

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR
PRADESH, LUCKNOW**



EVALUATION SCHEME AND SYLLABI

For

**B. Tech. 1ST Year
Biotechnology**

Effective from the Session: 2022-23

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY UTTAR PRADESH.
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B. Tech. First Year, Semester- I
(Biotechnology)

3- WEEKS STUDENT INDUCTION PROGRAMME														
in the beginning of the session														
S N	Subject Code	Subject Name	Type	Category	Period			Evaluation Scheme						Credit
								Sessional Component		Sessional (SW) (TS/PS)	End Semester Examination (ESE)	Total	Cr	
					L	T	P	CT	TA					
1.	BAS101/ BAS102	Engineering Physics/ Engineering Chemistry	T	BS	3	1	0	20	10	30	70	100	4	
2.	BBT101/ BBT102	Elementary Mathematics-I / Remedial Biology-I	T	BS	3	1	0	20	10	30	70	100	4	
3.	BEE101/ BEC101	Fundamentals of Electrical Engineering/ Fundamentals of Electronics Engineering	T	ES	2	1	0	20	10	30	70	100	3	
4.	BCS101/ BME101	Programming for Problem Solving/ Fundamentals of Mechanical Engineering	T	ES	2	1	0	20	10	30	70	100	3	
5.	BAS104/ BAS105	Environment and Ecology/ Soft Skills	T	BS/ HS	3	0	0	20	10	30	70	100	3	
6.	BAS151/ BAS152	Engineering Physics Lab/ Engineering Chemistry Lab	P	BS	0	0	3	-	50	50	50	100	1	
7.	BEE151/ BEC151	Basic Electrical Engineering Lab/ Basic Electronics Engineering Lab	P	ES	0	0	3	-	50	50	50	100	1	
8.	BCS151/ BAS155	Programming for Problem Solving Lab/ English Language Lab	P	ES/ HS	0	0	3	-	50	50	50	100	1	
9.	BCE151/ BWS151	Engineering Graphics & Design Lab/ Workshop Practice Lab	P	ES	0	1	3	-	50	50	50	100	2	
					13	5	12			350	550	900	22	

Abbreviation Used:

BS: Basic Science Course

ES: Engineering Science Course

HS: Humanities and Social Science Course

VA: Value Added Course

B. Tech. First Year, Semester- II (Biotechnology)

								Evaluation Scheme						
SN	Subject Code	Subject Name	Type	Category	Period			Sessional Component		Sessional (SW) (TS/PS)	End Semester Examination (ESE)	Total	Credit	
					L	T	P	CT	TA					CT+TA
1.	BAS202/ BAS201	Engineering Chemistry / Engineering Physics	T	BS	3	1	0	20	10	30	70	100	4	
2.	BBT201/ BBT202	Elementary Mathematics-II / Remedial Biology-II	T	BS	3	1	0	20	10	30	70	100	4	
3.	BEC201/ BEE201	Fundamentals of Electronics Engineering / Fundamentals of Electrical Engineering	T	ES	2	1	0	20	10	30	70	100	3	
4.	BME201/ BCS201	Fundamentals of Mechanical Engineering/ Programming for Problem Solving	T	ES	2	1	0	20	10	30	70	100	3	
5.	BAS205/ BAS204	Soft Skills / Environment and Ecology	T	HS/ BS	3	0	0	20	10	30	70	100	3	
6.	BAS252/ BAS251	Engineering Chemistry Lab / Engineering Physics Lab	P	BS	0	0	3	-	50	50	50	100	1	
7.	BEC251/ BEE251	Basic Electronics Engineering Lab/ Basic Electrical Engineering Lab	P	ES	0	0	3	-	50	50	50	100	1	
8.	BAS255/ BCS251	English Language Lab / Programming for Problem Solving Lab	P	HS/ ES	0	0	3	-	50	50	50	100	1	
9.	BWS251/ BCE251	Workshop Practice Lab / Engineering Graphics & Design Lab	P	ES	0	1	3	-	50	50	50	100	2	
10.	BVA251/ BVA252	Sports and Yoga / NSS	P	VA	0	0	3		100	*100		*100	0	
					13	5	12+			350+	550	900+	22	
							3*			*100		*100		

*Compulsory Qualifying Audit Course

*Summer Internship (4-week) / NPTEL Course (4-week) during summer break
after Semester-II and same will be assessed/evaluated in the Semester-III*

DETAILED SYLLABI

B. Tech. First Year (Biotechnology)

Effective from Session 2022-23

BAS101 / BAS201: ENGINEERING PHYSICS

Content	Contact Hours
Unit-1: Quantum Mechanics	9
Inadequacy of classical mechanics, Planck's theory of black body radiation(qualitative), Compton effect, de-Broglie concept of matter waves, Davisson and Germer Experiment, Phase velocity and group velocity, Time-dependent and time-independent Schrodinger wave equations, Physical interpretation of wave function, Particle in a one-Dimensional box.	
Unit-2: Electromagnetic Field Theory	8
Basic concept of Stoke's theorem and Divergence theorem, Basic laws of electricity and magnetism, Continuity equation for current density, Displacement current, Maxwell equations in integral and differential form, Maxwell equations in vacuum and in conducting medium, Poynting vector and Poynting theorem, Plane electromagnetic waves in vacuum and their transverse nature. Relation between electric and magnetic fields of an electromagnetic wave, Plane electromagnetic waves in conducting medium, Skin depth.	
Unit-3: Wave Optics	10
Coherent sources, Interference in uniform and wedge shaped thin films, Necessity of extended sources, Newton's Rings and its applications, Introduction to diffraction, Fraunhofer diffraction at single slit and double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power, Resolving power, Rayleigh's criterion of resolution, Resolving power of grating.	
Unit-4: Fiber Optics & Laser	9
Fibre Optics: Principle and construction of optical fiber, Acceptance angle, Numerical aperture, Acceptance cone, Step index and graded index fibers, Fiber optic communication principle, Attenuation, Dispersion, Application of fiber. Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications.	
Unit-5: Superconductors and Nano-Materials:	8
Superconductors: Temperature dependence of resistivity in superconducting materials, Meissner effect, Temperature dependence of critical field, Persistent current, Type I and Type II superconductors, High temperature superconductors, Properties and Applications of Super-conductors. Nano-Materials: Introduction and properties of nano materials, Basics concept of Quantum Dots, Quantum wires and Quantum well, Fabrication of nano materials -Top-Down approach (CVD) and Bottom-Up approach (Sol Gel), Properties and Application of nano materials.	

Course Outcomes:

On completion of course the students are able :		
CO	CO Statement	Bloom's Level
CO1	To explain the distribution of energy in black body radiation and to understand the difference in particle and wave nature with explanation of Compton effect and Schrodinger wave equation.	Understanding, Apply
CO2	To understand the concept of displacement current and consistency of Ampere's law and also the properties of electromagnetic waves in different medium with the use of Maxwell's equations.	Understanding, Analyze
CO3	To understand the behavior of waves through various examples/applications of interference and diffraction phenomenon and the concept of grating and resolving power.	Apply
CO4	To know the functioning of optical fiber and its properties and applications. To understand the concept, properties and applications of Laser.	Understanding, Apply
CO5	To know the properties and applications of superconducting materials and nano materials.	Understanding

Reference Books:

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Optics - Brijlal & Subramanian (S. Chand)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
4. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
5. Engineering Physics-Malik HK and Singh AK (Mc Graw Hill)

BAS102 / BAS202: ENGINEERING CHEMISTRY

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends and Polymer Composites.

