Semester II

Theory/ Practical	Sl. No	Course Type	Course Code	Course Name	Hours per week			Credit
					L	T	P	C
T	1.	BSC	BPY23111T	Physics	3	0	0	3
P	2.	BSC	BPY23111P	Physics Laboratory	0	0	2	1
T	3.	BSC	BMA23111T	Biology for Engineers	3	0	0	3
T	4.	BSC	BBI23101T	Mathematics - II	3	1	0	4
T	5.	ESC	BEL23101T	Basic Electrical Engineering	3	1	0	4
P	6.	ESC	BEL23101P	Basic Electrical Engineering Laboratory	0	0	2	1
T/P	7.	ESC	BCE23101P	Engineering Graphics and Design	1	0	4	3
P	8.	ESC	BCS23102P	Programming using C++	0	0	2	1
P	9.	AU	BME23101P	Design Thinking and Idea Lab	2	0	2	0
Total					**15**	**2**	**12**	**20**

BSC

PHYSICS

L	T	P	C
3	0	0	3

Pre-requisite: Physics and Mathematics course of 12th standard.

Course Objectives: To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

Course Outcome:

After successful completion of the course, the students will be able

CO1: understand the concept of fundamental of mathematical physics and apply in solving problems.

CO 2: to apply the mathematical physics to study the dielectric properties of matter.

CO 3: understand the basics of electromagnetism by applying magnetostatics and electrostatics theory.

CO 4: to understand the concept of transverse and longitudinal wave propagation.

CO 5: to understand the geometrical optics, wave optics and lasers.

Module 1: Mathematical Physics **6 hours**

Del operator, Laplacian operrtor gradient, divergenge and curl, problems related to these concepts, their physical significance (qualitative), Gauss's theorem, Stoke's Theorem

Module 2: Electrostatics in vacuum and other dielectric media **8 hours**

Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential, Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field

Module 3: Magnetostatics and Electromagnetic theory **6hours**

Bio-Savart law, Ampere's law, Inconsistency of Amere's law, Displacement current, faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF, magnetic substances, paramagnetic, diamagnetic, ferromagnetic, Maxwell's equations (qualitative)

Module 4:Harmonic motion , Non-dispersive transverse and longitudinal waves **8 hours**

Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, Transverse wave on a string, the wave equation on a string, Harmonic waves, longitudinal waves and the wave equation for them

Module 5: optics **8 hours**

Spherical and chromatic aberrations, Achromatism in different cases, interference of light in Newton's rings experiment, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, , different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium)

Total Lecture hours **36 hours**

Text Book(s)

1. Introduction to Electrodynamics, D.J Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. Electricity and Magnetism, Edward M.Purcell, 1986 McGraw-Hill Education
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill
5. Ian G. Main, Oscillations and waves in physics

Reference Books

1. The Feynman Lectures on Physics, Vol I, II,III
2. Bhattacharya & Nag, Engineering Physics
3. O. Svelto, Principles of Lasers

		L	T	P
BSC	**Physics Laboratory**	0	0	2

Prerequisite : Basics of 12 standard Physics lab

Course Objective :

1) To develop the laboratory skill in handling equipments.
2) Provide the basic idea of various electromagnet theorems
3) To develop the technical skill & ideas through continuous interactions..
4) To understand the basic concepts for performing different experiment for further application

Course Outcome:

CO1: Learning basic concept of various measuring instruments
CO2: Learning the basic concept measuring various electrical components by using Digital multimeter
CO3: Understand the concept of focal length and power of lens
CO4: Understand the concept of measuring inductance of coils.
CO5: Learning the concept of resonant and anti-resonant frequency concept of LCR circuit.
C06: The course provides the basic idea focal length, refractive index of a material and diffraction of light.

