COEP Technological University Pune

(A Unitary Public Univresity of Govt. of Maharashtra)

School of Electrical and Communication Engineering

Curriculum Structure & Detailed Syllabus

F.Y. B. Tech.
Electrical Engineering, E & TC, Instrumentation and Control

(Effective from: A.Y. 2023-24)

F.Y. B. Tech. in
Electrical Engineering, E & TC, Instrumentation and Control

List of Abbreviations

Abbreviation	Title	No of Courses	Credits	% of Credits
BS	Basic Science Course	05	14	35
ESC	Engineering Science Course	05	15	37.5
PCC	Programme Core Course (PCC)	01	03	7.5
PEC	Programme Elective Course (PEC)	--	--	--
OE/SE	Open/School Elective (OE/SE) other than particular program	--	--	--
MD M	Multidisciplinary Minor (MD M)	--	--	--
VSEC	Vocational and Skill Enhancement Course (VSEC)	01	02	5
HSMC	Humanities Social Science and Management	01	02	5
IKS	Indian Knowledge System (IKS)	01	02	5
VEC	Value Education Course (VEC)	--	--	--
RM	Research Methodology (RM)	--	--	--
--	Internship	--	--	--
--	Project	--	--	--
CEA	Community Engagement Activity (CEA)/Field Project	--	--	--
CCA	Co-curricular & Extracurricular Activities (CCA)	02	02	5
	Total	**16**	**40**	**100**

F.Y. B. Tech. in
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Semester -I

Sr. No.	Course Code	Course Title	L	T	P	S	Cr	Category
01	BS-01	Matrix Algebra, Calculus and Probability	2	1	0	1	3	BSC
02	BS-02	Engineering Chemistry	2	0	2	1	3	BSC
03	BS-03	Biology for Engineers	2	0	0	1	2	BSC
04	ES-01	Elements of Electronics Engineering	2	0	2	1	3	ESC
05	ES-02	Engineering Mechanics	2	0	2	1	3	ESC
06	ES-03	Programming for problem solving	2	0	2	2	3	ESC
07	HSMC-01	Indian Knowledge System	2	0	0	1	2	IKS
08	CCA-01	Liberal Learning course - I	0	0	2	2	1	CCA
		Total	**14**	**01**	**10**	**10**	**20**	

Semester -II

Sr. No.	Course Code	Course Title	L	T	P	S	Cr	Category
01	BS-04	Differential Equations and Complex Algebra	2	1	0	1	3	BSC
02	BS-05	Engineering Physics	2	0	2	1	3	BSC
03	ES-04	Basic Electrical Engineering	2	0	2	1	3	ESC
04	ES-05	Engineering Drawing and Computer Graphics	1	0	4	1	3	ESC
05	PCC-01	Fundamentals of measurement and sensors	2	0	2	1	3	PCC
06	VSEC-01	Data Visualization and Pre-processing	1	0	2	2	2	VSEC
07	HSMC-02	Communication Skills	1	0	2	0	2	AEC
08	CCA-02	Liberal Learning course - II	0	0	2	2	1	CCA
		Total	11	01	16	09	20	

- Exit option to qualify for Certification, common at the School Level:
  - Printed Circuit Board (PCB) Design and Production (3 Credits)
  - Electrical Workshop (3 Credits)
  - Instrumentation Workshop (3 Credits)

  Note: Exiting students need to take one SEC from his/her discipline and the other of his/her choice.

Semester - I

[BS-01]Matrix Algebra, Calculus and Probability

Teaching Scheme
Lectures: 2 hrs/week
Tutorials: 1 hr/week
Self-study: 1 hr/week

Examination Scheme
Internal Test : 20 marks
Tutorials: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Define** matrices, linear equations, and determinants, **recall** basics of probability theory,probability distribution, **recall** basic concepts of linear algebra, **recall** double / triple integrals, vector differentiation, vector integration.
2. **Understand** basic concepts such as linear dependence / independence of vectors, rank, nullity, **concepts** of probability, probability distributions, **understand** basic concepts of co-ordinate systems, iterated integrals, gradient, divergence and curl.
3. **Analyze** and **calculate** eigen values, eigen vectors, rank, nullity of a matrix, **evaluate** probability of compound events, **find** probabilities using standard distributions, **evaluate** multiple integrals, **find** area / mass / volume using multiple integrals, **evaluate** line integrals and surface integrals.
4. **Prove** theorems, **apply** Green's / Stoke's / Divergence theorem to different type of problems, **perform** analysis of variance.
5. **Apply** concepts of Matrix Algebra, Calculus and Probability to various problems including real life problems.