Content	Contact Hours
Unit-1:	8
<p>Atomic and Molecular Structure: Molecular orbital's of diatomic molecules, Bond Order, Magnetic characters and numerical problems.</p> <p>Chemistry of Advanced Materials:</p> <p>Liquid Crystals; Introduction, Types and Applications of liquid crystals, Industrially important materials used as liquid crystals.</p> <p>Graphite and Fullerene; Introduction, Structure and applications.</p> <p>Nanomaterials; Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials, Carbon Nano Tubes (CNT),</p> <p>Green Chemistry: Introduction, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green route (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.</p>	
Unit-2:	8
<p>Spectroscopic Techniques and Applications: Elementary idea and simple applications of UV, IR and NMR, Numerical problems.</p> <p>Stereochemistry: Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.</p>	
Unit-3:	8
<p>Electrochemistry and Batteries: Basic concepts of electrochemistry.</p> <p>Batteries; Classification and applications of Primary Cells (Dry Cell) and Secondary Cells (Lead Acid battery).</p> <p>Corrosion: Introduction to corrosion, Types of corrosion, Cause of corrosion, Corrosion prevention and control, Corrosion issues in specific industries (Power generation, Chemical processing industry, Oil & gas industry and Pulp & paper industries).</p> <p>Chemistry of Engineering Materials:</p> <p>Cement; Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).</p>	

Unit-4:	8
<p>Water Technology: Sources and impurities of water, Hardness of water, Boiler troubles, Techniques for water softening (Lime-Soda, Zeolite, Ion Exchange and Reverse Osmosis process), Determination of Hardness and alkalinity, Numerical problems.</p> <p>Fuels and Combustion: Definition, Classification, Characteristics of a good fuel, Calorific Values, Gross & Net calorific value, Determination of calorific value by Bomb Calorimeter, Theoretical calculation of calorific value by Dulong's method, Ranking of Coal, Analysis of coal by Proximate and Ultimate analysis method, Numerical problems, Chemistry of Biogas production from organic waste materials and their environmental impact on society.</p>	
Unit-5:	8
<p>Materials Chemistry:</p> <p>Polymers; Classification, Polymerization processes, Thermosetting and Thermoplastic Polymers, Polymer Blends and Composites, Conducting and Biodegradable polymers, Preparation, properties, industrial applications of Teflon, Lucite, Bakelite, Kelvar, Dacron, Thiokol, Nylon, Buna-N and Buna-S and their environmental impact on society, Speciality polymers.</p> <p>Organometallic Compounds: General methods of preparation and applications of Organometallic compounds (RMgX and LiAlH₄).</p>	

Course Outcomes:

Upon completion of the course the student should be able to:

Units	Course Outcomes	Bloom's Level
CO-1	Get an understanding of the theoretical principles of chemistry of molecular structure, bonding and properties, Chemistry of advanced materials (liquid crystals, Nanomaterials, Graphite & Fullerene) as well as the Principles of Green Chemistry.	K3
CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry.	K4
CO-3	Utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion and develop understanding of Chemistry of Engineering materials (Cement).	K3
CO-4	Develop understanding of the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	K3
CO-5	Develop the understanding of Chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and Chemistry applicable in industrial process.	K3

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S.Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sessa Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi
7. University Chemistry by BH Mahan
8. University Chemistry by CNR Rao

BBT101 : ELEMENTARY MATHEMATICS-I

Course Objectives:

The objective of this course is to familiarize the biotechnological engineers with techniques of Algebra, permutation and combinations, coordinate geometry, calculus and Differentiability and its applications in the real world. It aims to equip the students with standard concepts and tools from intermediate to advanced level that will enable them to tackle more advanced levels of mathematics and applications that they would find useful in their disciplines.

The students will learn:

- The effective mathematical tools of Algebra to solve the linear inequalities.
- The tools of permutation, combinations, and its applications. Also concepts of sequence and Series are introduced.
- To apply concepts of coordinate geometry in engineering mathematics.
- The elementary concept of calculus using limits and derivatives.
- To deal with continuous and differentiable functions to identify the rate of change and its applications in real life Situations.

Content	Contact Hours
Unit-1: Algebra	8
Fundamental Theorem of Algebra (without proof), solution of quadratic equations. Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of the system of linear inequalities in two variables-graphically.	
Unit-2: Arithmetic and Geometric Progressions	8
Arithmetic progression (A.P.), general term of A.P., sum of a series in A.P., arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of n terms of a G.P., sum of infinite terms in G.P., geometric mean (G.M.), relation between A.M. and G.M. Sum to n terms of the special series n , n^2 and n^3 in A.P..	
Unit-3: Coordinate Geometry	8
Straight Lines: Introduction, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two point form, intercepts form and normal form. General equation of a line. Distance of a point from a line, with numerical examples. Conic Sections: Sections of a cone: circle, ellipse, parabola, hyperbola and pair of intersecting lines. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle, with numerical examples	

Unit-4: Calculus I	8
Introduction, Definition of limit, continuity and differentiability, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric function, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, exponential, logarithmic and parametric forms. Logarithmic differentiation. Derivative introduced as rate of change both as that of distance function and geometrically.	
Unit-5: Calculus II	8
Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations illustrated examples. Applications of Derivatives: Applications of derivatives: rate of change, increasing/decreasing functions, tangents & normals, approximation and errors, maxima and minima of one variable. Simple problems (that illustrate basic principles and understanding of the subject as well as real- life situations).	

Course Outcomes:

	Course Outcome (CO)	Bloom's Level
At the end of this course, the students will be able to:		
CO 1	Illustrate the concept of equation and apply for solving quadratic equations and systems of linear inequality in two variables.	K3
CO 2	Apply the concept of arithmetic, and geometric progressions for finding the sum to n terms and infinite number of terms	K3
CO 3	Remember the concept of coordinate system and apply for finding distance of a point from a line and conics.	K1, & K3
CO 4	Understand the concept of differentiation and apply for finding rate of change, slope.	K2 & K3
CO 5	Remember the concept of differentiation and apply for finding the derivative of different types of functions and maxima and minima.	K1 & K3

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Recommended Text Books:

1. Mathematics - Textbook for Class XI, NCERT Publication
2. Mathematics Part I - Textbook for Class XII, NCERT Publication
3. Mathematics Part II - Textbook for Class XII, NCERT Publication

Reference Books:

1. B.V.Rammana: Higher engineering mathematics (Tata Macgraw Hill)
2. Glynjames : Advanced modern engineering mathematics (Pearson education)

BBT201 : ELEMENTARY MATHEMATICS-II

Course Objectives:

The objective of this course is to familiarize the Bio-Technological engineers with techniques in multivariate integrals, linear Differential Equations, vector calculus, three – dimensional geometry and probability. It aims to equip the students to deal with advanced levels of mathematics and applications that would be essential for their disciplines.

The students will learn:

- The basic concepts of Integration to deal with real world problems.
- The tool of linear differential equations that are used in engineering problems.
- To deal with vector calculus that is required in Biotechnology engineers.
- To apply the concepts of three dimensional geometry in engineering.
- The concepts of probability in a comprehensive manner.

Content	Contact Hours
Unit-1: Integrals	8
Integration of functions by substitution, partial fractions and by parts, only simple integrals of the type to be evaluated. Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals. Applications of the Integrals: Applications in finding the area between simple curves, especially lines, areas of circles/parabolas/ellipses (in standard form only).	
Unit-2: Differential Equations	8
Definition, order and degree, general and particular solutions of a differential equation Formation of differential equations whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type: $Dy + py = q$, where p and q are functions of x.	
Unit-3: Vector Algebra	8
Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.	

