FOUNDATION UNIVERSITY ISLAMABAD

فاؤنڈیشن یونیورسٹی اسلام آباد

Bachelor of Biomedical Engineering Technology

Department of Engineering Technology

Road Map BSc BMET

Program	No. of semesters	Course category	No. of courses in program	Credit hours
BSc BMET	08	Core / Compulsory	2	6
		General	12	30
		Interdisciplinary Elective	5	12
		Foundation	5	14
		Major	13	39
		Supervised Industrial Training	2	32
		Total	39	133

Semester Wise Course Plan

SEMESTER I

S#	Course Title	Credit Hours	Status
1	Basic Biology (for Pre-Engineering Students)/ Basic Mathematics (for Pre-Medical Students)	3	
2	Functional English	3	General
3	Islamic Studies	2	General
4	Applied Physics	2	General
5	Applied Physics Lab	1	General
6	Application of Information & Communication Technologies	2	General
7	Application of Information & Communication Technologies Lab	1	General
8	Workshop Practice	1	Major
9	Technical Drawing	1	IDE
	Total	**16**	

SEMESTER 2

S#	Course Title	Credit Hours	Status
1	Calculus and Analytical Geometry	3	General
2	Basic Electrical Technology	2	Major
3	Basic Electrical Technology Lab	1	
4	Human Anatomy & Physiology	3	Major
5	Human Anatomy & Physiology Lab	1	
6	Computer Programming	1	IDE
7	Computer Programming Lab	1	
8	Fundamentals of Management	2	General
. 9	Professional Practices	2	General
	Total	**16**	

SEMESTER 3

S#	Course Title	Credit Hours	Status
1	Signals and Systems	2	Major
2	Signals and Systems Lab	1	Major
3	Ideology and Constitution of Pakistan	2	General
4	Linear Algebra & Differential Equations	3	IDE
5	Electrical Circuit Analysis	2	Major
6	Electrical Circuit Analysis Lab	1	
7	Digital Logic Design	2	Major
8	Digital Logic Design Lab	1	
9	Civic & Community Engagement	2	General
	Total	**16**	

SEMESTER 4

S#	Course Title	Credit Hours	Status
1	Technical Report Writing	3	General
2	Probability and Statistics	3	General
3	Electronic Devices and Circuits	2	Major
4	Electronic Devices and Circuits Lab	1	
5	Microprocessors and Microcontrollers	2	Major
6	Microprocessors and Microcontrollers Lab	1	Major
7	Biochemistry	2	Major
8	Biochemistry Lab	1	Major
9	Entrepreneurship	2	General
	Total	**17**	

SEMESTER 5

S#	Course Title	Credit Hours	Status
1	Medical Imaging Processing	2	Major
2	Medical Imaging Processing lab	1	Major
3	Communication Skills	2	IDE
4	Biomedical Instrumentation	2	Minor
5	Biomedical Instrumentation Lab	1	
6	Biomedical Control Systems	2	Major
7	Biomedical Control Systems Lab	1	Major
8	Biomechanics	2	Major
9	Biomechanics Lab	1	Major
10	Project-I	3	
	Total	**17**	

SEMESTER 6

S#	Course Title	Credit Hours	Status
1	Medical Imaging Devices	2	Minor
2	Medical Imaging Devices Lab	1	
3	Biomaterials	2	Major
4	Biomaterials Lab	1	Major
5	Clinical Laboratory Equipment	2	Minor
6	Clinical Laboratory Equipment Lab	1	
7	Medical Device Quality System and Standards	3	Major
8	Rehabilitation Techniques	2	Minor
9	Rehabilitation Techniques Lab	1	
10	Project-II	3	
	Total	**18**	

SEMESTER 7

S#	Course Title	Credit Hours	Status
1	Supervised Industrial Training-I	16	
	Total	**16**	

SEMESTER 8

S#	Course Title	Credit Hours	Status
1	Supervised Industrial Training-II	16	
	Total	**16**	

COURSE TITLE: BASIC BIOLOGY

INTRODUCTION & OBJECTIVES:

Basic Biology course serves as an introduction to the fundamental concepts and principles of biology, the scientific study of living organisms and their interactions with the environment. This foundational course provides students with a broad understanding of life sciences and forms the basis for more advanced studies in biology.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Understand biology of living organisms.
2. Explain the working principles of nucleic acids (DNA and RNA) with respect to human body.
3. Use Basic Laboratory Equipment to analyze cell biology

COURSE OUTLINE FOR THEORY:

Biology: Major branches of biology: Three Domains of life. Prokaryotes and Eukaryotes. Chemistry of bio molecules including nucleic acids: lipids: carbohydrates and proteins and hormones: Shape of molecule and its function. Cell structure and division including mitosis and meiosis: Tour of the cells and its organelles. Central dogma of Molecular Biology: Chromosomes and DNA: genes: units of heredity: Genes & alleles. Mendel's laws of inheritance: multiple alleles: linkage and crossing over: sex determination: Viruses and Infectious diseases: Immune system: Recombinant DNA technology: Development and role of cytoplasm and nucleus in development.

COURSE OUTLINE FOR LAB:

1. Methodology of Autoclave for Sterilization
2. Observance of Cell division in Onion Root Tip
3. Identification of Carbohydrate Molisch Test
4. Benedicts Test
5. Iodine Test
6. Osazon Test
7. Identification of Proteins
8. Ninhydrin Test
9. Xanthoproteic Test
10. Isolation of Cholesterol from Egg Yolk
11. Protein Denaturation Test
12. Determination of Serum Creatinine
13. Chromatography
14. Open Ended Lab

RECOMMENDED BOOKS/READINGS:

1. Biology A Global Approach, Campbell, Jane B. Reece, Pearson Education (Latest Edition)
2. Life, The Science of Biology, David E. Sadava and W H Freeman (Latest Edition)

COURSE TITLE: BASIC MATHEMATICS

COURSE INTRODUCTION & OBJECTIVES:

A Basic Mathematics course serves as a foundational introduction to fundamental mathematical concepts and skills. It is designed to equip students with essential mathematical knowledge and problem-solving abilities that are applicable in various academic and real-world contexts.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Apply elementary knowledge of linear algebra to address mathematical problems.
2. Solve different mathematical problems using knowledge of calculus and analytical geometry.

COURSE OUTLINE FOR THEORY:

Complex Numbers: Properties of complex numbers: Conjugates and modulus: Geometrical representation of complex numbers: Quadratic Equations & Cube Roots: Roots of a quadratic equation (real: distinct: equal and imaginary roots): Formation of quadratic equation when the roots are given: Cube Root of Unity: Properties of cube root of unity: Matrices: Properties: sum: difference and multiplication of matrices: Cramer's rule: Solution of linear equations of three unknowns: Determinants: Properties: addition: subtraction and multiplication of determinants: Sequence and series: Arithmetic progression: Standard forms of an arithmetic progression: Arithmetic means: Geometric progression: Standard forms of a geometric progression: Sum of Infinite geometric series: Geometric means: Harmonic progression: Harmonic means: Relation between H.M.: A.M. and G.M.: Binomial Expansion: Expansion of type $(a+b)^n$ for positive integer of 'n': Use of the general term and determine the middle term or terms of the expansion: Partial Fractions: Resolve into partial fractions: Proper and improper fraction: Functions: One-one function: Onto function: Even function: Odd function: Exponential function: Trigonometric function: Logarithmic function: Circular Measure: Understand the definition of radians and use the relationship between radians and degrees: Trigonometric Functions: Basic functions e.g. sine: cosine: tangent etc. relation between them: Trigonometric identities: sum and difference formulae: multiple angle formulae: Inverse functions: Differential Calculus: Basic concepts: limits: exponential functions: differentiation of exponents and trigonometric functions: Integral Calculus: Basic integration: rules of integration: integration of exponential and trigonometric functions: integration by parts: integration using substitution: Analytical Geometry: Lines: midpoint: equation of lines: angles and sections.

RECOMMENDED BOOKS/READINGS:

1. Precalculus: Mathematics for Calculus, James Stewart, Lothar Redline and Saleem Watson, Cengage Learning (Latest Edition)
2. Mathematics for A Levels,CGP Books (Latest Edition)

COURSE TITLE: FUNCTIONAL ENGLISH

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to equip students with essential language skills for effective communication in diverse real-world scenarios. It focuses on developing proficiency in English language usage: word choices, grammar and sentence structure. In addition, the course will enable students to grasp nuanced messages and tailor their communication effectively through the application of comprehension and analytical skills in listening and reading. Moreover, the course encompasses a range of practical communication aspects including professional writing, public speaking, and everyday conversation, ensuring that students are equipped for both academic and professional spheres. An integral part of the course is fostering a deeper understanding of the impact of language on diverse audiences. Students will learn to communicate inclusively and display a strong commitment to cultural awareness in their language use. Additionally, the course will enable them to navigate the globalized world with ease and efficacy, making a positive impact in their functional interactions.

COURSE OUTCOMES:

On the successful completion of the course, candidates will be able to:

1. Apply enhanced English communication skills through effective use of word choices, grammar and sentence structure.
2. Comprehend a variety of literary / non-literary written and spoken texts in English.
3. Effectively express information, ideas and opinions in written and spoken English.
4. Recognize inter-cultural variations in the use of the English language and effectively adapt their communication style and content based on diverse cultural and social contexts.

COURSE CONTENTS:

Vocabulary building (contextual usage, synonyms, antonyms and idiomatic expressions), Communicative grammar (subject-verb-agreement, verb tenses, fragments, modifiers, articles, word classes, etc.), Word formation (affixation, compounding, clipping, back formation, etc.), Sentence structure (simple, compound, complex and compound-complex), Sound production and pronunciation, Understanding purpose, audience and context, Contextual interpretation (tones, biases, stereotypes, assumptions, inferences, etc.), Reading strategies (skimming, scanning, SQ4R, critical reading, etc.), Active listening (overcoming listening barriers, focused listening, etc.), Principles of communication (clarity, coherence, conciseness, courteousness, correctness, etc.), Structuring documents (introduction, body, conclusion and formatting) , Inclusivity in communication (gender-neutral language, stereotypes, cross-cultural communication, etc.), Public speaking (overcoming stage fright, voice modulation and body language), Presentation skills (organization content, visual aids and engaging the audience), Informal communication (small talk, networking and conversational skills), Professional writing (business e-mails, memos, reports, formal letters, etc.)

RECOMMENDED BOOKS/READINGS:

1. "Understanding and Using English Grammar" by Betty Schrampfer Azar.
2. "English Grammar in Use" by Raymond Murphy.
3. "The Blue Book of Grammar and Punctuation" by Jane Straus.
4. "English for Specific Purposes: A Learning-Centered Approach " by Tom Hutchinson and Alan Waters.

COURSE TITLE: ISLAMIC STUDIES

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide students with a comprehensive overview of the fundamental aspects of Islam, its beliefs, practices, history and influence on society. It will further familiarize the students with a solid foundation in understanding Islam from an academic and cultural perspective. Through this course, students will have an enhanced understanding of Islam's multifaceted dimensions which will enable them to navigate complex discussions about Islam's historical and contemporary role, fostering empathy, respect, and informed dialogue.