List of Experiments :

1) Measured the length, breadth and diameter of particular shapes by using slide calipers and screw gauge.
2) To measure the
   a) Resistance, Capacitance and Inductance
   b) AC & DC Voltage and current by using Digital Multimeter
3) To determine the inductance of a coil by Anderson's bridge
4) To study a series LCR circuit and determine it's
   a) Resonant frequency and b) Quality factor Q
5) To study a parallel LCR circuit and determine its
   a) Anti-resonant frequency and b) Quality factor Q.
6) Measure the self inductance of a coil by Rayleig's method.
7) To determination of the power of
   a) Convex lens b) Concave lens
8) To find the radious of curvature of a Plano convex lens using Newton's ring apparatus
9) To find the refractive index of water using a convex lens and a plain mirror.
10) To find the refractive index of the material of the Prism with the help of spectrometer.

Total Lab Hours :	26 Hours

Text Books :

1) A TEXT BOOK ON PRACTICAL PHYSICS: K.G. MAZUMDAR & B.GHOSH
2) A TEXT BOOK ON PRACTICAL PHYSICS: DR. SAMIR KUMAR GHOSH
3) BHATTACHARYA & NAG. ENGINEERING PHYSICS.
4) B.Sc. PRACTICAL PHYSICS BY C.L. ARORA.

BSC	Biology (Biology for Engineers)	L	T	P	C
		2	0	0	2

Prerequisite: Biology in intermediate level

Course Objectives:

XXXXXX

Course Outcome:

After studying the course, the student will be able to:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine
5. Classify enzymes and distinguish between different mechanisms of enzyme action.
6. Identify DNA as a genetic material in the molecular basis of information transfer.
7. Analyse biological processes at the reductionistic level
8. Apply thermodynamic principles to biological systems.
9. Identify and classify microorganisms

Module:1 Introduction **4 hours**

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module:2 Classification **4 hours**

The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module:3 Genetics **4 hours**

“Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Module:4 Biomolecules **3 hours**

All forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module:5 Enzymes **3 hours**

Without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

Module: 6 Information Transfer **3 hours**

The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination. DICOM Image formats, The DNA Technology (Use and Application) Regulation Bill, 2019

Module: 7 Macromolecular Analysis **3 hours**

How to analyses biological processes at the reductionistic level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module:8Metabolism **3 hours**

The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module:9Microbiology **3 hours**

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

Total hours **30 hours**

Text Book

1. General Biology, Uma Devi Koduru, Khanna Book Publishing Company.

Reference Books

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

BSC	MATHEMATICS-II (ODE & Complex Variables)	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Mathematics at Class XI & XII

Course Objectives:

1. To familiarize the prospective engineers with techniques in ordinary differential equations and complex variables
2. To provide the basic tools of mathematics for the purpose of modelling the problems and obtaining solutions.

Course Outcome:

After successful completion of the course, the students will learn

CO 1: the effective mathematical tools for the solutions of differential equations that model physical processes.

CO 2: the tools of differentiation and integration of functions of a complex variable that are used in varioustechniques dealing engineering problems.

Module 1:First Order Ordinary Differential Equations **10 hours**

Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2:Ordinary Differential Equations of Higher Orders **14 hours**

Second order linear differential equations with variable coefficients: Euler-Cauchy equations, Solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 3: Complex Variable – Differentiation **10 hours**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 4: Complex Variable – Integration **14 hours**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Total Lecture hours **48 hours**

Text Book

1. **AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable), Khanna Book Publishing Co.**

Reference Books

1. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
2. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005
7. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984
8. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
9. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958
10. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
11. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
12. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

ESC **BASIC ELECTRICAL ENGINEERING**

L	T	P	C
3	1	0	4

Pre-requisite:H.S Physics and H.S Mathematics

Course Objectives: The students will learn

1. The network reduction techniques such as source transformation, mesh analysis, nodal analysis and network theorems to solve different networks
2. The various configurations of electromagnetic induction used in magnetic circuits
3. The steady state response of complex electrical circuits with single phase AC supply
4. The three phase systems for star and delta connected systems and perform three phase power calculations for balanced and unbalanced loads.
5. The fundamentals of instrumentation in measurements and calibration of instruments.
6. The different parameters for characterizing different circuits like rectifiers, filters, voltage regulators etc. using p-n junction diodes, Zener diodes and BJTs.
7. The different cables, wiring systems, wiring circuits, earthing and its purpose, fuse, MCBs and their role in electrical installations.