Unit-4: Three-Dimensional Geometry	8
Three – dimensional Geometry: Direction cosines / ratios of a line joining two points. Cartesian equation of a line, coplanar lines, shortest distance between two lines. Cartesian equation of a plane, Angle between (a) two lines (b) two planes and (c) a line and a plane. Distance of a point from a plane.	
Unit-5: Probability	8
Exhaustive events , Random experiments , trial and events, Equally likely events, independent events, mutually exclusive events, compound events, favorable events, definition of probability, Axioms of probability, Addition theorem of probability with examples, Multiplication theorem of probability with illustrated examples. Conditional probability. Bayes theorem with examples.	

Course Outcomes:

	Course Outcome (CO)	Bloom's Level
At the end of this course, the students will be able to:		
CO 1	Apply the concept of integration to evaluate integrals and apply for finding definite integrals.	K3& K5
CO 2	Understand the concept of differentiation and apply for finding the solution of differential equations.	K2 & K3
CO 3	Understand the concept of vector and apply for finding direction cosines, projection of vector on a line.	K2 & K3
CO 4	Apply the concept of three dimensional geometry to find the shortest distance between two lines. Also apply for finding coplanar lines and Cartesian equation of a line.	K3
CO 5	Apply the probability to evaluate addition, multiplication and conditional law of probability	K3& K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Recommended Text Books:

1. Mathematics - Textbook for Class XI, NCERT Publication
2. Mathematics Part I - Textbook for Class XII, NCERT Publication
3. Mathematics Part II - Textbook for Class XII, NCERT Publication

Reference Books:

1. B.V. Ramana: Higher engineering mathematics (Tata Macgraw Hill)
2. Glynjames :Advanced modern engineering mathematics (Pearson education)

BBT102 : REMEDIAL BIOLOGY-I

Course Objective:

Basic idea of the course will be to introduce the basic knowledge of biology and its application for students who are starting biotechnology engineering courses. Our main objective is to be aware of the students with basic knowledge of biology who have a mathematical background so that they can use this information in biotechnology and higher research.

Content	Contact Hours
Unit-1:	8
The cell concept, structure of prokaryotic, eukaryotic cells, plant cells and animal cells, Structure and function of cell membrane, cell organelles and their function, Basics of cell signaling, Structure and use of compound microscope, Basic chemical constituents of living body	
Unit-2:	8
Tissues in animal and plants, Morphology, anatomy and functions of different parts of plants: Root, stem, leaf, inflorescence, flower, fruit and seed.	
Unit-3:	8
Classification of living organisms (Five kingdom classification, major groups and principles of classification in each kingdom), Systematic and binomial system of nomenclature, Concept of animal and plant classification	
Unit-4:	8
Concepts of alleles and genes, Mendelian Experiments, Cell cycle (Elementary Idea), mitosis and meiosis, techniques to study mitosis and meiosis. Origin of life, evidences for biological evolution, Mechanism of evolution –Variation (Mutation and Recombination), Natural Selection with examples, Types of natural selection	
Unit-5:	8
Plant Physiology: Concepts of diffusion, osmosis, imbibitions, Movement of water, food, nutrients and gasses, Photosynthesis, plant growth and development .Plant growth regulators	

Course Outcomes:

	Course Outcome (CO)	Bloom's Level
At the end of this course, the students will be able to:		
CO 1	To understand the basics of living systems	K1, K2
CO 2	To understand key common features of living organisms & its function	K1, K2
CO 3	To know the basic concepts of anatomy and functions of cells	K2, K3
CO 4	To understand the concept of the alleles and genes	K2, K3, K4
CO 5	To understand and analyze the basics of plant physiology	K4, K5

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication

Reference Book:

1. Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (McGraw Hill Publication)

BBT202 : REMEDIAL BIOLOGY-II

Course Objective:

Basic idea of the course will be to introduce the basic knowledge of human biology and biological evolution. Our target is to be aware of the students with basic knowledge of human physiology and immunology who have mathematical backgrounds so that they can use these information in daily life and in higher research.

Content	Contact Hours
Unit-1:	8
Brief history of microbiology, Types of microorganisms, Basic idea of domain bacteria, proteobacteria, non proteobacteria Gram –ve and Gram +ve bacteria, lichens, algae, protozoa, helminthes, viral structures, viral multiplication, Role of microorganisms in the production of industrial chemicals and pharmaceuticals	
Unit-2:	8
Functional Anatomy of Prokaryotic and Eukaryotic Cells: Size, shape, and arrangement of bacterial cells. Structure and function of cells	
Unit-3:	8
Catabolic & anabolic reactions: enzymes, energy production and carbohydrate metabolism. Lipid & protein catabolism, Energy production mechanism, metabolic diversity & pathways of energy use. Integration of metabolism	
Unit-4:	8
Energy Utilization: Structure of mitochondria, cellular respiration, relationship of carbohydrate metabolism to other compounds, Glycolysis, formation of acetyl co-A, Kreb cycle, Electron Transport System and Oxidative Phosphorylation, ATP, factors affecting respiration	
Unit-5:	8
Reproductive health and human welfare: Population and birth control, sexually transmitted diseases, infertility, Cancer and AIDS, Basic concepts of immunology, vaccines. Diagnosis of diseases- molecular and other methods	

Course Outcomes:

	Course Outcome (CO)	Bloom's Level
At the end of this course, the students will be able to:		
CO 1	To know the basic concepts and elementary knowledge of Microbiology	K1, K2
CO 2	To understand the functional Anatomy of Cells	K2, K3
CO 3	To know the energy production mechanism in the living cell	K1, K2
CO 4	To understand and analyze the energy utilization mechanism	K2, K3, K4
CO 5	Understand the reproductive health and human welfare	K ₂ .K4, K5, K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Recommended Text Book:

1. Biology-Textbook of Class XI, NCERT Publication
2. Biology-Textbook of Class XII, NCERT Publication
3. Microbiology- Pelzar, Tata Mcgraw- Hill Publishing Com. Ltd., 2002
4. An introduction to immunology by C.V. Rao, Narosa publishing house

Reference Book:

1. Biology by Peter H Raven, George b Johnson, Kenneth A., Mason, Jonathan Losos, Susan Singer (MacGraw Hill Publication)
2. General Microbiology: Stainier, Adelberg and Ingraham.

BEE101 / BEE201: FUNDAMENTALS OF ELECTRICAL ENGINEERING

Content	Contact Hours
Unit -1: DC Circuits	6
Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity, unilateral and bilateral elements. Kirchhoff's laws, Mesh and nodal methods of analysis.	
Unit-2: : Steady State Analysis of Single Phase AC Circuits	6
Representation of Sinusoidal waveforms – Average and effective values, Form and peak factors. Analysis of single phase AC Circuits consisting R-L-C combination (Series and Parallel) Apparent, active & reactive power, Power factor. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.	
Unit-3: Transformers	6
Magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.	
Unit-4: Electrical machines	8
DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems) Three Phase Induction Motor: Principle & Construction, Types, Slip-torque characteristics, Applications (Numerical problems related to slip only) Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications. Three Phase Synchronous Machines: Principle of operation of alternator and synchronous motor and their applications.	
Unit-5: Electrical Installations	4
Introduction of Switch Fuse Unit (SFU), MCB, ELCB, MCCB, ACB. Types of Wires, Cables and Bus-bars. Fundamentals of earthing and lightning protection. Types of Batteries	

Course Outcomes:

	Course Outcome (CO)
CO 1	Apply the concepts of KVL/KCL and network theorems in solving DC circuits.
CO 2	Analyze the steady state behavior of single phase and three phase AC electrical circuits.
CO 3	Identify the application areas of a single phase two winding transformer as well as an auto transformer and calculate their efficiency. Also identify the connections of a three phase transformer.
CO 4	Illustrate the working principles of induction motor, synchronous machine as well as DC machine and employ them in different area of applications.
CO 5	Describe the components of low voltage electrical installations and perform elementary calculations for energy consumption.