COURSE OUTCOMES:

On the successful completion of the course, candidates will be able to:

1. Demonstrate enhanced knowledge of Islamic foundational beliefs, practices, historical development, spiritual values and ethical principles.
2. Describe basic sources of Islamic law and their application in daily life.
3. Identify and discuss contemporary issues being faced by the Muslim world including social challenges, gender roles and interfaith interactions.

COURSE CONTENTS:

Definition of Islam and its core beliefs, the Holy Quran (introduction, revelation and compilation), Hadith and Sunnah (compilation, classification, and significance), Key theological concepts and themes (Tawhid, Prophethood, Akhirah etc.), Life and legacy of the Holy Prophet PBUH, Diverse roles of the Holy Prophet PBUH (as an individual, educator, peace maker, leader etc.), World before Islam, The Rashidun Caliphate and expansion of Islamic rule, Contribution of Muslim scientists and philosophers in shaping world civilization, Fundamental sources of Islamic jurisprudence, Pillars of Islam and their significance, Major schools of Islamic jurisprudence, Significance and principles of Ijtihad.

Status and rights of women in Islamic teachings, Marriage, family, and gender roles in Muslim society, Family structure and values in Muslim society, Relevance of Islam in the modern world (globalization, challenges and prospects), Islamophobia, interfaith dialogue, and multiculturalism, Islamic viewpoint towards socio-cultural and technological changes.

RECOMMENDED BOOKS/READINGS:

1. "The five Pillars of Islam: A Journey Through the Divine Acts of Worship" by Muhammad Mustafa Al-Azami.
2. "The Five Pillars of Islam: A Framework for Islamic Values and Character Building" by Musharraf Hussain
3. “Towards Understanding Islam” by Abul A’ la Mawdudi.
4. “Island Nazria e Hayat” by Khurshid Ahmad

COURSE TITLE: APPLIED PHYSICS

COURSE INTRODUCTION & OBJECTIVES:

The course on "Applied Physics" provides students with a comprehensive understanding of the fundamental principles and concepts that govern the behavior of electrical and magnetic phenomena in our physical world. Covering topics ranging from electric charge and electromagnetic fields to circuits and magnetic materials, this course equips students with the knowledge and practical skills necessary to analyze and manipulate electrical and magnetic systems. Through hands-on experiments and theoretical learning, students will delve into the laws of electrostatics, electromagnetism, and mechanics, enabling them to apply these principles to real-world scenarios. Additionally, the course emphasizes the importance of laboratory work and the application of physics in various technological applications, paving the

way for students to become adept problem solvers and critical thinkers in the field of applied physics.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Comprehend the laws of physics related to electrostatics and construction of capacitors.
2. Apply knowledge of electromagnetism and construct inductors, current and resistors
3. Describe basic laws of mechanics pertaining to force and motion.

COURSE OUTLINE FOR THEORY:

Electric charge: Conductors and insulators: Coulomb's law: Electric field: Field due to a point-charge Electric dipole and line of charge: Flux of an electric field: Permittivity of a medium: Gauss's law: Application of Gauss's Law:
Electric potential: calculating the potential from electric field: Potential due to a point-charge and a group of point-charges. Potential due to a dipole: Potential due to a continuous charge distribution:
Capacitors: calculating capacitance: Capacitors in series and parallel: Factors affecting capacitance: Application of Capacitors:
Current and Conductors: Electric current and current density: Resistance and resistivity: Ohm's law: The Steady Magnetic Field: Resistors in series and parallel: Temperature dependence of resistance and other factors affecting resistance: Application of resistors: The magnetic field: Magnetic force on a current carrying conductor: Torque on a current-loop
Magnetic field due to current: Force between two parallel current-carrying conductors: Biot Savart law and its applications: Ampere's law: Inductance and inductors: Factors affecting inductance Permeability Faraday's law of induction: Lenz's law: Energy stored in a magnetic field: Self-induction: Mutual Induction: Magnets and magnetic materials: Di-magnetic material: Para-magnetic material: Ferromagnetism. Concepts of Rest and motion: Force and friction: Work Energy and power: Momentum and law of conservation of momentum.

COURSE OUTLINE FOR LAB:

1. To investigate the properties of series combination of Capacitors
2. To determine the given resistance by leakage method using ballistic Galvanometer
3. To study the variation of Photoelectric current with intensity of incident beam
4. To determine the temperature coefficient of resistance of coil by wheat stone bridge
5. To study Ohm's law
6. To investigate the properties of Series Combination of Resistances
7. To investigate the properties of Parallel combination of Resistances
8. Practical Demonstration of Ampere Law
9. Practical Demonstration of Faraday Law
10. To demonstrate the function of transformer as Step Up and Step-Down Transformer

RECOMMENDED BOOKS/READINGS:

1. A Guidebook for Muslims, Syed. Abul Hasan Ali Nadvi (Latest Edition)
2. Halliday, Resnick and Walker, "Fundamentals of Physics" (Latest Edition)
3. Hugh D. Young and R.A. Freedman, University Physics. (Latest Edition)
4. Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with

modern Physics, (Latest Edition)

COURSE TITLE: APPLICATIONS TO INFORMATION AND COMMUNICATION TECHNOLOGIES

COURSE INTRODUCTION & OBJECTIVES:

An Information and Communication Technology (ICT) Lab Course is designed to provide hands-on practical experience with various hardware and software tools used in the field of information technology and communication. This course complements theoretical knowledge with practical skills, preparing students for careers in IT and related fields.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Describe major components of computer hardware and software.
2. Demonstrate the concepts of data communication and networks.
3. Demonstrate the working of hardware components of computer.
4. Practice MS Office applications.

COURSE OUTLINE FOR THEORY:

Introducing Computer Systems: Basic Definitions: Computer and Communication Technology: the applications of ICT - particularly for engineering technology: Basic Operations and Components of a Generic Computer System: Basic operations: Input: Processing: output: storage Basic components: Hardware: Software: Data: Users: types of storage devices: Processing Data: Transforming data into information: how computers represent and process data: Processing Devices: CPU architectures: The Internet: The Internet and the World Wide Web- browsers: HTML: URLs/ How DNS works: Email and other programs: Introduction to Embedded Systems: What is an Embedded System: Applications: Components: Programming Languages: Popular Development Platforms: Networking Basics: Uses of networks: Common types of networks (LAN: WAN: MAN etc.): Introduction to OSI Model: Future of Networks: Database Management: Hierarchy of Data: Maintaining Data: Database Management Systems: Exposure to ICT Tools and Blogs: Protecting your privacy: your computer and your data: Basic Security Concepts: threats to users: threats to hardware: threats to Data.

COURSE OUTLINE FOR LAB:

1. Introduction to the basics of the internet e.g., using search engines, using Wikipedia, checking your Email.
2. Personal computer components, inside the CPU.
3. Introduction to typing tutors, typing practice. Introduction to MS word.
4. Introduction to MS Power point.
5. Introduction to MS Excel.
6. Introduction to HTML
7. Introduction to HTML codes.
8. Writing small HTML codes.
9. Introduction to web designing.
10. Introduction to web designing (cont.)
11. Introduction to programming languages.
12. Introduction to programming languages (cont.)

RECOMMENDED BOOKS/READINGS:

1. “Introduction to Computers”, Peter Norton, McGraw-Hill (Latest Edition)
2. “Computing Essentials”, Timothy O’Leary and Linda O’Leary, McGraw-Hill (Latest Edition)
3. Using Information Technology: A Practical Introduction to Computers & Communications”, Williams Sawyer, McGraw-Hill (Latest Edition)
4. “Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning” Shelly GB, Vermaat ME

COURSE TITLE: WORKSHOP PRACTICE

COURSE INTRODUCTION & OBJECTIVES:

A Workshop Practices course provides hands-on training in various fundamental skills and techniques used in workshops and industrial settings. This practical course aims to equip students with the essential knowledge and abilities necessary for working with tools, machinery, and materials safely and efficiently.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Use safety equipment during workshop practice.
2. Participate in workshop activities individually as well as in a group.

COURSE OUTLINE FOR LAB:

1. Various technical facilities in the workshop including mechanical and electrical equipment Concepts in electrical safety
2. Safety regulations and Earthing concepts
3. Electric shocks, and treatment
4. Use of tools used by electricians
5. Wiring regulations
6. Types of cables and electric accessories including switches plugs, circuit breakers, fuses etc., symbols for electrical wiring schematics e.g., switches, lamps, sockets etc.
7. Drawing and practice in simple house wring and testing methods
8. Wiring schemes of two-way and three-way circuits and ringing circuits
9. Voltage and current measurements
10. Electric soldering and soldering tools, Soldering methods and skills
11. PCB designing, transferring a circuit to PCB, Etching, Drilling, and soldering component on PCB testing.

RECOMMENDED BOOKS/READINGS:

1. S. K. Choudhury, "Elements of Workshop Technology", (Latest edition)
2. Chapman, "Workshop Technology", (Latest edition)

COURSE TITLE: TECHNICAL DRAWING

COURSE INTRODUCTION & OBJECTIVES:

Technical drawing is a precise and standardized form of visual communication used in engineering, architecture, and various industries. It involves creating detailed and accurate drawings and diagrams to convey complex technical information, such as plans, schematics, and blueprints. These drawings use specific symbols, lines, and notations to represent objects, dimensions, and relationships, enabling engineers, architects, and technicians to design, document, and communicate their ideas effectively. Technical drawing plays a crucial role in the design, manufacturing, and construction processes, ensuring clarity, accuracy, and consistency in conveying technical concepts and specifications.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Recognize basic tools and shapes of Engineering Drawing.
2. Understand basic principles of Engineering Drawing Tools for representation of Engineering Drawing Models.
3. Practice Engineering Drawing Principles to draw 2-D & 3D sketches using modern tools.

COURSE OUTLINE FOR LAB:

Mechanical Drawing: Sheet Layout: free hand sketching: basic drafting techniques: drawing and lettering: dimensioning: projections and section of solids: practice of assembly drawing. Civil drawing: plan: elevations (front left and right)

Electrical Drawing: Electrical safety drawings: electric substation equipment layout: schematic diagrams of substations: lighting and power distribution boards in contrast with house and industrial wiring diagrams: electrical symbols and one-line diagrams of a typical power system and its parts using all details: 2D modelling using AutoCAD: Layering using AutoCAD: 3D Wireframe Modelling in AutoCAD: 3D Solid modelling in AutoCAD: Helical Spring using AutoCAD: 3D Surface Modeling: Open Ended Lab

RECOMMENDED BOOKS/READINGS:

1. Mitchel & Spencer, “Technical Drawing” (Latest Edition)
2. Choudhry, “Elements of Workshop Technology” Volume –I. (Latest Edition)
3. Chapman, “Workshop technology” Part-I, II, & III. (Latest Edition)

COURSE TITLE:

CALCULUS AND ANALYTICAL GEOMETRY

COURSE INTRODUCTION & OBJECTIVES:

The Calculus and Analytical Geometry course provides an in-depth exploration of fundamental mathematical concepts developed by luminaries like Newton, Leibniz, and Descartes. This course delves into the transformative principles of calculus, offering insights into the understanding of change, motion, and quantitative relationships. Simultaneously, it introduces analytical geometry, a discipline that seamlessly combines algebraic methods with geometric concepts. Throughout the journey, students will master the tools of differentiation, integration, and algebraic representation of geometric figures, equipping them with a powerful set of skills applicable across various disciplines. The course promises a mathematical adventure, culminating in a solid understanding of calculus and analytical geometry and the

ability to solve real-world problems with precision.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Discuss basic equations, graphical sketches of different functions, limits, and continuity.
2. Solve problems by applying techniques of differentiation and integration.
3. Analyze vector calculus and analytical geometry in multiple dimensions for the investigation of different engineering technology problems.