Unit 1 **(8L+4T+4S)**

Matrices and Linear Equations: Matrices and Linear Equations: basic properties of matrices, row operations and Gauss elimination, Determinants, and their basic properties, Basic concepts in linear algebra: vector spaces, subspaces,linear independence, and dependence of vectors. Row and Column rank. Solutions of Systems of linear equations using Gauss Elimination method; Rank and Nullity; Eigen Values and Eigen Vectors
S: basic properties of matrices, row operations, Determinants, and their basic properties

Unit 2 **(12L+6T+6S)**

Integral Calculus: Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates, substitutions in multiple integrals, Applications to Area, Volume, Moments, and Center of Mass. Vector differentiation, gradient, divergence and curl, line integral and arc length parameterization, surface integrals, path independence, statements, and illustrations of theorems of Green, Stokes and Gauss, applications.
S: Area, Volume, Moments, and Center of Mass

Unit 3 **(8L+4T+4S)**

Probability: Mean, median, mode, standard deviation, combinatorial probability, joint and conditional probability. Probability distributions, binomial distribution, Poisson distribution, normal distribution, exponential distribution.
S: exponential distribution

Textbooks:

- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley Eastern Ltd.

Reference Books:

- Erwin Kreyszig,"Advanced Engineering Mathematics" by, Wiley Eastern Ltd., 10th edition
- Serge Lang, "Linear Algebra" Springer , 3rd edition
- Gilbert Strang," Linear Algebra and its applications", Cengage Learnings RS, 4th edition
- Howard Anton and Chris Rorres ,"Elementary Linear Algebra ",John Wiley, and sons, 10th edition
- Ross S.M., "Introduction to probability and statistics for Engineers and Scientists", Elsevier Academic press, 8th Edition, 2014.
- Ronald E, Walpole, "Sharon L. Myers, Keying Ye, Probabilty and Statistics for Engineers and Scientists",Pearson Prentice Hall, 9th Edition, 2007.

Note 1:

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

Note 2:

- All the Course outcomes 1 to 3 will be judged by 75% of the questions and outcomes 4 and 5 will be judged by 25 % of questions.

[BS-02] Engineering Chemistry

Teaching Scheme
Lectures: 2 hrs./week
Practical: 2hr / week
Self-study: 1 hr/week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Impart an understanding of Engineering chemistry's fundamental concepts, analytical methods and technological features.
2. Develop the capacity to analyze engineering problems based on the knowledge of chemistry.
3. Develop problem-solving ability.
4. Keep students abreast of the newest advancements and uses of contemporary materials

Unit 1 **(7hrs)**

Analytical Techniques for Engineers:

- Role of materials in engineering fields.
- Quality control and assurance in engineering contexts.
- Qualitative and quantitative analysis
- Emerging trends and applications of analytical techniques for engineering.
- Instrumental methods of analysis: spectroscopy (UV and IR), chromatography (GLC and HPLC), Microscopy: SEM, Thermo-gravimetry: TGA

Unit 2 **(6hrs)**

Corrosion and material protection

- Introduction to corrosion and its impact on engineering materials
- Mechanism, Types/forms of corrosion, Factors that enhance corrosion and choice of parameters to mitigate corrosion.
- Corrosion prevention techniques, advanced surface coatings and corrosion inhibitors
- Case studies and real-world applications in corrosion prevention

Unit 3 **(8 hrs)**

Electrochemical energy systems

- High energy electrochemical energy systems: Lithium-ion batteries principle, construction, working, advantages and applications, Na-ion Battery, fiber battery
- New emerging Fuel cells-working principles, advantages, applications
- Solar cells, Types Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells- working principles, characteristics and applications
- Green hydrogen technology