Text Books:

1. Ritu Sahdev, "Basic Electrical Engineering", Khanna Publishing House, 2018.
2. P.V. Prasad, S.Sivanagaraju, "Electrical Engineering: Concepts and Applications" Cengage, 2018
3. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
4. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
3. V. D. Toro, "Electrical Engineering Fundamentals", Pearson India, 1989.

Spoken Tutorial (MOOCs):

1. AC DC Circuit Analysis using NgSpice, Open Source Software (<http://spoken-tutorial.org>)

BEC101 / BEC201 : FUNDAMENTALS OF ELECTRONICS ENGINEERING

Topics	Contact Hours
Unit-1	8
Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical Diodes, Diode Equivalent Circuits, Zener Diodes breakdown mechanism (Zener and avalanche) Diode Application: Diode Configuration, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits Special Purpose two terminal Devices: Light-Emitting Diodes, Photo Diodes, Varactor Diodes, Tunnel Diodes.	
Unit-2	8
Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration Field Effect Transistor: Construction and Characteristic of JFETs. Transfer Characteristic. MOSFET (MOS) (Depletion and Enhancement) Type, Transfer Characteristic.	
Unit-3	8
Operational Amplifiers: Introduction, Op-Amp basic, Practical Op-Amp Circuits (Inverting Amplifier, Non-inverting Amplifier, Unit Follower, Summing Amplifier, Integrator, Differentiator). Differential and Common-Mode Operation, Comparators.	
Unit-4	8
Digital Electronics: Number system & representation, Binary arithmetic, Introduction of Basic and Universal Gates, using Boolean algebra simplification of Boolean function. K Map Minimization upto 6 Variables.	
Unit-5	8
Fundamentals of Communication Engineering: Basics of signal representation and analysis, Electromagnetic spectrum Elements of a Communication System, Need of modulation and typical applications, Fundamentals of amplitude modulation and demodulation techniques. Introduction to Wireless Communication: Overview of wireless communication, cellular communication, different generations and standards in cellular communication systems, Fundamentals of Satellite & Radar Communication.	

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Describe the concept of PN Junction and devices.
2. Explain the concept of BJT, FET and MOFET.
3. Apply the concept of Operational amplifier to design linear and non-linear applications.
4. Perform number systems conversions, binary arithmetic and minimize logic functions.
5. Describe the fundamentals of communication technologies.

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. George Kennedy, "Electronic Communication Systems", McGrawPublication
3. David A. Bell, "Electronic Devices and Circuits", Oxford UniversityPress.
4. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGrawHill.
5. A. Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018.

BCS101 / BCS201: PROGRAMMING FOR PROBLEM SOLVING

Content	Contact Hours
Unit -1:	8
<p>Introduction to Components of a Computer System: Memory, Processor, I/O Devices, Storage, Operating System, Concept of Assembler, Compiler, Interpreter, Loader and Linker.</p> <p>Idea of Algorithm: Representation of Algorithm, Flowchart, Pseudo Code with Examples, From Algorithms to Programs, Source Code.</p> <p>Programming Basics: Structure of C Program, Writing and Executing the First C Program, Syntax and Logical Errors in Compilation, Object and Executable Code. Components of C Language. Standard I/O in C , Fundamental Data types, Variables and Memory Locations, Storage Classes.</p>	
Unit-2:	8
<p>Arithmetic Expressions and Precedence : Operators and Expression Using Numeric and Relational Operators, Mixed Operands, Type Conversion, Logical Operators, Bit Operations, Assignment Operator, Operator precedence and Associativity.</p> <p>Conditional Branching: Applying if and Switch Statements, Nesting if and Else and Switch.</p>	
Unit-3:	8
<p>Iteration and Loops: Use of While, do While and for Loops, Multiple Loop Variables, Use of Break , Goto and Continue Statements.</p> <p>Arrays: Array Notation and Representation, Manipulating Array Elements, using Multi Dimensional Arrays. Character Arrays and Strings, Structure, union, Enumerated Data types, Array of Structures, Passing Arrays to Functions.</p>	
Unit-4:	8
<p>Functions: Introduction, Types of Functions, Functions with Array, Passing Parameters to Functions, Call by Value, Call by Reference, Recursive Functions.</p> <p>Basic of searching and Sorting Algorithms: Searching & Sorting Algorithms (Linear Search , Binary search , Bubble Sort, Insertion and Selection Sort)</p>	
Unit-5:	8
<p>Pointers: Introduction, Declaration, Applications, Introduction to Dynamic Memory Allocation (Malloc, Calloc, Realloc, Free), String and String functions , Use of Pointers in Self-Referential Structures, Notion of Linked List (No Implementation)</p> <p>File Handling: File I/O Functions, Standard C Preprocessors, Defining and Calling Macros and Command-Line Arguments.</p>	

Course Outcome:

Course Outcome (CO)		Bloom's Level
At the End of Course , the Student will be Able to Understand		
CO 1	To Develop Simple Algorithms for Arithmetic and Logical Problems.	K ₂ , K ₃
CO 2	To Translate the Algorithms to Programs & Execution (in C Language).	K ₃
CO 3	To Implement Conditional Branching, Iteration and Recursion.	K ₃
CO 4	To Decompose a Problem into Functions and Synthesize a Complete Program Using Divide and Conquer Approach.	K ₄
CO 5	To Use Arrays, Pointers and Structures to Develop Algorithms and Programs.	K ₂ , K ₃

K₁- Remember, K₂- Understand, K₃- Apply, K₄- Analyze , K₅- Evaluate , K₆- Create

Text Books:

1. Schaum's Outline of Programming with C by Byron Gottfried , McGraw-Hill
2. The C programming by Kernighan Brain W. and Ritchie Dennis M., Pearson Education .
3. Computer Basics and C Programming by V.Rajaraman , PHI Learning Pvt. Limited, 2015.
4. Computer Concepts and Programming in C, E Balaguruswami, McGraw Hill
5. Computer Science- A Structured Programming Approach Using C, by Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Third Edition , Cengage Learning - 2007.
6. Let Us C By Yashwant P. Kanetkar.
7. Problem Solving and Program Design in C, by Jeri R. Hanly, Elliot B. Koffman, Pearson Addison-Wesley, 2006.
8. Programming in C by Kochan Stephen G. Pearson Education – 2015.
9. Computer Concepts and Programming in C by D.S. Yadav and Rajeev Khanna, New Age International Publication.
10. Computer Concepts and Programming by Anami, Angadi and Manvi, PHI Publication
11. Computer Concepts and Programming in C by Vikas Gupta, Wiley India Publication
12. Computer Fundamentals and Programming in C. Reema Thareja, Oxford Publication