Course Outcome: After successful completion of this course, the students will be able to

1. Analyze DC networks and theorems using various solution techniques.
2. Apply fundamental concepts of magnetic circuits and AC networks to solve problems.
3. Explain different types of measuring instruments and their workings.
4. Demonstrate the operating principle and output characteristics of PN junction diodes, Zener diode, BJT, rectifiers anddifferent filter circuits.
5. Describe the components of low voltage electrical installations andperform elementary calculations for energy consumption.

Module 1: DC Networks **8 hours**

Definitions of active, passive, linear non-linear circuit elements and networks; Kirchhoff's laws; Nodal and mesh analysis; Voltage and current sources;Network theorems:Superposition, Thevenin's, Norton's and Maximum power transfer.

Module 2: Magnetic Circuits **8 hours**

Definitions of mmf, flux, flux-density and reluctance; comparison between electric and magnetic circuits; series, parallel and series-parallel circuits and their solutions; energy stored in a magnetic circuit; lifting power of a magnet; electromagnetic induction, self and mutual inductance, hysteresis and eddy current losses.

Module 3: AC Circuits **12 hours**

Waveforms of alternating voltages and currents, instantaneous, average and RMS values, form factor & peak factor, forms of representation of alternating quantities, concept of phasor & phasor diagrams, Concept of lead & lag, reactances& impedances, AC circuits-resistive, inductive, capacitive, RL, RC & RLC series, parallel and series parallel combination, impedance triangle, admittance, active & reactive power & power factor.

Concepts of 3-phase AC, connections, phase & line values in star & delta connections, solutions of simple 3-phase balanced circuits with resistive & reactive loads, 3-phase power, and phase sequence

Module 4: Instruments **8 hours**

Classification of instruments; essentials of indicating type instruments-deflecting controlling and damping torque; types of indicating instruments; moving coil and moving iron ammeters and voltmeters; extension of range of instruments -use of shunts and multiplier.

Module 5:Electronics **8 hours**

Diode as a rectifier-half wave and full wave rectifier circuits; ripples in output waveform-ripple factor; introduction to filters; Zener diode and its application as voltage regulator; bipolar junction transistor and its classification, static characteristics.

Module 6: Basics Of Electrical Installations **4 hours**

Basic knowledge of domestic wiring, types of cables, types of wiring; circuit layouts-single phase AC mains to DB; 3 phase connections; accessories-main switch, ceiling rose, fuse, MCB etc. Earthing-purpose & methods.

Total Lecture hours **48 hours**

Text Book(s)

1. Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2. Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3. Electro Technology: H Cotton, CBS Publishing.
4. Electrical and Electronic Technology-Edward Hughes, Pearson Education India.
5. AICTE's Prescribed Textbook: Basic Electrical Engineering, Khanna Book Publishing

Reference Books

1. Basic Electrical Engineering: Ravish R Singh, McGraw Hill Education (India) Pvt Ltd.
2. Basic Electrical Engineering: K. Uma Rao, Pearson Education India.
3. Basic Electrical and Electronics Engineering: R.K. Rajput, University Science Press.
4. Basic Electrical and Electronics Engineering: J.B. Gupta, S.K. Kataria and Sons

ESC	BASIC ELECTRICAL ENGINEERINGLABORATORY	L	T	P	C
		0	0	2	1

Pre-requisite: H.S Physics and Mathematics

Course Objectives: The students will try to learn

1. Implement different circuits and verify circuit concepts for DC and AC circuits.
2. Measure the parameters for RL, RC and RLC circuits.
3. Prove the various theorems used to reduce the complexity of electrical network.