COURSE OUTLINE FOR THEORY:

Basics: Basic definition of derivative: differentiation of different function: rule of differentiation: chain rule implicit differentiation
Applications: slope: equation of tangent and normal, maxima, minima and point of inflection
Integration: Indefinite integral: different techniques of integration i.e., integration by parts: integration by substitution: by partial fraction: integration of different trigonometric identity
Definite integrals: Application of definite integral: i.e.: Area under the curve. Area between the curve: mean value theorem: finding the volume by slicing: volume of solid revolution Disk and Washer method: moment and centre of mass etc.
Vector Spaces: Vector in space: vector calculus: Divergence: curl of vector field: Directional derivatives: multivariable function Partial derivatives: Spherical: polar: cylindrical coordinates Vectors in Planes: Dot product and cross products: line and plane in space. Application: work: angle between two vectors: Area of triangle: Area of parallelogram etc.

RECOMMENDED BOOKS/READINGS:

1. Calculus, G. B. Thomas, A. R. Finney, Pearson Education (Latest Edition)
2. Calculus, Early Transcendental, H Anton, I C Bivens and S Davis, John Wiley (Latest Edition)
3. Essential Calculus, James Stewart (Latest Edition)
4. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley (Lated Edition).

COURSE TITLE: BASIC ELECTRICAL TECHNOLOGY

COURSE INTRODUCTION & OBJECTIVES:

The Basic Electrical Technology course is a foundational exploration into the fundamental principles of electrical engineering. This course is designed to provide students with a comprehensive understanding of basic electrical concepts and their practical applications. Starting with an introduction to electrical circuits, the course covers essential topics such as voltage, current, resistance, and power. Students will learn about different circuit components, including resistors, capacitors, and inductors, and how they interact within electrical systems.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Define the concepts of fundamental electrical quantities, electromagnetism, and electrostatics.
2. Describe the relationship between line and phase voltage, and relationship between line and phase current in three-phase circuits of star and delta connections.
3. Demonstrate the construction, working & applications of electrical machines.
4. Operate AC/DC machines to determine various characteristics.
5. Appropriately exhibit the practical findings.

COURSE OUTLINE FOR THEORY:

Basic Concepts: Series and parallel circuits: Independent and Dependent Sources: power: energy: inductance: magnetic circuits: Faraday's laws of electromagnetic induction: Fleming's right-hand rule: Lenz's law: capacitance: capacitance in series & parallel circuits: types: charging and discharging of capacitors.

A.C Fundamentals: Generation of alternating current and voltage: equations of alternating current and voltage: wave form: cycle: time-period: frequency: amplitude: phase: phase difference: root mean square (RMS) value: average value: form factor: power factor: Star and Delta connections: Instantaneous and Average Power Complex Power: Maximum Power Transfer: Power Factor.

DC Machines: Constructional details: principle of operation: back e.m.f: production of torque: types: characteristics: applications: methods of speed control.
AC Machines: Single – phase machines: types: characteristics and applications: three – phase machines: constructional details: production of torque: speed control.
Transformer: Constructional details: principle of operation: e.m.f equation: phasor diagrams on no-load/on-load: equivalent circuit: regulation: losses and efficiency; open circuit and short circuit tests: auto transformers: instrument transformers.

COURSE OUTLINE FOR LAB:

1. Ohm's law verification.
2. RMS, average and peak values of periodic waveforms using the oscilloscope.
3. Star and delta connections, relationship between line voltage and phase voltage/ line current and phase current in the three- phase star and delta connections.
4. Load test on D.C shunt/compound generators.
5. Open circuit characteristics of D.C generator.
6. Speed/torque characteristics of D.C motors.
7. Load test on single phase induction motor.
8. Efficiency of a single – phase transformer.
9. Effect of field excitation on generation of voltage by a generator.
10. Voltage regulation of three – phase generator.

RECOMMENDED BOOKS/READINGS:

1. B.L.Theraja, A.K.Theraja - A text book of Electrical Technology, Vol. 2, S. Chand & Co. (Latest Edition)
2. Edward-Hughes- Electrical Technology. (Latest Edition)
3. Mehta V.K- Principles of Electrical Engineering and Electronics, S.Chand& Co. (Latest Edition)

COURSE TITLE: HUMAN ANATOMY AND PHYSIOLOGY

COURSE INTRODUCTION & OBJECTIVES:

The Human Anatomy and Physiology course is a comprehensive exploration of the structure and function of the human body. It provides a detailed examination of the various organ systems, their interconnections, and the physiological processes that sustain life. The course covers a wide range of topics, beginning with an overview of basic anatomical terminology and principles.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Define basic cells tissue and organ of the human body system.
2. Explain the relationships among the bones, muscles, joints, and tissues.
3. Illustrate the respiratory system, cardiovascular system, alimentary system, and urinary system.
4. Work on different laboratory machines (BP apparatus: Sphygmomanometer, Hematology analyzers, ECG machine).
5. Document practical findings in form of reports.

COURSE OUTLINE FOR THEORY:

Cell: Tissue: Organ: Organelles: Organ System: Basic Cell Structure: Plasma: The Blood Cell: Pressure: Flow And Resistance: Heartbeat Coordination: Mechanical Events of the Cardiac Cycle: The Cardiac Output: Measurement of Cardiac Function: Connective Tissue: Bones: Muscle and Joints (Structure & Types) Basic Anatomy and Physiology of Skeletal System: Nervous System: Respiratory System: Cardiovascular System: Digestive System and Urinary System. Homeostatic Mechanisms and Cellular Communication: Sensory and Neural Control Mechanism (Basic). Hormonal functions in Man and Women.

COURSE OUTLINE FOR LAB:

1. Safety precaution in performance and operation of Basic Medical laboratory Apparatus
2. Examining the basic Histological slides (Cell, Tissue)
3. Analysis of blood samples (CBC, Hemoglobin (Hb), WBC.)
4. Examination of Bleeding Time, Coagulation Time, and Blood groups
5. Determination of Tidal volume and Demonstration of Artificial Respiration
6. Recording of Arterial Pulse, Recording of Arterial Blood Pressure and Electro cardiogram
7. Isolation and separation of blood components through Centrifuge machine

RECOMMENDED BOOKS/READINGS:

1. Snell, "Clinical Anatomy for Medical Students" (Latest Edition)
2. Gerard J. Tortora, Principles of Anatomy and Physiology, (Latest Edition)
3. Ellis, horlad , Clinical Anatomy, A Revision and applied Anatomy for Clinical Students (Latest Edition)

COURSE TITLE: COMPUTER PROGRAMMING

COURSE INTRODUCTION & OBJECTIVES:

The Computer Programming course is designed to introduce students to the principles and practices of writing and developing computer programs. This comprehensive course covers a range of key concepts and skills essential for programming in various languages.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Apply knowledge of programming language to solve real-world problems effectively.
2. Write and compile computer programs and troubleshoot for errors.

COURSE OUTLINE FOR THEORY:

Introduction to the course, C/C++/Java/Python and their IDEs (the DAI can teach any of these languages), Data types and operators, Functions, Conditions (if, if-else, nested if-else), Conditions (switch statement, conditional operator),Recursion, Iteration (for loop, while, do-while), Iteration (do-while), Strings, File handling, Structures, Arrays, Sorting and their big O analysis, Array and passing arrays to functions.

COURSE OUTLINE FOR LAB:

1. Introduction to a programming language (C/C++/Java/Python)
2. Arithmetic operations
3. Conditional statements
4. Repetitive statements/loops
5. Functions
6. Recursion
7. Arrays- one dimensional
8. Sorting algorithms
9. Arrays – 2 dimensional
10. Strings
11. Graphical User Interfaces (GUIs)
12. Object Oriented Programming (OOP)
13. Open ended Lab(s)

RECOMMENDED BOOKS/READINGS:

1. Python crash course: A hands-on, project-based introduction to programming, Matthes, Eric, No Starch Press (Latest Edition)
2. Learning python: Powerful object-oriented programming, Lutz, Mark, O'Reilly Media Inc. (Latest Edition)
3. C++ How to Program, Deitel & Deitel, Prentice Hall (Latest Edition)
4. Problem Solving with C++, Walter Savitch, Addison Wesley (Latest Edition)
5. Java, Paul J Deitel and Harvey M Deitel, Pearson Press (Latest Edition)

COURSE TITLE: PROFESSIONAL PRACTICES

COURSE INTRODUCTION & OBJECTIVES:

This course offers accepted and expected behaviors, norms, and standards within a specific profession or industry. These practices are often established to ensure a high level of competence, ethics, and effectiveness in the workplace. The concept of professional practices encompasses a wide range of aspects

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Comprehend the basis of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life and professional career, and consequences of acting unethically in organization and society.
2. Acquire knowledge of various roles of engineering technologist in applying ethical principles at various professional levels.
3. Resolve the ethical dilemmas using common ethical values and identify possible actions to be taken in response.

COURSE OUTLINE FOR THEORY:

Introduction:
Introduction to ethics; personal and professional ethics; the nature of engineering ethics; legal; professional and historical definitions; origin of professional ethics; profession and professionalism; professional accountability; professional success; professional risks; professional associations; benefits of acting ethically and consequences of acting unethically.

Value of Ethics:
Values in professional ethics; central responsibility of engineering professionals; ethics in different fields of work; IEEE code of ethics; ethical code for engineering professionals; global issues in professional ethics; ethics in manufacturing and marketing; intellectual property rights; business ethics and corporate governance.

Ethical Dilemmas:
Common ethical dilemmas; resolution of ethical dilemmas; possible actions in response to dilemmas; probable consequences of these
actions.

RECOMMENDED BOOKS/READINGS:

1. Engineering Ethics Concepts & Cases by Charles E Harris, (Latest Edition)
2. Kenneth Blanchard, Professional Ethics, (Latest Edition)
3. Ethics in Engineering, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, (Latest Edition)
4. The Seven Habits of Highly effective people by Stephan r. Covey (Latest Edition)
5. Engineering Ethics: Concepts and Cases, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, (Latest Edition)
6. Professional Ethics: R. Subramanian, Oxford University Press, (Latest Edition)
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press (Latest Edition)

COURSE TITLE: SIGNALS AND SYSTEMS

COURSE INTRODUCTION & OBJECTIVES:

The course provides a foundation for understanding and analyzing signals, which represent variations of physical quantities over time or space, and systems, which manipulate or process these signals. This also includes study and analysis of body signals.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Apply operations on signals like shifting, time-reversal, convolution, and scaling.
2. Analyze signals and systems in frequency domain.
3. Investigate stability and causality of systems described by differential equations/difference equations using methods such as Z-transform.
4. Perform experiments related to analysis of signals and systems.
5. Operate proficiently MATLAB/Python to perform tasks such as: matrix manipulation, generating and plotting, load/save data, small programs.