BME101 / BME201: FUNDAMENTALS OF MECHANICAL ENGINEERING

Content	Contact Hours
Unit -1: Introduction to Mechanics	8
<p>Force moment and couple, principle of transmissibility, Varignon's theorem. Resultant of force system- concurrent and non-concurrent coplanar forces, Types of supports (Hinge, Roller) and loads (Point, UDL, UVL), free body diagram, equilibrium equations and Support Reactions.</p> <p>Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety.</p>	
Unit-2: Introduction to IC Engines and Electric Vehicles	8
<p>IC Engine: Basic definition of engine and Components, Construction and Working of Two stroke and four stroke SI & CI engine, merits and demerits, scavenging process; difference between two-stroke and four stroke IC engines and SI and CI Engines.</p> <p>Electric vehicles and hybrid vehicles: Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV.</p>	
Unit-3: Introduction to Refrigeration and Air-Conditioning	8
<p>Refrigeration: Refrigerating effect, Ton of Refrigeration; Coefficient of performance, methods of refrigeration, construction and working of domestic refrigerator, concept of heat pump.</p> <p>Air-Conditioning: Its meaning and application, humidity, dry bulb, wet bulb, and dew point temperatures, comfort conditions, construction and working of window air conditioner.</p>	
Unit-4: Introduction to Fluid Mechanics and Applications	8
<p>Introduction: Fluids properties, pressure, density, dynamic and kinematic viscosity, specific gravity, Newtonian and Non-Newtonian fluid, Pascal's Law and Continuity Equation.</p> <p>Working principles of hydraulic turbines (Pelton Wheel and Francis)& pumps (Centrifugal and Reciprocating) and their classifications and hydraulic lift.</p>	
Unit-5: Introduction to Measurement and Mechatronics	12
<p>Introduction to Measurement: Concept of Measurement, Error in measurements, Calibration, measurements of pressure(Bourdon Tube Pressure and U-Tube Manometer), temperature(Thermocouple and Optical Pyrometer), mass flow rate(Venturi Meter and Orifice Meter), strain(Bonded and Unbonded Strain Gauge), force (Proving Ring) and torques(Prony Brake Dynamometer); Concepts of accuracy, precision and resolution.</p> <p>Introduction to Mechatronic Systems: Evolution, Scope, Advantages and disadvantages of Mechatronics, Industrial applications of Mechatronics, Introduction to autotronics, bionics, and avionics and their applications. Sensors and Transducers: Types of sensors, types of transducers and their characteristics.</p>	

<p>Overview of Mechanical Actuation System – Kinematic Chains, Cam, Ratchet Mechanism, Gears and its type, Belt, Bearing.</p> <p>Hydraulic and Pneumatic Actuation Systems: Overview: Pressure Control Valves, Direction Control Valves, Rotary Actuators, Accumulators and Pneumatic Sequencing Problems.</p>	
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Course Outcomes:

The students will be able to		Blooms Level
CO1	Apply the concept of force resolution and stress and strain to solve basic problems	K3
CO2	Understand the construction details and working of internal combustion engines, electric vehicle and hybrid vehicles.	K2
CO3	Explain the construction detail and working of refrigerator, heat pump and air-conditioner.	K2
CO4	Understand fluid properties, conservation laws and hydraulic machinery used in real life.	K2
CO5	Understand the working principle of different measuring instrument and mechatronics with their advantages, scope and Industrial application.	K2

Reference Books:

1. Basic Mechanical Engineering, G Shanmugam, S Ravindran, McGraw Hill
2. Basic Mechanical Engineering, M P Poonia and S C Sharma, Khanna Publishers
3. Mechatronics : Principles, Concepts and Applications, Nitaigour Mahalik, McGraw Hill
4. Mechatronics, As per AICTE: Integrated Mechanical Electronic Systems, K.P. Ramachandran, G.K. Vijayaraghavan, M.S.Balasundaram, Wiley India
5. Mechanical Measurements & Control, Dr. D. S. Kumar. Metropolitan Book Company
6. Fluid Mechanics and Hydraulic Machines, Mahesh Kumar, Pearson India

BAS104 / BAS204: ENVIRONMENT AND ECOLOGY

Course Objectives:

1. Aims and objectives of environmental education emphasize the relationship between man and the environment and educate young people about the importance of nature and the environment.
2. Environmental education aims to **impart ecological knowledge** and promote environmentally conscious behavior towards nature.
3. It encourages young minds to take **responsibility for protecting** the natural environment protection through information and knowledge and to develop environmental awareness.
4. Incidentally, promoting awareness and a sense of respect for nature leads to a comprehensive understanding of the environment and a reasonable attitude towards protecting it.
5. The focus of environmental education is Awareness, Knowledge, Attitude, Skills, Capacity Building and Participation.

Topics	Contact Hours
Unit-1	8
<p>Environment: Definition, Types of Environment, Components of environment, Segments of environment, Scope and importance, Need for Public Awareness.</p> <p>Ecosystem: Definition, Types of ecosystem, Structure of ecosystem, Food Chain, Food Web, Ecological pyramid. Balance Ecosystem.</p> <p>Effects of Human Activities such as Food, Shelter, Housing, Agriculture, Industry, Mining, Transportation, Economic and Social security on Environment, Environment Impact Assessment, Sustainable Development.</p>	
Unit-2	8
<p>Natural Resources: Introduction, Classification.</p> <p>Water Resources; Availability, sources and Quality Aspects, Water Borne and Water Induced Diseases, Fluoride and arsenic Problems in Drinking Water.</p> <p>Mineral Resources; Material Cycles; Carbon, Nitrogen and Sulfur cycles.</p> <p>Energy Resources; Conventional and Non conventional Sources of Energy.</p> <p>Forest Resources; Availability, Depletion of Forests, Environment impact of forest depletion on society.</p>	
Unit-3	8
<p>Pollution and their Effects; Public Health Aspects of Environmental;</p> <p>Water Pollution, Air Pollution, Soil Pollution, Noise Pollution, Solid waste management.</p>	
Unit-4	8
<p>Current Environmental Issues of Importance; Global Warming, Green House Effects, Climate Change, Acid Rain, Ozone Layer Formation and Depletion, Population Growth and Automobile pollution, Burning of paddy straw.</p>	

Unit-5	8
Environmental Protection; Environmental Protection Act 1986, Initiatives by Non Governmental Organizations (NGO's), Human Human Population and the Environment: Population growth, Environmental Education, Women Education.	

Course Outcomes:

Upon completion of the course, the student will be able to:

	Course Outcomes	Bloom's Level
CO-1	Gain in-depth knowledge on natural processes that sustain life, and govern economy.	K2
CO-2	Estimate and Predict the consequences of human actions on the web of life, global economy and quality of human life.	K3
CO-3	Develop critical thinking for shaping strategies (scientific, social, economic and legal) for environmental protection and conservation of biodiversity, social equity and sustainable development.	K4
CO-4	Acquire values and attitudes towards understanding complex environmental-economic social challenges, and participate actively in solving current environmental problems and preventing the future ones.	K3
CO-5	Adopt sustainability as a practice in life, society and industry.	K3

Reference Books:

1. Textbook of Environment and Ecology by Dave, Katewa & Singh, 2nd Edition, Cengage Learning India Pvt Ltd Delhi.
2. Environmental Studies by S Deswal, Dhanpat rai & Co.
3. Environmental Science by VK Ahluwalia, TERI
4. Environmental Studies by R Rajgopalan, Oxford University Press.
5. Environment & Ecology by Singh & Malviya, Acme Learning

BAS105 / BAS205: SOFT SKILLS

Course Objectives:

1. Students will be enabled to **understand** the correct usage of grammar.
2. Students will be able to **converse** well with effective speaking and listening skills in English.
3. Students will be able to **create** substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading and writing
4. Student will be able to **equip** with basics of communication skills and will **apply** it for practical and oral purposes by being honed up in presentation skills and voice-dynamics.
5. Students will be able **build up** personal traits that will make the transition from institution to workplace smoother and help them to excel in their jobs.