Unit 4 **(7hrs)**

Nanomaterials for electronics

- Nanomaterials, classification, Nanoscale phenomena and quantum effects
- Top-down and bottom –up approach, Synthesis methods: ball milling, RF sputtering, pulsed laser deposition, thin film deposition
- Applications of nanomaterials in electronics
- Fundamentals of Sensors and materials used in sensors, Synthesis of a sensor.
- Fundamentals of Super capacitor and materials used in super capacitor, Synthesis

of a super capacitor

@ 13-15 lectures per credit per course

Self-study - Green Chemistry (12 principles and industrial case study)

List of Recommended Books:

- Willard Dean, Merrittee, "Instrumental Methods of Chemical Analysis",Tata McGraw Hill Limited.
- Gurdeep R. Chatwal,"Instrumental Methods of Chemical Analysis",Himalaya Publishing House.
- Jain and Jain "A textbook of Engineering Chemistry", Dhanpatrai Publication.
- S. S. Dara , "A textbook of Engineering Chemistry", S. Chand Publication 2010 ed.
- Shashi Chawla, "A textbook of Engineering Chemistry", Dhanpatrai Publication.
- Prof. Jianmin Ma, "Battery Technologies: Materials and Components", Wiley
- Charles P. Poole, Frank J. Owens "Introduction to Nanotechnology"
- Shripad Revankar, Pradeep Majumdar , "Fuel Cells"
- Fuel Cell Fundamentals-Ryan O'Hayre, Suk-Won Cha
- SuddhasatwaBasu, "Recent Trends in Fuel Cell Science and Technology"

Engineering Chemistry: Laboratory

Course Outcomes:

Students will demonstrate the ability to

1. Apply theoretical knowledge for practical use and solve engineering problems.
2. Design and carry out scientific experiments, accurately record and analyze the results of experiments.

List of Experiments

1. Preparation and standardization of analytical reagents
2. pH-metric analysis of a sample solution
3. Analysis of inorganic solution by spectroscopic method (Calorimetry)
4. Corrosion testing of electronic integrated circuits
5. Finding the Calorific value of fuel by Bomb calorimeter (GCV, LCV)
6. Flash point-fire point and cloud point-pour point of fuel/lubricant
7. Synthesis of nanomaterials by green route (co-precipitation method)
8. Synthesis of nanomaterial by Ball-milling technique
9. Synthesis of thin films by Spin-coating
10. Characterization of material obtained by Ball-milling technique

Course Educational Objectives:

CEO1: To impart an understanding of Engineering chemistry's concepts, analytical methods and technological features.

CEO2: To acknowledge Laboratory Safety rules.

[BS-03] Biology for Engineers

Teaching Scheme
Lectures: 2 hrs./week
Self-study: 1 hr/week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand the overlapping areas between biology and engineering
2. Observe the principles of biological organization with lessons of increasing efficiency of engineered technologies
3. Analyze the analogies between biological and engineering processes
4. Explore the basic biological principles as guiding elements for engineering structures and processes
5. Appreciate the technological optimization of living systems

Unit 1 **(4 hrs)**

Crosstalk between Biology and Engineering:

a) Biologically inspired technologies: Case studies of designs in nature and inspired technologies, Biomemetics: Nature inspired material and mechanisms, Self-cleaning surfaces; Self-healing Bioconcrete, Biomining, Algorithms in nature,

b) Contribution of engineering in biological domain: Contribution of Microscope, Imaging techniques, Bio-medical Instruments, Mechanisms (Ergonomics)

Unit 2 **(8 hrs)**

Organization of Living Machines:

Biomolecules and manufacturing of Biopolymers:

- Carbohydrates (structure-based function and engineering applications)
- Lipids (structure-based function and engineering applications)
- Proteins (structure-based function and engineering applications)
- Nucleic Acids (structure-based function and engineering applications)

Organization of life forms: Cell to organism

Bioenergetics- Energy dynamics in biological system- principles of energy conservation and optimization

Unit 3 **(6 hrs)**

Analogy of biological organ/system and engineering Device/Mechanism:

Organ & system: Brain & CPU, Eye & Camera, Kidney & Filtration system, Lungs & purification system, Heart & Pumping system

Process: Photosynthesis & solar cells, Xylem & plumbing, Thermoregulation in human body & heat transfer in machine, Defense mechanism in organism, signaling processing in biology and electronics