COURSE OUTLINE FOR THEORY:

Basic Signals: unit impulse sequence, step sequence, complex exponential sequence. Signal operations include time-shifting, scaling, time-reversal. System properties include linearity, causality, time-invariance, and stability. Implementation of discrete time-systems using convolution expression. Spectral representation of periodic and aperiodic signals using Fourier series and Fourier transform. Frequency response of an LTI system. Transformation techniques for signals. Analysis of stability and causality of discrete-time systems characterized by difference equations. Understanding of tradeoffs involved in the design of FIR and IIR filters and design of digital filters in MATLAB/Python. Overview of basic biomedical signals like ECG, EEG, EMG.

COURSE OUTLINE FOR LAB:

1. Introduction to MATLAB/Python
2. Writing programs using conditional statements, loops and efficient implementation using vectorization of code
3. Plotting signals
4. Basic Signal Generation
5. Symbolic toolbox for performing integration, differentiation, Fourier transform computation.
6. Implementing LTI system using difference equation/convolution operation
7. Transformation techniques
8. Frequency domain analysis of signals
9. Frequency domain analysis of systems
10. Filter design
11. Open Ended Lab

RECOMMENDED BOOKS/READINGS:

1. Signal Processing First, James H. McClellan, Ronald Schafer, and Mark Yoder. Latest Edition, Pearson
2. A Oppenheim, A Willsky and H Nawab, “Signals and Systems” Pearson, Latest Edition

3. Simon Haykin and Barry Van Veen, “Signals and Systems” Wiley, Latest Edition

COURSE TITLE: IDEOLOGY AND CONSTITUTION OF PAKISTAN

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide students with a fundamental exploration of the ideology and the constitution of Pakistan. The course focuses on the underlying principles, beliefs, and aspirations that have been instrumental in shaping and developing Pakistan as a sovereign state. Moreover, the course will allow the students to understand the core provisions of the constitution of the Islamic Republic of Pakistan concerning the fundamental rights and responsibilities of Pakistani citizens to enable them to function in a socially responsible manner.

COURSE OUTCOMES:

On the successful completion of the course, candidates will be able to:

1. Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.
2. Demonstrate fundamental knowledge about the constitution of Pakistan 1973 and its evolution with special reference to state structure.
3. Explain the guiding principles on rights and responsibilities of Pakistani citizens as enshrined in the constitution of Pakistan 1973.

COURSE CONTENTS:

Introduction to the Ideology of Pakistan

Definition and significance of ideology, Historical context of the creation of Pakistan (with emphasis on socio-political. religious, and cultural dynamics of British India between 1857 till 1947), Contributions of the founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc. Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.

Two-Nation Theory

Evolution of the 'wo-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla, Deputation 1906, Allama Iqbal’s Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940), Role of communalism and religious differences.

Introduction to the Constitution of Pakistan

Definition and importance of a constitution.

Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949). Overview of constitutional developments in Pakistan,

Constitution and State Structure

Structure of Government (executive, legislature, and judiciary), Distribution of powers between federal and provincial governments, 18th Amendment and its impact on federalism,

Fundamentals Rights, Principles of Policy and Responsibilities

Overview of fundamental rights guaranteed to citizensby constitution of Pakistan 1973(articles 8-28), Overview of principles of policy (articles 29-40), Responsibilities of Pakistani citizens(article 5)

Constitutional Amendments

Procedures for amending the constitution, Notable constitution amendments and their implications

RECOMMENDED BOOKS/READINGS:

1. "The Idea of Pakistan” by Stephen P. Cohen.

2. “Ideology of Pakistan” by Javed Iqbal.
3. The Struggle for Pakistan” by 1. H. Qureshi.
4. “Pakistan the Formative Phase” by Khalid Bin Sayeed.
5. “Pakistan: Political Roots and Development” by Safdar Mahmood.
6. “Ideology of Pakistan” by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics” by Ayesha Jalal.
8. "Jinnah, Pakistan and Islamic Identity: The Search for Saladin" by Akbar S. Ahmed.
9. "The Making of Pakistan: A Study in Nationalism" by K.K. Aziz.
10. “Pakistan: A New History” by lan Talbot.
11. “Pakistan in the Twentieth Century: A Political History” by Lawrence Ziring.
12. “The Constitution of Pakistan 1973”. Original.
13. “Constitutional and Political Development of Pakistan” by Hamid Khan.
14. “The Parliament of Pakistan” by Mahboob Hussain.
15. "Constitutional Development in Pakistan" by G.W. Choudhury.
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury

COURSE TITLE:

LINEAR ALJEBRA AND DIFFERENTIAL EQUATIONS

COURSE INTRODUCTION & OBJECTIVES:

A course on Linear and Differential Equations typically covers fundamental mathematical concepts and techniques related to linear algebra and differential equations

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Apply elementary knowledge of linear algebra to address mathematical problems.
2. Solve different mathematical problems using knowledge of calculus and analytical geometry.

COURSE OUTLINE FOR THEORY:

Complex Numbers: Properties of complex numbers: Conjugates and modulus: Geometrical representation of complex numbers: Quadratic Equations & Cube Roots: Roots of a quadratic equation (real: distinct: equal and imaginary roots): Formation of quadratic equation when the roots are given: Cube Root of Unity: Properties of cube root of unity: Matrices: Properties: sum: difference and multiplication of matrices: Cramer’s rule: Solution of linear equations of three unknowns: Determinants: Properties: addition: subtraction and multiplication of determinants: Sequence and series: Arithmetic progression: Standard forms of an arithmetic progression: Arithmetic means: Geometric progression: Standard forms of a geometric progression: Sum of Infinite geometric series: Geometric means: Harmonic progression: Harmonic means: Relation between H.M.: A.M. and G.M.: Binomial Expansion: Expansion of type $(a+b)^n$ for positive integer of 'n': Use of the general term and determine the middle term or terms of the expansion: Partial Fractions: Resolve into partial fractions: Proper and improper fraction: Functions: One-one function: Onto function: Even function: Odd function: Exponential function: Trigonometric function: Logarithmic function: Circular Measure: Understand the definition of radians and use the relationship between radians and degrees: Trigonometric Functions: Basic functions e.g. sine: cosine: tangent etc. relation between them: Trigonometric identities: sum and difference formulae: multiple angle formulae:

Inverse functions: Differential Calculus: Basic concepts: limits: exponential functions: differentiation of exponents and trigonometric functions: Integral Calculus: Basic integration: rules of integration: integration of exponential and trigonometric functions: integration by parts: integration using substitution: Analytical Geometry: Lines: midpoint: equation of lines: angles and sections

RECOMMENDED BOOKS/READINGS:

1. Precalculus: Mathematics for Calculus, James Stewart, Lothar Redline and Saleem Watson, Cengage Learning (Latest Edition)
2. Mathematics for A Levels,CGP Books (Latest Edition)

COURSE TITLE: ELECTRICAL CIRCUIT ANALYSIS

COURSE INTRODUCTION & OBJECTIVES:

The objective of this course is to provide the students an insight to analysis of different circuits. To make them familiar with the circuit reduction and circuit solving techniques. Its ultimate aim is to develop the skills in students to investigate the complex circuits which help them in their future work.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Understand the concepts of electric circuits with DC & AC sources.
2. Analyze the transient and steady-state response of 1st order and 2nd order electric circuits .
3. Understand and implement circuits in the S-domain.
4. Demonstrate knowledge of constructing electric circuits using hardware or software.
5. Exhibit practical findings in form of reports.

COURSE OUTLINE FOR THEORY:

Basic Concept: Electric charge: current: voltage: power: energy: and sources; circuit elements- resistor: inductor and capacitor. Series and parallel combination of circuit elements. Circuit Laws and Rules: Ohm's law: Kirchhoff's laws: voltage divider rule and current divider rule. Analysis Methods: Nodal analysis: mesh analysis: source transformation: linearity and superposition: maximum power transfer theorem. RL: RC (1st order) Circuits: Natural and step response. RLC (2nd order) Circuits: Natural and step response. Sinusoidal Steady-State Analysis: Average and RMS values of signals: the phasor: admittance: impedance: AC analysis methods: resonance: and matching: power in AC circuits: inductive coupling and transformers. Laplace Transform; Step and impulse functions: applying Laplace transform: poles and zeros: circuit analysis in S-domain: transfer functions: frequency response and bode plots.

COURSE OUTLINE FOR LAB:

1. Use of basic instruments in electrical circuit analysis i.e., function generators power supplies, oscilloscopes, etc.
2. Design and implement different electrical circuits using different laws.
3. Verify circuit transformations using lab instruments.
4. Use software to simulate and analyze circuits.

RECOMMENDED BOOKS/READINGS:

1. W Hayt, J Kemmerly and S Durbin, “Engineering Circuit Analysis”, McGraw- Hill, (Latest Edition).
2. Nilsson and Riedel, “Electric Circuits”, (Latest Edition).
3. Robert L. Boylestad, “Introductory Circuit Analysis”, (Latest Edition).
4. C Alexander and M Sadiku, “Fundamentals of Electric Circuits”, McGraw- Hill, (Latest Edition)
5. J D Irwin and R M Nelms, “Basic Engineering Circuit Analysis”, Wiley,(Latest Edition)
6. R E Thomas, A J Rosa and G J Toussaint, “The Analysis and Design of Linear Circuits”, John Wiley, (Latest |Edition)

COURSE TITLE: DIGITAL LOGIC DESIGN

COURSE INTRODUCTION & OBJECTIVES:

A Digital Logic Design course introduces students to the principles and techniques used in designing and analyzing digital circuits and systems. This course covers the fundamentals of digital electronics and logic gates, emphasizing their application in building complex digital systems.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Understand fundamental concepts used in design of digital systems.
2. Analyze the working of combinational and sequential logic circuits using digital logic principles and Boolean algebra.
3. Apply principles of digital systems to design solutions for Broadly Defined Problems.
4. Execute small-scale digital circuits using Boolean algebra and K- maps for sustainable solutions.
5. Carryout experiments, using contemporary tools, under the supervision of instructors.

COURSE OUTLINE FOR THEORY:

Number Systems: Truth Functions: Binary connectives: Evaluation of truth functions: Many statement compounds: Physical realizations: Sufficient sets of connectives: Digital computer examples: Boolean Algebra: Switching Devices: Minimization of Boolean functions: Tabular Minimizations. Cubical representation of Boolean functional: Determination of prime implicants: Selection of an optimum set of prime implicants: Design of NAND and NOR networks and properties of combinational networks: Switching expressions for NAND and NOR networks: Comparator: decoders: encoders: multiplexers and demultiplexers. Transient response of combination networks: Introduction to Sequential Networks: Latches: Sequential networks in fundamental mode: Introduction to the synthesis of sequential networks: Minimization of the number of states: Clocked networks. Flip-flops (RS: JK: D: T: master/slave). Field programmable gate arrays.