Content	Contact Hours
Unit-1 Applied Grammar and Usage:	8
Transformation of Sentences: Simple, Compound and Complex, Subject-verb agreement, Prefix and Suffix, Advanced Vocabulary: Antonyms, Synonyms, Homophones, , Homophones, New word Formation, Select word power	
Unit-2: Listening and Speaking Skills	8
Active Listening :Meaning and Art of Listening, Traits of a Good Listener, Listening modes, listening and Note taking, Types of Listening, Listening Techniques using Ted Talk Audio listening with script reading, Pronunciation; Speaking style ; content and sequencing.	
Unit-3: Reading and Writing Skills:	8
Reading style: Skimming; Scanning; Churning & Assimilation, Effective writing tools and methods: Inductive Deductive; Exposition; Linear; Interrupted; Spatial & and Chronological etc, Official and Business Letter writing, Agenda, Notices, Minutes of meeting,	
Unit-4: Presentation and Interaction Skills	8
Introduction to oral communication, Nuances and Modes of Speech Delivery, Public speaking: confidence, clarity, and fluency, Individual Speaking: Elements; Non verbal Communication: Kinesics, Paralinguistic features of Voice-Dynamics, Proxemics, Chronemics, and Presentation Strategies: planning, preparation, organization, delivery	
Unit-5: Work- place skills:	8
Leadership qualities; Impact, Communication skills for Leaders: Listening and Responding; Mental health at work place: Managing Stress; Techniques: Application of 4 A's; Avoid; Alter; Access; Adapt	

Course Outcomes:

1. **Write** professionally in simple and correct English.
2. **Demonstrate** active listening with comprehension, and the ability to write clear and well-structured emails and proposals.
3. **Learn** the use of correct body language and tone of voice to enhance communication.
4. **Acquire** the skills necessary to communicate effectively and deliver presentations with clarity and impact
5. **Understand** and apply some important aspects of core skills, like Leadership and stress management.

Prescribed Books:

1. Technical Communication, (Second Ed.); O.U.P., Meenakshi Raman & S.Sharma New Delhi, 2011.
2. Business Communication for Managers, Payal Mehra, Pearson, Delhi, 2012.
3. Personality Development, Harold R. Wallace et. al, Cengage Learning India Pvt. Ltd; New Delhi 2006.
4. Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi 2013.
5. Personality Development & Soft Skills, Barun K.Mitra, Oxford University Press, New Delhi, 2012.
6. Public Speaking, William S. Pfeiffer, Pearson, Delhi, 2012.
7. Human Values, A.N. Tripathi, New Age International Pvt. Ltd. Publishers New Delhi, 2005.
8. English Grammar & Usage, R.P.Sinha, Oxford University Press, New Delhi, 2005.
9. English Grammar & Composition, *Wren & Martin* S.Chand & Co Ltd, New Delhi, 2009.
10. Soft Skills for Everyone. Jeff Butterfield, Cengage Learning India Pvt. Ltd; New Delhi 2017.

BAS151 / BAS251: ENGINEERING PHYSICS LAB

List of Experiments

Any ten experiments (at least four from each group).

Group A

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To determine the focal length of the combination of two lenses separated by a distance and verify the formula for the focal length of combination of lenses.
5. To measure attenuation in an optical fiber.
6. To determine the wavelength of He-Ne laser light using single slit diffraction.
7. To study the polarization of light using He-Ne laser light.
8. To determine the wavelength of sodium light with the help of Fresnel's bi-prism.
9. To determine the coefficient of viscosity of a given liquid.
10. To determine the value of acceleration due to gravity (g) using compound pendulum.

Group B

1. To determine the energy band gap of a given semiconductor material.
2. To study Hall effect and determine Hall coefficient, carrier density and mobility of a given semiconductor material using Hall effect setup.
3. To determine the variation of magnetic field with the distance along the axis of a current carrying coil and estimate the radius of the coil.
4. To verify Stefan's law by electric method.
5. To determine resistance per unit length and specific resistance of a given resistance using Carey Foster's Bridge.
6. To study the resonance condition of a series LCR circuit.
7. To determine the electrochemical equivalent (ECE) of copper.
8. To calibrate the given ammeter and voltmeter by potentiometer.
9. To draw hysteresis (B-H curve) of a specimen in the form of a transformer and to determine its hysteresis loss.
10. To measure high resistance by leakage method.

Course outcomes:

At the end of the course, students will be able to		
CO	CO Statement	Bloom's Level
CO-1	Apply the principle of interference and diffraction to find the wavelength of monochromatic and polychromatic light.	Apply
CO-2	Compute and analyze various electrical and electronic properties of a given material by using various experiments.	Analyze
CO-3	Verify different established laws with the help of optical and electrical experiments.	Apply
CO-4	Determine and calculate various physical properties of a given material by using various experiments.	Apply
CO-5	Study and estimate the performance and parameter of given equipment by using graphical and computational analysis.	Apply

Reference Books

1. Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)
2. Engineering Physics-Theory and Practical- Katiyar & Pandey (Wiley India)
3. Engineering Physics Practical- S K Gupta (Krishna Prakashan Meerut)

BAS152 / BAS252 : ENGINEERING CHEMISTRY LAB

Course Objectives:

1. To enable the students to understand about the fundamental concepts of analytical instruments
2. To enable the students to understand about the analysis of chloride content, hardness, alkalinity of water.
3. To enable the students to understand about the measure of pH, surface tension and viscosity of a liquid.
4. To enable the students to understand about the preparation of different resins.
5. To enable the students to understand about the synthesis of organic compounds such as adipic acid and paracetamol by conventional and green route.

LIST OF EXPERIMENTS

1. Calibration of Analytical Equipment and apparatus.
2. Determination of Hardness of water sample by EDTA method.
3. Determination of Alkalinity of water sample.
4. Determination of pH by titrimetric method.
5. Determination of surface tension of given liquid.
6. Determination of Viscosity of a given liquid by viscometer.
7. Determination of the strength of Ferrous ammonium sulfate using external indicator.
8. Determination of the strength of Potassium dichromate using internal indicator.
9. Determination of available chlorine in bleaching powder.
10. Determination of chloride content in water sample.
11. Preparation of Phenol formaldehyde (PF) resin.
12. Preparation of Urea formaldehyde (UF) resin.
13. Preparation of Adipic acid / Paracetamol.
14. Determination of Cell Conductance of a solution.
15. Determination of Rate constant of hydrolysis of esters.
16. Element detection and identification of functional groups in organic compounds.

NOTE: Instructor may choose any 10 experiments from above and may also change any two of the above..

Course Outcomes:

Upon completion of the course the student should be able to:

	Course Outcomes	Bloom's Level
CO-1	Get an understanding of the use of different analytical instruments.	K3
CO-2	Measure the molecular / system properties such as surface tension, viscosity, conductance of solution, chloride and iron content in the water.	K3
CO-3	Measure the hardness and alkalinity of the water.	K3
CO-4	Know the fundamental concepts of the preparation of phenol formaldehyde & urea formaldehyde resin, adipic acid and Paracetamol.	K3
CO-5	Estimate the rate constant of reaction.	K3

BEE151 / BEE251 : BASIC ELECTRICAL ENGINEERING LAB

LIST OF EXPERIMENTS

Note: A minimum of ten experiments from the following should be performed.

(A) Hardware based experiments

1. Verification of Kirchhoff's laws
2. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
3. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
4. Connection and measurement of power consumption of a fluorescent lamp (tube light).
5. Measurement of power in 3- phase circuit by two-wattmeter method and determination of its power factor for star as well as delta connected load.
6. Determination of parameters of ac single phase series RLC circuit
7. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase Transformer
8. Determination of efficiency of a dc shunt motor by load test
9. To study running and speed reversal of a three phase induction motor and record speed in both directions.
10. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.