Course Outcome:

After successful completion of the course, the students will be able learn

CO1: Practical implementation of Electrical fundamentals.

CO2: To demonstrate measurement and calibration using electrical instruments.CO3: To implement various electrical theorems and study parameters ofelectrical and electronic circuits.

List of Experiments

1. Basic safety precautions, introduction and use of measuring instruments.
2. Calibration of a Milliammeter as a Voltmeter
3. Calibration of a Millivoltmeter as an Ammeter
4. Verification of Thevenins Theorem
5. Verification of Maximum Power Transfer Theorem
6. Study of R-L-C Series Circuit
7. Forward Characteristics of Semiconductor Diode
8. Measurement of power in a single phase AC circuit using Wattmeter.
9. Demonstration of layout of house wiring
10. Demonstration of measurement of insulation resistance

List of Equipments

1. AC, DC Voltmeter
2. AC, DC Ammeter
3. Wattmeter meter
4. Rheostat
5. DC supply

Text Book(s)

1	Basic Electrical Engineering: I J Nagrath and DP Kothari, McGraw Hill Education Pvt Ltd.
2	Basic Electrical Engineering: Mittle and Mittle, McGraw Hill Education (India) Pvt Ltd.
3	Electrical and Electronic Technology-Edward Hughes, Pearson Education India.

Reference Books

1.	Basic Electrical Engineering manual; available at Department of Electrical Engineering, GCU

ESC	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
		1	0	4	3

Pre-requisite: Nil

Course Objectives:

1. To provide the basic knowledge about Engineering Drawing.
2. Detailed concepts are given in projections, technical drawing, dimensioning and specifications

Expected Course Outcome:

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

1. To prepare themselves to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
2. To prepare themselves to communicate effectively
3. To prepare themselves to use the techniques, skills, and modern engineering tools necessary for engineering practice

Module:1 *Introduction to Engineering Drawing* — **7 hours**

i. Principles of Engineering Graphics and their significance, usage of Drawing instruments

ii. Lettering - Single stroke letter – Vertical and inclined capital and small letter

iii. Scales – Plain, Diagonal and Vernier Scales

iv. Curves - Ellipse, parabola, hyperbola, different methods of construction of conic sections, tangents and normal to conics

Module:2 *Orthographic Projections* — **13 hours**

i. Principles of Orthographic Projections-Conventions

ii. Projections of Points and lines inclined to both planes

iii. Projection of lines (First angle only) : Line parallel to one or both planes, line perpendicular to a plane, line inclined to one plane and parallel to other, line inclined to both plane.

iv. iv. Projections of planes (First angle only): Plane perpendicular to one plane and parallel to other, plane perpendicular to both plane, plane inclined to one plane and perpendicular to other.

v. v. Projection of solids (First angle only) : Axis perpendicular to one plane and parallel to other, axis parallel to both plane, axis inclined to one plane and parallel to other, axis inclined to both plane.

Module:3 *Sections and Sectional Views of Right Angular Solids* — **4 hours**

Section of solids: Section plane parallel to one plane and perpendicular to other, section plane inclined to one plane and perpendicular to other.
Development of surfaces of Right Regular Solids- Prism, Pyramid, Cylinder and Cone

Module:4 *Isometric Projections* — **4 hours**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module:5 *Introduction of Computer Graphics* — **5 hours**

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]	
Module:6 *Demonstration of simple team design (Students Project as group work)*	**3 hours**
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	
Total Lecture hours	**36 hours**
Text Book(s)	
1. AICTE's Prescribed Textbook: Engineering Graphics & Design (ISBN: 978-93-91505-066)	
Reference Books	
1. Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.	
2. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing.	
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson.	
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.	
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.	
6. (Corresponding set of) CAD Software Theory and User Manuals.	