COURSE OUTLINE FOR LAB:

1. To study basic logic gates and their functions
2. To design a half adder circuit
3. To design a full adder circuit
4. To design and implement 4-bit adder using logic gate ICs

5. To design and implement 4-bit subtractor using logic gate ICs
6. To analyze the operation of BCD to 7-segment decoder
7. To design a synchronous and asynchronous counter using J K flip flops
8. To design combinational circuits using multiplexer and demultiplexer
9. To analyze and study the operations of RS and Clocked RS Flip-Flop and D Flip-Flop
10. To analyze and study the operations of JK and Master-Slave JK Flip-Flop and T Flip-Flop
11. To design and implement 8 bits added on FPGA
12. To design and implement BCD to seven segment decoders on FPGA
13. Design and implement 8-bit counter with synchronous reset and load functionality on FPGA.

RECOMMENDED BOOKS/READINGS:

1. Morris Mano and Charles R. Kime, “Logic and Computer Design Fundamentals”, Prentice Hall
2. Tocci and Widmer, "Digital Systems: Principles and Applications"

COURSE TITLE: CIVIC AND COMMUNITY ENGAGEMENT

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide students with fundamental knowledge about civics, citizenship, and community engagement. Students will learn about the essentials of civil society, government, civic responsibilities, inclusivity, and effective ways to participate in shaping the society which will help them apply theoretical knowledge to the real-world situations to make a positive impact on their communities.

COURSE OUTCOMES:

By the end of this course, students will be able to:

1. Demonstrate fundamental understanding of civics, government, citizenship, and civil society.
2. Understand the concept of community and recognize the significance of community engagement for individuals and groups.
3. Recognize the importance of diversity and inclusivity for societal harmony and peaceful co-existence.

COURSE CONTENTS:

Introduction to Civics and Citizenship:

Definition of civics, citizenship, and civic engagement, Historical evolution of civic participation, types of citizenship: active, participatory, digital, etc, the relationship between democracy and citizenship.

Civics and Citizenship

Concepts of civics, citizenship, and civic engagement, foundations of modern society and citizenship, types of citizenship: active, participatory, digital, etc.

State, Government and Civil Society

Structure and functions of government in Pakistan, the relationship between democracy and civil society, right to vote and importance of political participation and representation.

Rights and Responsibilities

Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973, Civic responsibilities and duties, ethical considerations in civic engagement (accountability, non-violence, peaceful, dialogue, civility, etc.)

Community Engagement

Concept, nature and characteristics of community, Community development and social cohesion, approaches to effective community engagement, case studies of successful community driven initiatives.

Advocacy and Activism

Public discourse and public opinion, role of advocacy in addressing social issues, social action movements.

Digital Citizenship and Technology

The use of digital platforms for civic engagement, cyber ethics and responsible use of social media, digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.

Diversity, Inclusion and Social Justice:

Understanding diversity in society (ethnic, cultural, economic, political etc.), youth, women, and minorities' engagement in social development, addressing social inequalities and injustices in Pakistan, promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

RECOMMENDED BOOKS/READINGS:

1. "Civics Today: Citizenship, Economics, & You" by McGraw-Hill Education
2. "Citizenship in Diverse Societies" by Will Kymlicka and Wayne Norman.
3. "Engaging Youth in Civic Life" by James Youniss and Peter Levine.
4. "Digital Citizenship in Action: Empowering Students to Engage in OnlineCommunities" by Kristen Mattson.
5. "Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education" by Graham Pike and David Selby.

COURSE TITLE: TECHNICAL REPORT WRITING

COURSE INTRODUCTION & OBJECTIVES:

Intensive study of and practice in writing for professional settings. Focus on the types of documents necessary to make decisions and take action on the job, such as proposals, reports, instructions, policies and procedures, e-mail messages, letters, and descriptions of products and services. Practice in individual and collaborative processes involved in the creation of ethical and efficient documents.

COURSE OUTCOMES:

On the successful completion of the course, candidates will be able to:

1. Able to gain the knowledge and skill of utilizing modern presentation skills.
2. Able to understand the basics of technical report writing
3. Able to adopt a skill of writing technical English in proposal preparation, research papers, and reports presentation according to the correct standards.

COURSE CONTENTS:

Introduction to Technical Writing

Definition and importance of technical writing, evolution and historical background, key elements of effective technical communication.

Technical Communication Process

Overview of the communication process, target audience and purpose in technical writing, types of technical documents.

Proposal Write-up and Improvement Strategies

Crafting effective proposals, strategies for improving proposal writing, peer review and feedback mechanisms.

Introduction to Research and Research Types

Understanding research in technical writing, basic research types: applied and fundamental, interdisciplinary and collaborative research.

Choosing Research Problems and Research Advisors

Identifying relevant research problems, importance of research advisors, building a research proposal.

How to Carry Out Research

Research planning and execution, data collection and analysis methods, ethical considerations in research.

Different Parts of Technical Writing

Components of a technical document, structure and organization of technical writing, visual elements in technical documents

Formulation – Problem Statement

Crafting a clear problem statement, defining objectives and scope, importance of a well-defined problem.

Literature Review

Role and significance of literature review, conducting a comprehensive literature review, synthesizing information from existing studies

Design – Methodology

Developing a research design, methodology selection and justification, experimental design and data collection

Analysis - Data Analysis and Interpretation

Statistical analysis techniques, interpreting research findings, presenting results effectively

Good Writing Style Techniques

Clarity and conciseness in writing, tone and style considerations, grammar and punctuation rules

Uses of Correct Words

Precision in language usage, avoiding ambiguity and jargon, commonly misused words in technical writing

Presenting and Publishing Research

Strategies for effective presentations, publishing in peer-reviewed journals, conference presentations and proceedings

Write Business/Professional Correspondence

Importance of professional correspondence, crafting effective cover letters and cvs, email etiquette in a professional setting

Writing Meeting Minutes

Role and purpose of meeting minutes, structure and content of meeting minutes, timely distribution and follow-up

Introduction to Informal Writing

Characteristics of informal writing, use cases for informal reports, informal communication in the workplace

Uses of Informal Reports

Types and formats of informal reports, informal reporting for decision-making, effective communication in informal settings.

RECOMMENDED BOOKS/READINGS:

1. Successful Writing at Work, by Phillip C. Kolin, 4th Concise Edition. Cengage.
2. Burnett, Rebecca E. Technical Communication.

COURSE TITLE: PROBABILITY AND STATISTICS

COURSE INTRODUCTION & OBJECTIVES:

This course will explore the basic principles of probability theory, understand how to calculate probabilities, and learn how to apply these concepts to real-world situations. This deals with the collection, analysis, interpretation, and presentation of data. Statistical methods are used to draw conclusions about populations based on samples to get a solid foundation in both descriptive and inferential statistics.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Discuss fundamentals of graphical representation and frequency distributions.
2. Apply concepts of descriptive statistics to solve problems in the domain of Biomedical Engineering Technology.
3. Compare different types of data by exploiting their statistical characteristics using t-test, chi-square test and ANOVA to evaluate statistical significance.

COURSE OUTLINE FOR THEORY:

Fundamentals of probability theory: Probability distribution and statistical characteristics of a random signal: Measures of central tendency and variation: Chebychev's theorem: z-scores: Frequency distributions: Graphical representation of data and Box plots: Symmetry: skewness and Quintiles (percentiles: deciles & Quartiles): Conditional probability and Bayes's theorem: counting techniques: Concept of random variable: Discrete and continuous variable: Variance: standard deviation and different types of distributions: Regression models and correlation coefficients: ANOVA: Estimation of statistical characteristics of data: Classical and Bayesian method of estimation: Estimation of Z-test: t-test and Goodness of

fit test: Estimation theory and optimum estimators: Concept of uncorrelated: independent and orthogonal data.

RECOMMENDED BOOKS/READINGS:

1. Introduction to Probability and Statistics, William Mendenhall, Robert J Beaver and Barbara M Beaver, Cengage Learning (Latest Edition)
2. Applied Statistics and Probability for Engineers, Douglas C Montgomery and George C Runger, John Wiley & Sons (Latest Edition)
3. Statistics: A Biomedical Introduction, Bryon W Brown and Myles Hollander, Wiley-Interscience (Latest Edition)
4. Schaum's Outline of Probability and Statistics, Murray Spiegel, John Schiller and R Srinivasan, McGraw Hill Education (Latest Edition)

COURSE TITLE: ELECTRONICS DEVICES AND CIRCUITS

COURSE INTRODUCTION & OBJECTIVES:

Electronic Devices and Circuits form the foundational building blocks of modern electronic systems and technologies. This course serves as an essential introduction to the principles, functionalities, and applications of electronic components, devices, and their configurations within circuits.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Apply the concept of semiconductor diode and use it for various applications to solve circuits.
2. Analyze the working principles and characteristics of the different transistors for various source configurations and biasing techniques.
3. Demonstrate and analyze different electronic circuits and
4. practice transistor's operations to achieve desired outputs.
5. Perform the lab task in a group team environment with minimal direction of instructor.

COURSE OUTLINE FOR THEORY:

Semiconductor: Doping: PN junction: Diode Characteristics curve: Resistances in Diode: Ideal & practical Models: Q-point analysis: Diode as Half wave & Full-wave Rectifier: Diode Switching Circuit: Clippers: Clampers: Bipolar Junction Transistors: its configurations and characteristics: BJT as an inverter: Transistor types: Zener Diode: LED: Laser Diode: Photo & tunnel Diode: Field Effect Transistors: JFET: JFET current source: JFET Analog switch: JFET Biasing: MOSFET types & configuration.

COURSE OUTLINE FOR LAB:

1. Investigate the electrical characteristics of Diodes, BJT and FET.
2. Design, implementation, and measurements of electronic circuits for different applications.
3. Zener diode regulators
4. Biasing in BJT and FET
5. Small signal amplifiers in BJT and FET
6. Amplifiers using lab equipment and computer simulation tools.

RECOMMENDED BOOKS/READINGS:

1. Electronic Devices and Circuit Theory, H. Boylestad and L. Nashelsky, (Latest Edition)
2. Electronic Devices, Thomas L. Floyd, (Latest Edition)
3. Electronics Principles, Alberto P Malvino(Latest Edition)
4. Electrical Technology By B.L Theraja and A.K Theraja(Latest Edition)
5. Theodore F. Bogart, Jeffrey S. Beasley, Guillermo Rico, “Electronic devices and circuits”, (Latest Edition)

COURSE TITLE: MICROPROCESSORS AND MICROCONTROLLERS

COURSE INTRODUCTION & OBJECTIVES:

The Microprocessor and Microcontroller course focuses on the study of central processing units (CPUs) at the core of digital systems, covering the architecture, programming, interfacing, and applications of both microprocessors and microcontrollers.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain basic knowledge, features, and operation of contemporary microcontroller and microprocessor.
2. Explain different internal architectures and applications of Microprocessor and Microcontroller.
3. Apply assembly language programming to analyze different blocks of the Microprocessor/Microcontroller.
4. Imitate experiments using development kits, ICs and simulation software.
5. Reproduce the skills of Programming Arduino processor in C++.