(B) Experiments available on virtual lab

1. Kirchhoff's laws.
Virtual lab link: <http://vlab.amrita.edu/?sub=3&brch=75&sim=217&cnt=2>
2. Thevenin Theorem.
Virtual lab link: <https://vlab.amrita.edu/?sub=1&brch=75&sim=313&cnt=1>
3. RLC series resonance.
Virtual lab link: <https://vlab.amrita.edu/?sub=1&brch=75&sim=330&cnt=1>
4. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
Virtual lab link: <http://vp-dei.vlabs.ac.in/Dreamweaver/measurement.html>
5. Determination of parameters of ac single phase series RLC circuit.
Virtual lab link: <https://vlab.amrita.edu/?sub=1&brch=75&sim=332&cnt=1>
6. To observe the B-H loop of a ferromagnetic material in CRO.
Virtual lab link: <https://vlab.amrita.edu/?sub=1&brch=282&sim=1507&cnt=2>
7. Determination of the efficiency of a dc motor by loss summation method (Swinburne's test). Virtual lab link: <http://em-iitr.vlabs.ac.in/exp5/index.php?section=Theory>

Course Outcomes:

	Course Outcome (CO)	Bloom's Level
At the end of this course, the students should be able to:		
CO 1	Conduct experiments illustrating the application of KVL/KCL and network theorems to DC electrical circuits.	K ₃
CO 2	Demonstrate the behavior of AC circuits connected to single phase AC supply and measure power in single phase as well as three phase electrical circuits.	K ₄
CO 3	Perform experiment illustrating BH curve of magnetic materials.	K ₃
CO 4	Calculate efficiency of a single phase transformer and DC machine.	K ₄
CO 5	Perform experiments on speed measurement and reversal of direction of three phase induction motor and Identify the type of DC and AC machines based on their construction.	K ₄

K₁ – Remember, K₂ – Understand, K₃ – Apply, K₄ – Analyze, K₅ – Evaluate, K₆ – Create

BEC151 / BEC251: BASIC ELECTRONICS ENGINEERING LAB

Suggestive List of Experiments

Part A:

1. Study of various types of Active & Passive Components based on the ir ratings.
2. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.
3. PCB Lab: a. Artwork & printing of a simple PCB. b. Etching & drilling of PCB
4. Winding shop: Step down transformer winding of less than 5VA.
5. Soldering shop: Soldering and disordering of Resistor in PCB. Soldering and disordering of IC in PCB. Soldering and disordering of Capacitor in PCB

Part B:

1. Study of Lab Equipment and Components: CRO, Multimeter, and Function Generator, Power supply-Active, Passive Components and Bread Board.
2. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
3. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of V_{rms} , V_{dc} , and ripple factor.
4. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
5. Characteristic of BJT: BJT in CE configuration.
6. To study Operational Amplifier as Adder and Subtractor
7. Verification of Truth Table of Various Logic Gate.
8. Implementation of the given Boolean function using logic gates in both SOP and POS forms.

Part (C):

Part A	PCB Lab: a. Artwork & printing of a simple PCB. b. Etching & drilling of PCB	This practical is not possible by virtual lab. It will be conducted only in physical mode
Part B	Study of Lab Equipment's and Components: CRO, Multi meter, Function Generator, Power supply-Active, Passive Components and Bread Board.	NA, These test equipment can be Demonstrated online from any lab of ECE department or physical mode is only option.

(D) Experiments available on virtual lab

PN Junction on diode: Characteristics of PN Junction diode-Static and dynamic resistance measurement from graph.	http://vlabs.iitkgp.ernet.in/be/exp5/index.html
Applications of PN Junction diode: Half & Full wave rectifier- Measurement of V_{rms} , V_{dc} , and ripple factor.	http://vlabs.iitkgp.ernet.in/be/exp6/index.html http://vlabs.iitkgp.ernet.in/be/exp7/index.html
Characteristics of Zener diode: V-I characteristics of Zener diode, Graphical measurement of forward and reverse resistance.	http://vlabs.iitkgp.ernet.in/be/exp10/index.html
Characteristic of BJT: BJT in CE configuration.	http://vlabs.iitkgp.ernet.in/be/exp11/index.html
To study Operational Amplifier as Adder and Subtractor	http://vlabs.iitkgp.ernet.in/be/exp17/index.html http://vlabs.iitkgp.ernet.in/be/exp18/index.html
Verification of Truth Table of Various Logic Gate	https://de-iitr.vlabs.ac.in/digital-electronics-iitr/exp/truth-table-gates/
Implementation of the given Boolean function using logic gates in both SOP and POS forms.	https://de-iitr.vlabs.ac.in/digital-electronics-iitr/exp/realization-of-logic-functions/

BCS151 / BCS251: PROGRAMMING FOR PROBLEM SOLVING LAB

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula $C/5=(F-32)/9$.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
 - Between 90-100%-----Print 'A'
 - 80-90%-----Print 'B'
 - 60-80%-----Print 'C'
 - Below 60%-----Print 'D'
11. WAP that takes two operands and one operator from the user, perform the operation, and prints the result by using Switch statement.
12. WAP to print the sum of all numbers up to a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.

26. WAP to add and multiply two matrices of order nxn.
27. WAP that finds the sum of diagonal elements of a mxn matrix.
28. WAP to implement strlen (), strcat (), strcpy () using the concept of Functions.
29. Define a structure data type TRAIN_INFO. The type contain Train No.: integer type
Train name: string Departure Time: aggregate type TIME Arrival Time: aggregate type
TIME Start station: string End station: string The structure type Time contains two
integer members: hour and minute. Maintain a train timetable and implement the
following operations:
 - a. List all the trains (sorted according to train number) that depart from a particular section.
 - b. List all the trains that depart from a particular station at a particular time.
 - c. List all the trains that depart from a particular station within the next one hour of a given time.
 - d. List all the trains between a pair of start station and end station.
30. WAP to swap two elements using the concept of pointers.
31. WAP to compare the contents of two files and determine whether they are same or not.
32. WAP to check whether a given word exists in a file or not. If yes then find the number of times it occurs.

Note:

- a) The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner
- b) The subject teachers are suggested to use the concept of project based learning. The subject teacher may give certain use cases/case studies where student is able to apply multiple concepts in one single program
- c) It is also suggested that open source tools should be preferred to conduct the lab. Some open source online compiler to conduct the C lab are as follows:

- ❖ <https://www.jdoodle.com/c-online-compiler/>
- ❖ https://www.tutorialspoint.com/compile_c_online.php
- ❖ <https://www.programiz.com/c-programming/online-compiler/>
- ❖ <https://www.hackerrank.com/>

Mapping with Virtual Lab

Name of the Lab	Name of the Experiment
Problem Solving Lab	Numerical Representation
	Beauty of Numbers
	More on Numbers
	Factorials
	String Operations
	Recursion
	Advanced Arithmetic
	Searching and Sorting
	Permutation
	Sequences

Course Outcomes:

Course Outcome		Bloom's Level
At the end of course , the student will be able to:		
CO 1	Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.	K ₃ , K ₄
CO 2	Demonstrate an understanding of computer programming language concepts.	K ₃ , K ₂
CO 3	Ability to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.	K ₆ , K ₄
CO 4	Able to define data types and use them in simple data processing applications he/she must be able to use the concept of array of structures.	K ₁ , K ₅
CO 5	Develop confidence for self-education and ability for life-long learning needed for Computer language.	K ₃ , K ₄

BAS155 / BAS255 : ENGLISH LANGUAGE LAB

Course Objectives:

1. To facilitate software based learning to provide the required English Language proficiency to students.
2. To acquaint students with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
3. To train students to use the correct and error-free writing by being well versed in rules of English grammar.
4. To cultivate relevant technical style of communication and presentation at their work place and also for academic uses.
5. To enable students to apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics.

