several concepts in chemistry that have been introduced at the 10+2 level. Technology is being increasingly based on the Electronic, Atomic and Molecular level modifications. The course will enable the student to:	
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 10**	**PO 11**	**PO 12**	**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, Mobility and Conductivity, 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. Miller's theorem and it's duality. 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 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
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 program
CO-4	Use standard library functions in C and develop modular programs using user defined functions and structured data types

	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
Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. **Number Systems**: Binary, Octal, Decimal, 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 Goto 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, Lvalue and Rvalue, 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 Reading Comprehension:

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**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

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 understand the working principles of DC motor, DC generator, Transformers and single phase induction motors.
3	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 exciting with DC and AC excitations.
CO-2	Apply different theorems to solve complicated electrical circuits to obtain the current, voltage and power.
CO-3	Understand the main components, characteristics, applications of different DC and AC electrical machines used in industry.
CO-4	Understand the importance of protective devices and their rating used in electrical circuits.
CO-5	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 10**	**PO 11**	**PO 12**	**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.

Unit – I: DC Circuits
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton 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 and 3-ph Induction Motors
Transformers: Electromagnetic induction, Faradays laws, Statically induced emf, Lenz law, BH characteristics, ideal and practical transformer, losses and efficiency, Auto-transformer and three-phase transformer connections. **Three Phase Induction motor:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, squirrel cage IM, slip-ring IM, Applications

Unit – IV Single-phase induction motor & DC Machines Single-phase induction motor
Construction and principle of operation, Capacitor start & capacitor run motor, applications **DC Generators:** Dynamically induced emf, Flemming's Right hand and Left hand rules, Construction and principle of operation of DC generator, EMF equation, Types of DC Generators, OCC characteristics, applications **DC Motors:** principle of operation of DC Motor, Types of DC motors, applications.

Unit – V Electrical Installations
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

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

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 10**	**PO 11**	**PO 12**	**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**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

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**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

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.

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	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

	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	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.

	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.

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

ES 251 EE	**BASIC ELECTRICAL ENGINEERING LAB**					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

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 understand the working principles of DC motor, DC generator, Transformers and single phase induction motors.
3	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	Get an exposure to common electrical components and their ratings. Make electrical connections by wires of appropriate ratings.
CO-2	Understand the usage of common electrical measuring instruments.
CO-3	Analyze the performance of AC and DC circuits with appropriate operating conditions.
CO-4	Understand the basic characteristics of transformers and electrical machines.
CO-5	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 10**	**PO 11**	**PO 12**	**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 1: Basic safety and precautions - Introduction and use of measuring instruments
1.	Verification of Kirchhoff's Laws
2.	Verification of Thevenin's & Norton's Theorem
3.	Steady- state and transient time-response of R-C circuit to a step change in voltage.
4.	Sinusoidal steady state response of R-L and R-L-C circuits- impedance calculation and verification
5.	Measurement of three-phase power in balanced three-phase circuits using Two-Wattmeter method
II - Cycle	
	Demonstration 2. Demonstration of cut-out sections of machines: DC machine, induction machine, synchronous machine and single-phase machine.
6.	Load test on single phase transformer: measurement of primary and secondary voltages, currents and power.
7.	Three-phase Transformer: Star and Delta connections. Voltage and current relationship.
8.	Torque speed characteristics of separately excited DC motor.
9.	Synchronous speed of two- pole and four-pole, three-phase induction motor, Speed reversal by change of phase-sequence.
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**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

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 10**	**PO 11**	**PO 12**	**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 and components of Computer-aided design (CAD)/Computer-aided manufacturing (CAM) Menu of a CAD/CAM software
2.	Solid Modeling and Viewing; Modeling entities & features, Modeling operations and strategies
3.	Part Modeling - Draft, Patterns, Mirroring
4.	Sweeps, and Circular Patterns
5.	3D Curves and Sweeps
6.	Swept Blends/Lofting
7.	Modeling Aids and Tools; Entity selection, transformation, measurement, color, material
8.	Mass and Geometric Properties; Area, Volume, Centroid, inertia, etc.
9.	Assembly Modeling; Bottom-up, top-down assembly approaches, Mating conditions, subassemblies, assembly analysis
10.	Engineering Drawing; Drawing structures, Angle of projections, Annotations, Tolerances, Manufacturing information
11.	Product Data Exchange; IGES, STEP, ACIS & DXF, STL
12.	Heart stent designing
13.	Honeycomb designing
14.	Structural analysis, Thermal analysis

HS 251 EG	**COMMUNICATIVE ENGLISH LAB**					
Pre-requisites	English proficiency above B1 level as per the CEFR (Common European Framework of Reference) for languages.		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Learn IPA and the transcription; using dictionary to decode phonetic transcription overcome the difficulties with sounds of English; self learning through CALL
2	Demonstrate use of English speech sounds, stress and intonation in day-to-day Situations/conversations/interactions
3	Introducing oneself in various contexts : Social, Academic and Professional
4	Improve listening and understand various accents – GIE, RP and Gen Am
5	Learn to participate in various contexts – extempore, gds, and presentations

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Sensitize the nuances of English speech sounds with computer-assisted individualized and independent language learning
CO-2	Use better pronunciation and accent
CO-3	Use functional English
CO-4	Listen and speak effectively by understanding various accents
CO-5	Increase possibilities of job prospects and communicate confidently

	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
English Sound system: Sounds of English, Vowels, Consonants, using dictionary to decode phonetic transcription, transcription exercises with the help of CALL (Computer Aided Language Lab)

Unit - II
Stress and Intonation: Syllable, Word stress and its importance, Intonation-falling and rising tone

Unit - III
Introductions and Presentation skills: In social, formal, academic and professional contexts; JAM, Picture description/perception; Role plays: use of dialogues in various situations and settings; Occasions to give various presentations with emphasis on visual aids and body language

Unit - IV
Listening Comprehension: Listening to various accents, listening practice and exercises.

Unit - V
Group Discussions: Types of group discussions; case studies; dos and don'ts of group discussion-intensive practice.

Suggested Reading/Software:

1	T.Balasubramanian.A TextbookofEnglishPhoneticsforIndianStudents. Macmillan,2008.
2	J. Sethi et al., A Practical Course in English Pronunciation (with CD). PrenticeHallofIndia, 2005.
3	Hari Mohan Prasad. How to Prepare for Group Discussions and Interviews. TataMcGraw Hill, 2006
4	English for Engineers and Technologists (Combined edition , Vol. 1 and 2) Orient Blackswan 2010.
5	**Software:** 1. Sky Pronunciation Suite 2. Study Skills 3. English Pronunciation Dictionary –CALD