COURSE OUTLINE FOR THEORY:

Introduction to Intel family microprocessors/microcontrollers, instruction set architecture (ISA). Assembly language programming, hardware model, read/write cycles, exception/interrupt processing, I/O devices, DMA, interfacing to memory and I/O devices. Introduction to PIC/Atmel 8051. Introduction to microcontrollers; architecture and programming, Arithmetic Instructions, Logic Instructions, Program Control Instructions, Introduction to Interrupts

COURSE OUTLINE FOR LAB:

1. Introduction to development kit of any microcontroller
2. Development of different applications on microcontroller kit.
3. Learn to read datasheets/manuals in order to develop practical applications.
4. Assembly and C language-based microcontroller (PIC or Raspberry Pi)
5. Interfacing for interrupt and data-based applications involving LED/ LCD, GPIO ports, communication ports, A/D, and D/A interfacing.
6. Project can be input voltage-based speed control of DC Motor / stepper motor using PWM

RECOMMENDED BOOKS/READINGS:

1. Douglas V. Hall, "Microprocessor and Interfacing", Tata McGraw-Hill. (Latest edition)

2. 8051 Microcontroller and Embedded Systems, M. Ali Mazidi, J. Mazidi and R. McKinlay, Prentice Hall, ISBN: 013119402X (Latest Edition)
3. The Intel Microprocessors Architecture, Programming & Interfacing, Barry B. Brey (Latest Edition)
4. Microprocessor and Interfacing, Douglas V. Hall, Tata McGraw-Hill, ISBN: 0070601674 (Latest Edition)
5. PIC Microcontroller: An Introduction to Software & Hardware Interfacing, Han-Way Huang, T. Delmar Learning, ISBN: 1401839673 (Latest Edition)

COURSE TITLE: ENTREPRENEURSHIP

COURSE INTRODUCTION & OBJECTIVES:

Entrepreneurship is the dynamic process of identifying opportunities, marshaling resources, and creating value through innovative ideas and ventures. This course aims to provide students with a comprehensive understanding of the entrepreneurial mindset, skills, and strategies necessary to navigate the complexities of starting, managing, and growing successful businesses. Through a combination of theoretical frameworks, case studies, and practical exercises, this course will equip individuals with the tools needed to thrive in the competitive landscape of entrepreneurship.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Understand entrepreneurship concept as a whole and the role of entrepreneurship in economic development.
2. Compare the role and importance of the small and medium sized enterprises in the economy.
3. Find an attractive market and apply the understanding of business planning concept for new business creation and growth.

COURSE OUTLINE FOR THEORY:

The concept of entrepreneurship; the economist view of entrepreneurship; the sociologist view; Behavioral approach; Entrepreneurship and Management. The process of entrepreneurship; Entrepreneurial Management; The entrepreneurial business; Entrepreneurship in service institutions; the new venture. Innovation concepts; Importance of innovation for entrepreneurship; Sources of innovative opportunities; the innovation process; Risks involved in innovation. Entrepreneurial profile; Trait approach to understanding entrepreneurship; Factors influencing entrepreneurship; the environment; Socio cultural factors; Support systems. Teamwork; Networking organization; Motivation and compensation; Value system. Defining SMEs; Scope of SMEs; Entrepreneurial; managers of SME; Financial and marketing problems of SMEs; Framework for developing entrepreneurial marketing; Devising entrepreneurial marketing plan; Entrepreneurial marketing strategies; Product quality and design; Role of entrepreneur in the economic development generation of services; Employment creation and training; Ideas; knowledge and skill development; The Japanese experience; Case Studies of Successful Entrepreneurs

RECOMMENDED BOOKS/READINGS:

1. Technology Ventures: From Idea to Enterprise by Thomas Byers, Richard Dorf, Andrew

Nelson, 4th Edition, McGraw Hill (Latest Edition)

2. Paul Burns and Jim Dew Hurst: “Small Business and Entrepreneurship”, Palgrave Macmillan Publishing Company, Second Edition (Latest Edition)
3. Peter F. Drucker: “Innovation and Entrepreneurship”, Harper Business, Reprint Edition (Latest Edition)
4. The Startup Owner’s Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank, Bob Dorf, K & S Ranch, (Latest Edition)
5. The Lean Startup: How Today’s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Penguin Books (Latest Edition)
6. John B. Miner, “Entrepreneurial Success”, Berrett-Koehler Publishers, (Latest Edition)

COURSE TITLE: BIOCHEMISTRY

COURSE INTRODUCTION & OBJECTIVES:

Biochemistry is the study of chemical processes and substances that occur within living organisms. This course serves as an essential foundation for understanding the molecular mechanisms underlying biological functions, including metabolism, cell structure, and the interaction of biological molecules.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Comprehend knowledge of biochemistry and macro- molecules.
2. Compare metabolic pathways for diagnosis of metabolites in human body.
3. Investigate the structure and activity of biomolecules at cellular level.
4. Conduct experiments for the detection of biomolecules.
5. Demonstrate amino acid separation using chromatographic methods.

COURSE OUTLINE FOR THEORY:

Introduction to Biochemistry: Colloidal state, buffer, pH, significance of pH Henderson equation, surface tension, viscosity, osmosis, diffusion, Biological Membrane and chromatographic techniques (TLC, Paper, HPLC)

Carbohydrates, their metabolism and energy cycles (Glycolysis, gluconeogenisisetc), Lipids, types and their metabolism and Proteins, Amino acids and their metabolism.

Bioenergetics: DNA & RNA and role of ATP for biological energy transfer, thermodynamics of life, Micromolecules and traces elements.

COURSE OUTLINE FOR LAB:

1. Preparation of solution in laboratory
2. Determination of pH by pH meter and Litmus paper
3. Demonstration the action of buffer
4. To determine the principal application of Hander son- Haselbash's equation
5. Tests for proteins
6. Examination of egg white
7. Color reactions for proteins
8. Isolation of Casein from milk

9. Tests on carbohydrates
10. Measurement of Blood Glucose level with help of spectrophotometer
11. Oral Glucose Tolerance Test (OGTT)
12. Tests of Lipid profile by chemical analyzer
13. Separation of Amino Acids by chromatographic methods.
14. Open Ended Lab I
15. Open Ended Lab II
16. Open Ended Lab III

RECOMMENDED BOOKS/READINGS:

1. Biochemistry (Lippincott's illustrated reviews series), Richard A Harvey and Denise R Ferrier (Latest Edition)
2. Modern experimental biochemistry, Boyer, Rodney, Pearson Education, (Latest Edition)
3. Principles of Biochemistry, Lehninger, W.H Freeman and Co, (Latest Edition)
4. Fundamentals of Biochemistry, Donald Voet and Judith G. Voet,, (Latest Edition)

COURSE TITLE: MEDICAL IMAGE PROCESSING

COURSE INTRODUCTION & OBJECTIVES:

Medical Image Processing is a specialized field at the intersection of medicine, computer science, and imaging technologies. This course aims to equip participants with the theoretical knowledge and practical skills required to analyze, interpret, and manipulate medical images for diagnostic, therapeutic, and research purposes. The course delves into the fundamental principles, techniques, and algorithms utilized in processing various medical imaging modalities such as MRI (Magnetic Resonance Imaging), CT (Computed Tomography), X-ray, ultrasound.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain the fundamentals of Medical Image Processing techniques (spatial domain, frequency domain, noise removal, image reconstruction and image segmentation).
2. Analyze the medical image to remove noise.
3. Practice various filtration techniques on medical images using software tools.
4. Perform the segmentation and classification on different medical images using software tools.

COURSE OUTLINE FOR THEORY:

Digital Image Fundamental:
a. Image file formats b. Elements of Visual Perception c. Image Sampling and Quantization d. An Introduction to the Mathematical Tools Used in Digital Image Processing, Intensity
Transformations and Spatial Filtering:
a. Basic Intensity Transformation Functions b. Histogram Processing c. Fundamentals of Spatial Filtering d. Smoothing Spatial Filters e. Sharpening Spatial Filters, Filtering in the
Frequency Domain:
a. Review of Concept about Fourier in 1D b. Fourier Functions of Two Variable c. The Basics of Filtering in the Frequency Domain d. Image Smoothing Using Frequency Domain Filters e. Image Sharpening Using Frequency Domain Filters,
Image Restoration and Reconstruction:

a. Noise Models b. Restoration in the Presence of Noise Only-Spatial Filtering c. Periodic Noise Reduction by Frequency Domain Filtering d. Inverse Filtering, Least Squares Filtering, GM filtering e. Image

Reconstruction from Projections, Image Segmentation:

a. Point, Line, and Edge Detection b. Thresholding c. Region-Based Segmentation d. Segmentation Using Morphological Watersheds e. The Use of Motion in Segmentation, Image

Compression:

a. Compression Standards b. Some Basic Compression Methods (Huffman Coding, Golomb Coding)

COURSE OUTLINE FOR LAB:

1. MATLAB: Introduction to MATLAB and image processing toolbox
2. Digital Image Fundamentals: Sampling and quantization, bits per pixel & shades, spatial resolution & image size, Zooming & shrinking images
3. Basic Gray Level transformations: Image Negative, Log transform.
4. Application Of Gamma Correction to enhance image
5. Contrast stretching and thresholding
6. Introduction to image Histogram , Histogram sliding
7. Histogram equalization
8. Enhancement using arithmetic/logic operations
9. Smoothing spatial filters (Mean and Median filters)
10. Sharpening spatial filters (Laplace and Sobel)
11. Un-sharp masking and high-boost filtering Combining Spatial Enhancement methods
12. Review of Fourier transform and convolution theorem, 2D-FT, FT and frequency components of an image
13. Lowpass and Highpass Filters: Ideal filters, Butterworth filters, Gaussian filters. Filters comparison, Unsharp Masking
14. Dilation and erosion
15. Detection of discontinuities, Edge linking and boundary detection, Segmentation by thresholding
16. Object recognition, classification and image compression

RECOMMENDED BOOKS/READINGS:

1. Digital Image Processing for Medical Applications by Geoff Dougherty, Cambridge University Press (Latest Edition)
2. Digital Image Processing by Gonzales, R. C., Prentice Hall, New Jersey (Latest Edition)

COURSE TITLE: COMMUNICATION SKILLS

COURSE INTRODUCTION & OBJECTIVES:

This course explores the art and science of effective communication. It introduces the ability to convey ideas, collaborate, and connect with others is paramount. This course aims to equip the students with the essential tools and knowledge to excel in various personal and professional contexts.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Understand the importance of written and spoken communication.
2. Add value to communication as a team member.

COURSE OUTLINE FOR THEORY:

Vocabulary building: common writing errors: purposeful writing: business writing: critical reading: reading for understanding: introduction to communication process: seven Cs of communication: types of listening: listening skills: verbal and non-verbal communication: basic presentation skills: Presentation Strategies and public speaking skills: use of Audio-Visual Aids: basics of group communication: communicate effectively in job interviews.