Professional Communication Lab shall have two parts:

1-Interactive Communication Skills:

Students should practice the language with variety of activities and exercises based on employability skills. Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication, based on International Phonetic Alphabets (I.P.A.)

LIST OF PRACTICALS

1. Group Discussion: Practical based on Accurate and Current Grammatical Patterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic/Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ proposals based on proper Stress and Intonation Mechanics
5. Official/Public Speaking practice sessions based on suitable Rhythmic Patterns.
6. Theme Presentation/ Keynote Presentation based on correct methodologies of argumentation
7. Individual Speech Delivery/Conferencing with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practical's on a model Audio
10. Startup presentations, Video portfolio, Extempore, Role play, Just a Minute (JAM) etc.

2-Computer assisted software based Language Learning:

Software based self-guided learning to provide the required English language proficiency to students from an employability and career readiness standpoint. The software should align to Common European Framework of Reference for Languages (CEFR) and deliver a CEFR level – B2 upon completion.

Course Outcome:

1. Students will be enabled to understand the basic objective of the course by being acquainted with specific dimensions of communication skills i.e. Reading, Writing, Listening, Thinking and Speaking.
2. Students would be able to create substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing and speaking etc.
3. Students will apply it at their work place for writing purposes such as Presentation/official drafting/administrative communication and use it for document/project/report/research paper writing.
4. Students will be made to evaluate the correct and error-free writing by being well-versed in rules of English grammar and cultivate relevant technical style of communication & presentation at their work place and also for academic uses.
5. Students will apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing interpersonal communication skills and positive attitude leading to their professional competence.

Suggested Softwares:

- *Oxford Achiever* by Oxford University Press.
- *Cambridge English Empower* by Cambridge University Press.
- *MePro*. by Pearson India Education Services Pvt. Ltd.
- *New Interactions* by McGraw-Hill India.

Reference Books:

1. Word Power Made Easy by Norman Lewis, W.R.Goyal Pub. & Distributors, 2009, Delhi.
2. Manual of Practical Communication by L.U.B. Pandey; A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi
3. Practical Communication Process & Practice, LU.B. Pandey: A.I.T.B.S. Pub. India Ltd Krishna Nagar, Delhi, 2013.
4. English Grammar and Usage by R.P. Sinha, Oxford University Press, 2005, New Delhi.
5. English Grammar, Composition and Usage by N.K.Agrawal & F.T.Wood, Macmillan India Ltd., New Delhi.
6. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House
7. English Grammar & Composition by Wren & Martin, S.Chand & Co. Ltd., New Delhi.
8. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt.Ltd, 2011, New Delhi.
9. Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, New Delhi
10. Personality Development & Soft Skills, Barun K.Mitra, Oxford University Press, 2012 New Delhi.
11. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
12. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.
13. Spoken English- A manual of Speech and Phonetics by R.K.Bansal & J.B.Harrison, Orient Blackswan, 2013, New Delhi.
14. Business English by Ken Taylor, Orient Blackswan, 2011, New Delhi

BCE151/ BCE251: ENGINEERING GRAPHICS & DESIGN LAB

Course Objectives:

- To prepare the students for the effective technical communication.
- To provide them exposure of techniques, skills, and modern engineering tools necessary for engineering practice.
- To prepare the students to design a system, component, or process to meet desired needs within realistic constraints around them in professional life.

Content	Contact Hours
Unit-1: Introduction to Engineering Drawing and Orthographic Projections	8
Principles of Engineering Graphics and their significance. Dimensioning, Lettering. Scales: Plain, Diagonal and Engineering Scales. Orthographic Projection, Projection of Point, Projection of Lines: Projection of straight lines; Projection of lines inclined to one plane and both planes.	
Unit-2: Projection of Planes and Solids	8
Projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes. Classification of solids, Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.	
Unit-3: Sections of Regular Solids and development of Surfaces	8
Sections of Solids: Right regular solids and Auxiliary views for the true shape of the sections such as Prism, Cylinder, Pyramid, and Cone. Development of surfaces for various regular solids such as Prism, Cylinder, Pyramid and Cone.	
Unit-4: Isometric Projection	8
Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids. Perspective Projection: Orthographic representation of perspective views — Plane figures and simple solids — Visual Ray Method. Conversion of pictorial view into orthographic Projection.	
Unit-5: Introduction to Computer Aided Design	8
Introduction to AutoCAD: Basic commands for 2D drawing: Line, Circle, Polyline, Rectangle, Hatch, Fillet, Chamfer, Trim, Extend, Offset, Dim style, etc. Transformation of Projections: Conversion of Isometric Views to Orthographic Views and Vice-Versa in AutoCAD. Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form.	

Course Outcome:

After completion, of course students will be able to:

- CO 1: Use scales and draw projections of objects.
- CO 2: Explain views of solids and their sectional surfaces.
- CO 3: Analyze and draw isometric projections of objects.
- CO 4: Demonstrate orthographic representation of perspective views using modern tools.
- CO 5: Apply AutoCAD software for creation of engineering drawing and models

Suggested Text/ Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication
4. Engineering Graphics & Design, A.P. Gautam & Pradeep Jain, Khanna Publishing House
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
6. (Corresponding set of) CAD Software Theory and User Manuals.

BWS151/ BWS251: WORKSHOP PRACTICE LAB

S. No.	Mechanical Workshop	Duration
1	Introduction to Mechanical workshop material, tools and machines	3 Hrs
	To study layout, safety measures and different engineering materials (mild steel, medium carbon steel, high carbon steel, high speed steel and cast iron etc) used in workshop.	
	To study and use of different types of tools, equipment, devices & machines used in fitting, sheet metal and welding section.	
	To determine the least count of Vernier calliper, vernier height gauge, micrometer (Screw gauge) and take different reading over given metallic pieces using these instruments.	
2	Machine shop	3 Hrs
	Demonstration of working, construction and accessories for Lathe machine	
	Perform operations on Lathe - Facing, Plane Turning, step turning, taper turning, threading, knurling and parting.	
3	Fitting shop	3 Hrs
	1. Practice marking operations. 2. Preparation of U or V -Shape Male Female Work piece which contains: Filing, Sawing, Drilling, Grinding.	
4	Carpentry Shop	3 Hrs
	Study of Carpentry Tools, Equipment and different joints.	
	Making of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint	
5	Welding Shop	6 Hrs
	Introduction to BI standards and reading of welding drawings.	
	Practice of Making following operations Butt Joint Lap Joint TIG Welding MIG Welding	
6	Moulding and Casting Shop	6 Hrs

	Introduction to Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes Demo of mould preparation and Aluminum casting Practice – Study and Preparation of mould for Plastic	
7	CNC Shop	6 Hrs
	Study of main features and working parts of CNC machine and accessories that can be used. Perform different operations on metal components using any CNC machines	
8	To prepare a product using 3D printing	3 Hrs
	Total	33 Hrs

Course Outcome:

The students will be able to		Blooms Level
CO1	Use various engineering materials, tools, machines and measuring equipments.	K3
CO2	Perform machine operations in lathe and CNC machine.	K3
CO3	Perform manufacturing operations on components in fitting and carpentry shop.	K3
CO4	Perform operations in welding, moulding, casting and gas cutting.	K3
CO5	Fabricate a job by 3D printing manufacturing technique	K3

Reference Books:

1. Workshop Practice, H S Bawa, McGraw Hill
2. Mechanical Workshop Practice, K C John, PHI
3. Workshop Practice Vol 1, and Vol 2, by HazraChoudhary , Media promoters and Publications
4. CNC Fundamentals and Programming, By P. M. Agrawal, V. J. Patel, Charotar Publication.