		L	T	P	C
ESC	**DESIGN THINKING**	**0**	**0**	**2**	**1**

Prerequisite: NA

Course Objectives: The objectives of this course are to:

1. To instill the core ideas of design thinking
2. To educate students on the design process as a tool for innovation.
3. To create, conceptualize, build and present ideas on the basis of prototypes
4. To provide an authentic opportunity for students to develop teamwork and leadership skills.

Course Outcome: After successful completion of this course, the students will be able to

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education.
- Analyze emotional experience and produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact.
- Understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices.
- Perceive individual differences and its impact on everyday decisions and further Create a better customer experience.

Module 1: Design Thinking Overview **2 hours**

Understanding the Process of Learning, Remembering and Emotions, Kolb's Learning Styles, Memory Retention and enhancement techniques, Assessment and Interpretation, Principles of Design Thinking

Module 2: Design Thinking Approach in Stages **5 hours**

Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design, Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs

Module 3: Adopt and Adapt Design Thinking **5 hours**

Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, 3D printing; Experimenting/testing.

Module 4: Feedback, Re-Design & Re-Create **3 hours**

Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, **Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".**

Total hours **15 hours**

Text Book(s)

1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
3. Idris Mootee, Design Thinking for Strategic Innovation,2013, John Wiley & Sons Inc

Reference Books

1. Ulrich &Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004
2. Kevin Henry, Drawing for Product designers, 2012, Laurence King Publishing Ltd

		L	T	P	C
U	**IDEA Lab Workshop**	2	0	2	0

Pre-requisite: Mathematics-1, Physics-1, Engineering Graphics & Design

Course Objectives: The objectives of this course are to:

5. Learn all the skills associated with the tools and inventory associated with the IDEA Lab.
6. Learn useful mechanical and electronic fabrication processes.
7. Learn necessary skills to build useful and standalone system/ project with enclosures.
8. Learn necessary skills to create print and electronic documentation for the system/project.

Course Outcome: After successful completion of this course, the students should be able to

1. Think outside the box and generate new and innovative ideas.
2. Identify and solve problems using critical thinking skills and creative problem-solving techniques.
3. Work collaboratively in a team, motivate others and understand the importance of effective communication, cooperation and conflict resolution to achieve a common goal.
4. Use various technologies and tools to develop, implement and explore new plans testing their ideas.

Module 1: Introduction toTools **2 hours**

- Introduction to basic hand tools - Tape measure, Vernier caliper,Hammers, Fasteners, Wrenches, Pliers, Saws, Tube cutter, Chisels, Vice and Clamps, Tapping and Threading. Adhesives.
- Introduction to Power tools - Power saws, Jigsaw, Angle grinder, Belt sander, Bench grinder, Rotary tools. Various types of drill bits.

Module 2: Mechanical Cutting/Joining Process **8 hours**

- Mechanical cutting processes - Basic Turning, Milling, Drilling, Grinding, Carpentry, Black Smithy operations, Wood Lathe.
- Basic welding, brazing and other joining techniques for assembly.

Module 3: Additive & Subtractive Manufacturing **8 hours**

- 3D printing and prototyping technology, 3D printing using FDM, SLS and SLA.
- Basics of 3D scanning, point cloud data generation for reverse engineering.
- Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers.

Module 4: Basic Electronic Components and Devices **2 hours**

- Electronic component familiarization, familiarization& use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal, and function generator. Understanding electronic system design flow.

Module 5:PCB Fabrication **10 hours**

- Schematic design and PCB layout and Gerber creation using Eagle CAD, Circuit prototyping using (a) breadboard (b) custom PCB. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven.

Module 6: Sensors and Arduino Programming **6 hours**

- Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Power Supply design (Linear and Switching types), Wireless power supply, Solar panels, Battery types and charging.

Total Lecture hours **36 hours**

Text Book(s)

1. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.
2. 3D Printing & Design, Dr. SabrieSoloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
3. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing," Springer, 2010
4. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
5. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
6. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
7. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
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