RECOMMENDED BOOKS/READINGS:

1. Practical English Grammar, A. J. Thomson and A. V. Martinet, Oxford University Press. (Latest Edition)
2. Practical English Grammar Exercises 1, A. J. Thomson and A. V. Martinet, Oxford University Press (Latest Edition)
3. A Practical Guide to Business Writing: Writing in English for Non-Native Speakers, Khaled Mohamed Al Maskari, Wiley (Latest Edition)
4. Communication Skills for Engineers, Sunita Marshal and C. Muralikrishna (Latest Edition)
5. The Essentials of Technical Communication, Elizabeth Tebeaux and Sam Dragga, Oxford University Press (Latest Edition)
6. College Writing Skills, John Langan (Latest Edition)
7. Exploring the World of English, Saadat Ali Shah, Ilmi Kitab Khana (Latest Edition)

COURSE TITLE: BIOMEDICAL INSTRUMENTATION

COURSE INTRODUCTION & OBJECTIVES:

A Biomedical Instrumentation course introduces students to the principles and applications of specialized instruments and devices used in healthcare, medical research, and diagnostics. This course provides a foundation for understanding the design, operation, and significance of biomedical instruments.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain the basic concepts related to the classification
2. techniques and working principles of biomedical equipment.
3. Demonstrate the use of sensors, transducers, and biopotentials for the design of biomedical applications.
4. Design operational prototypes using fundamental components for various biomedical applications.
5. Imitate electronics circuits with microcontroller interface.
6. Participate effectively in lab experiments individually or in small groups.

COURSE OUTLINE FOR THEORY:

Various forms of bio signals (bioelectric: bio optic: biochemical: biomechanical: bioacoustics): Active and passive transducers: displacement sensors: inductive and capacitive sensors: piezoelectric sensors: temperature sensors: optical sensors: radiation sensors: electro-chemical sensors: bio sensors: fiber optics: Introduction to (medical) instrumentation: accuracy: sensitivity: reproducibility: biocompatibility: classification: measurement constraints: invasive & non-invasive techniques: design criteria: Different types of electrodes (EEG: ECG: EMG: ERG: MEG): Physiological effects of electricity: micro and macro shock hazards: electrical safety codes and standards: basic approaches for protection against shock: protection equipment design: electrical safety analyzers: testing the electric system: testing of electrical appliances. Cardiovascular Devices: Blood Pressure Devices: Pacemaker: Defibrillator: Pulmonary Function Analyzer: Spirometry: Pulse Oximetry: Nebulizer: Capnography: Anesthesia Machine: Ventilators: Heart Lung Machine: Hemodialysis Machine: Patient Monitors: Surgical Theater Devices

COURSE OUTLINE FOR LAB:

1. Introduction to Arduino and IDE
2. Interfacing LCD with Microcontroller
3. Interfacing Keypad with Microcontroller
4. Interfacing Ultrasonic sensor with Microcontroller
5. Interfacing Humidity and Temperature sensor with Microcontroller
6. Interfacing Flex sensor with Arduino
7. Interfacing Reed Switch with Arduino
8. Interfacing Magnetic Hall sensor with Microcontroller
9. Interfacing Rotary Encoder with Arduino
10. Interfacing Infrared Temperature sensor with Arduino
11. Interfacing Heart Rate sensor with Microcontroller
12. Interfacing Joystick with Arduino

13. Open ended lab-I
14. Open ended lab-II

RECOMMENDED BOOKS/READINGS:

1. Medical Instrumentation: Application and Design; John Webster; Latest Edition; John Wiley & Sons (Latest Edition)
2. Introduction to Biomedical Engineering; John Enderle, Joseph Bronzino; Latest Edition, Academic Press (Latest Edition)
3. Introduction to Biomedical Equipment Technology; Joseph J. Carr, John M. Brown; Latest Edition; Pearson (Latest Edition)
4. Biomedical Instrumentation: Technology and Applications; Khandpur; Latest Edition; McGraw-Hill Education (Latest Edition)

COURSE TITLE: BIOMEDICAL CONTROL SYSTEMS

COURSE INTRODUCTION & OBJECTIVES:

Biomedical Control Systems involve the application of control theory and engineering principles to medical and biological systems. These systems play a critical role in various healthcare applications, monitoring and regulating physiological processes or medical devices.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Analyze the response and stability of a control system in time and frequency domains.
2. Perform simplification of the block diagrams and signal flow graphs for linear time invariant control systems.
3. Develop, test, debug and correct MATLAB programs using knowledge of control systems.
4. Design Proportional / Integral / Differential (or in combinations) controller for different closed loop applications.

COURSE OUTLINE FOR THEORY:

Introduction to Control Systems: Open – loop and closed – loop systems and their transfer functions: block diagrams: signal flow graphs: Importance of modeling: Formation of differential equations of electrical: mechanical: electromechanical and other systems: Modeling of human systems: Poles and zeros of a transfer function: stability: standardized inputs: steady – state and transient response of first – order: second order and higher order systems: Transient response specifications in time and frequency domain: Introduction to state space concepts and terminology: formation of state and output equations for physical systems: Solution of state equations: Eigenvalues and Eigen vectors: state – transition and transfer function matrices: Types and analysis of feedback control systems based on steady-state error coefficients: sensitivity function: Root locus diagrams: Analysis and Design of Control Systems Based on Root locus technique: Routh-Herwitz Stability criterion: Bode plots: Polar plots: Nyquist stability criterion: Gain and phase margins: Nichol's chart: Application of principles of control theory to analysis of biological system development of computer simulations techniques to study dynamic response of physiological system.

COURSE OUTLINE FOR LAB:

1. Using MATLAB for control systems
2. Modelling of physical systems, linear control system modelling
3. LTI Systems, First and Second Order system response
4. Computing Nyquist Criteria, root-locus and Bode plots
5. PI, PD and PID controllers
6. Servo motor control

RECOMMENDED BOOKS/READINGS:

1. S.K. Bhattacharya, Control Systems Engineering (Latest Edition)
2. Norman Nice, Control Systems (Latest Edition)
3. B. Kuo, Automatic Control Systems. (Latest Edition)
4. D'Azzo Control System (Latest Edition)
5. Shaum Series. Feedback Control System (Latest Edition)

COURSE TITLE: BIOMECHANICS

COURSE INTRODUCTION & OBJECTIVES:

A Biomechanics Course is designed to provide the knowledge of fundamental human mechanical models and design. It provides with the theoretical knowledge with practical skills, preparing students for work in human body mechanics, engineering, and related fields.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain the basic knowledge of moving system mechanics with an overview of anatomical terminology, to understand gross human movements.
2. Apply the knowledge of human biomechanics to provide solutions to case studies for specific body segments.
3. Perform experiments under supervision related the kinematics and kinetics of upper and lower limb using hardware and software.
4. Communicate the results of the experiment effectively in written and oral form.

COURSE OUTLINE FOR THEORY:

Definition and perspective: Review of statics: Review of Dynamics: Review of deformable body mechanics: Viscoelasticity: material properties. Density: mass: and inertial properties: Direct measurement of anthropometric parameters: Muscle anthropometry: Mechanical advantage of muscle: Multipoint muscles. Forms of motion: Standard reference systems and joint movement terminology: Spatial reference systems: qualitative vs. quantitative analysis of human movement: limb-segment angles: joint angle: linear and angular velocities: and acceleration: Tools for direct/indirect measurement of kinematic quantities. Link segment models: Internal and external forces acting on the link-segment model: Joint reaction forces: Direct Force measurements. Composition and structure of bone tissue: Material constituents: Structural organization: Types of bones: Bone growth and development: Bone response to stress: Osteoporosis. Joint architecture: stability: and flexibility: common joint injuries: and pathologies. Behavioral properties of musculotendinous unit: Structural organization of skeletal muscle and its function: Muscular force: strength: power: and endurance: Common

muscle injuries. Structure: movement and loads of shoulder: elbow: and wrist: Common injuries of upper limb. Structure: movement and loads of hip: knee: ankle: and foot: Common injuries of lower limb**.** Structure: movement and loading of spine: Common injuries of back and neck. Methods of gait analysis: Gait cycle: Temporal-spatial parameters: Hip: knee and ankle joint kinematics and kinetics: Interpretation of gait data

COURSE OUTLINE FOR LAB:

1. To observe the human skeletal joints and their movement in anatomical reference planes.
2. To demonstrate the use of various methods of solving vectors problems in biomechanical analysis
3. To investigate the kinetics involved in different types of motion
4. To determine the coordinates of the center of gravity (COG) of a body using segmentation method
5. To understand the nature of torque and its effects on the body.
6. To determine the muscle force required by the biceps while holding a known weight in hand for a range of elbow joint angles using the mechanical arm model.
7. To estimate the biomechanical power of an individual using the Sargent Jump test
8. To study and test the biomechanical power of an individual using the Vertical Jump test via Jump Mat
9. To study and investigate the gait cycle mechanism and collect data on the temporal-spatial parameters of gait for a range of anatomically intact individuals
10. To assess the joint flexibility (ROM) and effects of fatigue on ROM using a simple mechanical Goniometer
11. To investigate and plot the movement of ideal and practical biomechanical elbow model using MATLAB
12. To calculate the lower limb joint angles, joint angular velocity and joint power using raw coordinate data
13. Open Ended Lab

RECOMMENDED BOOKS/READINGS:

1. Basic Biomechanics, Susan J. Hall (Latest Edition)
2. Biomechanics and Motor Control of Human Movement, David A. Winter, Latest Edition, Jhon Wiley & Sons (Latest Edition)

COURSE TITLE: PROJECT - I

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to evaluate the learnt skills of students through implementation of hardware or software project. This polishes their skills which they got through their degree program. This is divided in to two phases technical project I and technical project II.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Identification of the problem
2. Research and Information gathering
3. Definition of the project
4. Development of a plan
5. Modern Tool usage
6. Impact of Engineering on Society and the Environment
7. Environment and Sustainability
8. Ethics
9. Individual and Teamwork
10. Communication

COURSE TITLE: MEDICAL IMAGING DEVICES

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide a comprehensive understanding of medical imaging devices, their principles, applications, and the role they play in modern healthcare. his course aims to equip the students with the knowledge and skills necessary to navigate and contribute to this dynamic and rapidly evolving field.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Describe the fundamental concepts related to radiation physics
2. involved in various diagnostic imaging modalities.
3. Analyze working and applications of various diagnostic medical imaging equipment.
4. Troubleshoot diagnostic radiological equipment.
5. Read different types of images from DICOM and test image and perform different spatial domain transformation and reconstruction of images in programming software.

COURSE OUTLINE FOR THEORY:

Interaction of Radiation with Matter: Scattered & absorbed Radiation: spatial image formation. Imaging Transducers: Various transducers used in medical imaging systems. Imaging development: X-ray Film: Fluoroscopic imaging: Digital Imaging System: X-ray imaging: Film-less radiographic imaging: CT imaging: Emerging areas in medical imaging: Ultrasound Imaging: Medical imaging software: Algorithms: techniques: imaging archival and management: Molecular imaging and other advance biomedical imaging techniques and their image manipulation.

COURSE OUTLINE FOR LAB:

1. Demonstration of X-rays Equipment.
2. Demonstration of Ultrasound Equipment.
3. Introduction, Technicalities, MATLAB
4. Histograms and Morphological Operators on X-rays
5. Intensity Transformation using MATLAB
6. Spatial Filtrating using MATLAB of medical Images
7. Filtrating in frequency Domain of medical Images
8. Image restoration of Medical Images

RECOMMENDED BOOKS/READINGS:

1. Bushberg J.T., The Essential Physics of Medical Imaging (Latest Edition)
2. Z. H. Cho, Foundations of Medical Imaging (Latest Edition)
3. Atamdhawan, Medical Image Analysis (Latest Edition)
4. Buxton, Richard B, Introduction to Functional Magnetic Resonance Imaging: Principles and Techniques (Latest Edition)
5. Murdy, Karen M., Biomedical Imaging (Principles & Application Engg: Series) (Latest Edition)
6. Andrew G. Webb, Introduction to Biomedical Imaging (IEEE Press Series on Biomedical Richard A. Robb, Engineering) Biomedical Imaging, Visualization, and Analysis (Latest Edition)

COURSE TITLE: BIOMATERIALS

COURSE INTRODUCTION & OBJECTIVES:

This course aims to provide you with a comprehensive understanding of the principles, properties, and applications of biomaterials. This course will equip the students with the knowledge and skills to navigate the diverse field of biomaterials and contribute to advancements in medical science.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Define the fundamental concepts and principles of biomaterials, their types and structures, characteristics of
2. biomaterials, material fabrication techniques and their testing.
3. Analyze various materials based on their performance.
4. Apply knowledge from basic concepts of materials to propose sustainable solution to existing problem.
5. Participate effectively in lab experiments individually or in small groups.
6. Perform experiments related to biomaterial and investigate the findings to achieve the desired results.

COURSE OUTLINE FOR THEORY:

Historical development and impact of Biomaterials: Hard Tissues and Pathologies: Atomic molecular and crystal structure of solids: Crystalline and non-crystalline materials: Crystal imperfections: Metals: types: properties: and fabrications: Introduction to ceramics: structure:

properties: surface reactive ceramics and analysis of ceramics surfaces: Polymers: types: properties: and applications: Composites: Anisotropy: particulates: fibrous and porous materials: Corrosion and Deterioration of Materials: Biological testing: Performance of implants: Safety and efficacy testing:

COURSE OUTLINE FOR LAB:

1. To study methods of sample sectioning
2. To study methods of mounting
3. To study methods of grinding
4. To study methods of polishing
5. To study method of etching
6. To study different microscopic techniques used in metallographic analysis
7. To study the degradation behavior in acid and basic media
8. To study the degradation behavior in biological fluids
9. To do the hardness testing of various biomaterials
10. To do the tensile testing of biomaterial
11. To study the densification and heat treatment of bio ceramics
12. Open-ended labs

RECOMMENDED BOOKS/READINGS:

1. Michael N. Helmus, Biomaterials in the Design and Reliability of Medical Devices (Latest Edition)
2. David Hill, Design Engineering of Biomaterials for Medical Devices (Latest Edition)
3. Buddy D. Ratner, et al, Biomaterials Science, Second Edition: An Introduction to Materials in Medicine (Latest Edition)
4. Kay C. Dee, et al, An Introduction to Tissue-Biomaterial Interactions (Latest Edition)
5. Rolando Barbucci, Integrated Biomaterials Science (Latest Edition)
6. Materials Science and Engineering: An Introduction, William D. Callister, Jr., David G. Rethwisch (Latest Edition)
7. Biomaterials Science: An Introduction to Materials in Medicine, Edited by Buddy D. Ratner (Latest Edition)
8. Biomaterials Principles and Application, Joon B. Park, Joseph D. Bronzino (Latest Edition)

COURSE TITLE: CLINICAL LABORATORY EQUIPMENT

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide a comprehensive understanding of the clinical laboratory equipment used in healthcare settings for diagnostic and research purposes., Thiis course aims to equip the students with the knowledge and skills necessary to operate, maintain, and understand the applications of various laboratory instruments.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Discuss the working principle, calibration, and maintenance of analytical

equipment.

2. Explain the impact of chemical safety and biohazards on the environment and sustainable development.
3. Observe the working principle of laboratory instruments.
4. Fix and troubleshoot clinical laboratory equipment.

COURSE OUTLINE FOR THEORY:

Understanding of clinical laboratory instrumentation principles: their specific applications and the process of instrument selection as well as their calibration and maintenance to produce quality analysis: particularly the following instruments: spectrophotometers: ion-selective electrodes: thermal equipment: centrifuges and balances: turbid meters. hematology analyzers: coagulation instruments: clinical chemistry analyzers: osmometers: electrochemistry: electrophoresis: chromatography: molecular techniques: automation and immunochemical methodologies.

COURSE OUTLINE FOR LAB:

1. Identify the types and uses of laboratory balances.
2. Explain the advantages of laboratory refrigerators.
3. Describe the importance of ovens, water baths and incubators.
4. State the use of photometers and desiccators.
5. Identify the types and uses of microscopes.
6. State the basic components centrifuge

RECOMMENDED BOOKS/READINGS:

1. Locquin, M. Handbook of Microscopy. Butterworths. Boston (Latest Edition)
2. Raphael, S.S. Lynch's Medical Laboratory Technology. W.B. Saunders. Toronto (Latest Edition)

COURSE TITLE: MEDICAL DEVICE QUALITY SYSTEM AND STANDARDS

COURSE INTRODUCTION & OBJECTIVES:

A Medical Device Quality System and Standards Course focuses on the principles, regulations, and standards governing the development, manufacturing, and quality assurance of medical devices. This course provides students with a comprehensive understanding of the quality management systems and compliance requirements essential for producing safe and effective medical devices

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain the quality management system for medical device manufacture.
2. Compare the approval process for new medical devices in different jurisdiction.

COURSE OUTLINE FOR THEORY:

Quality Management System: Term and Definition: General Requirements: Quality Manual: Control of Documents: Controls of Records: Management Responsibility and Resource a. Management commitment Requirement: Planning: Responsibility: Authority: and Communication. Provision of Resources: Infrastructure and work environments: Product Realization: Planning of Product Realization: Customer Related Processes: Design and Development: Purchasing: Production and Service Provision: Validation of Processes of Production: Identification and Traceability: Control of Monitoring and Measuring: Regulation for Medical Devices by DRAP. Quality System Regulations (21CFR820).

RECOMMENDED BOOKS/READINGS:

1. A Complete Guide to Quality Management in the Medical Device Industry, ItayAbuhav (Latest Edition)

COURSE TITLE: REHABILITATION TECHNIQUES

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide a comprehensive understanding of the various approaches and methods used in rehabilitation to help individuals recover from physical, mental, or cognitive impairments. This course aims to equip the students with the knowledge and skills necessary to contribute to the recovery and well-being of individuals facing diverse health challenges.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Explain the domains of rehabilitation engineering technology
2. Explain working principles of prosthetic, orthotic, and devices for visually as well as hearing impairment.
3. Measure physiological parameters during electrical stimulation.
4. Operate assistive devices for hearing and visually impaired.

COURSE OUTLINE FOR THEORY:

Introduction a. Introduction to rehabilitation engineering and assistive technology (AT) b. Domains of rehabilitation techniques, Limb Prosthetic Devices a. Classification of amputation b. Prosthetic prescription and fabrication c. Components of upper limb prosthesis d.

Components of lower limb prosthesis, Orthotic Devices a. Introduction b. Biomechanical principles of orthoses c. Design consideration d. Spinal orthoses e. Limb orthoses, Devices for Visually Impaired a. Dimensions of visual impairment and their impact on task performance b. General purpose assistive technology solutions c. Task-specific assistive technologies d. Technology for reading e. Writing and graphic access, Devices for Hearing Impairment a. Types of hearing impairment b. Historical overview of HAT (Hearing assistance technology) c. Medical and surgical approaches to restoring hearing function d. Assistive listening devices solutions e. Environmental adaptations and universal designs, Wheelchairs a. Manual wheelchairs and electrical power wheelchairs with brief history b. User profiles c. Basic structural components d. Power and drive systems e. Control system f. Power assisted wheelchairs g. Multifunctional wheelchairs h. Wheelchair standards, Neurorehabilitation a. Functional Electrical Stimulation b. Transcutaneous Electrical Stimulation c. Brain Computer Interface d. Assessment methods for neurorehabilitation.

COURSE OUTLINE FOR LAB:

1. Angle measurements using electronic goniometer in rest and walking state
2. Foot pressure measurement using force sensitive resistors (FSR)
3. Modeling and simulation of biomechanics arm using Autocad
4. Gait parameter analysis 5. EMG measurement during Functional electrical stimulation (FES)
5. Assessment of EMG before and after TENS
6. Design of brain computer interface using neurosky EEG device to detect subject's response
7. Control of peripheral devices such as using neurosky EEG device to switch ON/OFF home appliances
8. Demonstration of electrical power wheelchair
9. Demonstration of hearing aid.
10. Demonstration of visually impaired devices.
11. Open ended Lab 1
12. Open ended Lab 2
13. Open ended Lab 3

RECOMMENDED BOOKS/READINGS:

1. Rory A Cooper and HisaichiOhnabe, An Introduction to Rehabilitation Engineering, ISBN: 9780849372223 (Latest Edition)
2. Pedro Encarnação and Albert Cook, Robotic Assistive Technologies: Principles and Practice, ISBN: 9781498745727 (Latest Edition)
3. Marko B. Popović, Biomechanics and Robotics, ISBN: 9789814411370 (Latest Edition)
4. Albert M. Cook and Janice Miller Polgar, Assistive Technologies: Principles and Practice, 4th Edition, ISBN: 9780323096317 (Latest Edition)
5. Kevin Russell Henderson, Wheelchairs: Perceptions, Technology Advances and Barriers, ISBN: 9781536103908 (Latest Edition)
6. Michelle M. Lusardi, Orthotics and Prosthetics in Rehabilitation, ISBN: 9781437719369 (Latest Edition)

COURSE TITLE: PROJECT - II

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to evaluate the learnt skills of students through implementation of hardware or software project. This polishes their skills which they got through their degree program. This is divided in to two phases technical project I and technical project II.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Identification of the problem
2. Research and Information gathering
3. Definition of the project
4. Development of a plan
5. Modern Tool usage
6. Impact of Engineering on Society and the Environment
7. Environment and Sustainability
8. Ethics
9. Individual and Teamwork
10. Communication

COURSE TITLE: SUPERVISED INDUSTRIAL TRAINING – I & II

COURSE INTRODUCTION & OBJECTIVES:

This course is designed to provide students and professionals with practical, hands-on experience in an industrial setting. The course is divided into SIT I and SIT II. Students will seek exposure to real-world work environments or a professional looking to enhance skills, this Supervised Industrial Training Course aims to bridge the gap between theoretical knowledge and practical application in diverse industrial sectors.

COURSE OUTCOMES:

On the successful completion of the course candidates will be able to:

1. Problem Analysis
2. Life Long Learning
3. Ethical Practice
4. Individual and Teamwork
5. Communication (Content /Organization)
6. Investigation
7. Project Management
8. Modern Tools Usage