Unit 4 **(6 hrs)**

Concepts in Bioengineering:

Biomechanics: Mechanical properties of tissues, Prosthesis and rehabilitation

Bioprinting: 3D printing of biological tissues and organ engineering and transplanting

Biomaterials: Types, properties and applications

Tissue Engineering: Principle, Components, Methods of Scafold synthesis, properties and

applications

Unit 5 (6 hrs)

Application areas of Bioengineering:

Databases & Biocomputing: Acquisition, storage, processing and transmission of biological data and its applications like PCR
Bioinstrumentation: Diagnostic and Therapeutic devices
Bioimaging: Principle, types and examples
Biosensors: Principle, types and examples
Computational biology and application of Artificial Intelligence in bio-medical field

Suggested learning resources:

1. Lodish H, Berk A, Zipursky SL, et al. (2000)" Molecular Cell Biology" W. H. Freeman
2. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000),"*Lehninger principles of biochemistry"* New York: Worth Publishers
3. Lewin B. (2000) "Genes VII" Oxford University Press
4. Rao CNR, et.al. , "Chemistry of Nanomaterials: Synthesis, Properties and Applications"
5. Eggins BR. (1006) , "Biosensors: An Introduction", John Wiley & Sons Publishers
6. Palsson B.O. and Bhatia S.N. (2009) "Tissue Engineering" Pearson

[ES-01]Elements of Electronics Engineering

Teaching Scheme
Lectures: 2 hrs./week
Practical: 2hr / week
Self-study: 1 hr/week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Illustrate the band theory of solids and the carrier concentration in solids.
2. Articulate and estimate the charge distribution and charge transfer process in semiconductors.
3. Analyze the characteristics of PN junction diode and junction transistor.
4. Exemplify the applications of diode.
5. Design logic expressions using gates.

Unit 1 **(8 hrs)**

Semiconductor Physics

Classification of Solids, intrinsic and extrinsic semiconductors, equilibrium carrier concentration, Mass action law, Fermi-Dirac probability function, Temperature dependence of carrier concentration, direct and indirect band-gap semiconductors, Carrier Transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations, Diffusion length and mean life time, Tunneling process.

Unit 2 **(6 hrs)**

Semiconductor Diodes

Formation of p-n junctions, position of Fermi level in equilibrium, V-I characteristics in forward and reverse bias, Capacitances in p-n junction diode, Zener diode, Zener diode as a voltage regulator, Applications of special purpose diodes viz. PIN diode, Schottky diode, Gunn diode, LED, Laser Diode, photo diode, Tunnel diode, and solar cell, Diode Circuits: clipping, clamping, voltage multiplier and rectifiers.

Unit 3 **(6hrs)**

Junction Transistors

Structure of NPN and PNP Transistors, BJT Configurations, Operation of BJT Common Emitter Configuration, V-I characteristics, Introduction to FET and MOSFET, Application as a switch.

Unit 4 **(6hrs)**

Fundamentals of Digital Electronics

Difference between analog & digital signals, Basics of Boolean algebra, logic Gates: Symbols, Truth tables, Boolean Expressions; Boolean Laws, Standard representation for logic functions(SOP and POS forms), Minimisation of logic expressions using Boolean Laws and K-map, Number Systems: Binary, octal, decimal, hexadecimal; Introduction to Combinational logic design: Adder/Subtractor, Multiplexers/de-multiplexers; Introduction to Sequential Circuits: Flip-Flops using NAND gates S-R flip flop, clocked S-R flip flop, J-K flip

flop.

Textbooks:

- Millman &Halkies, "Electronic Device and Circuits", 4th edition, Tata McGraw Hill.
- R.P.Jain, "Modern Digital Electronics", 4th edition, Tata McGraw Hill.

Reference Book:

- Millman Halkies, "Integrated Electronics", Tata McGraw Hill.
- Boylestead&Nashelsky, "Electronic devices and Circuits Theory", 8th edition, PHI
- Streetman, Ben G., and Sanjay Banerjee. "Solid state electronic devices", 6th edition. New Jersey: Prentice hall.
- M Morris Mano, "Digital Design", 4th edition, Pearson.

Elements of Electronics Engineering: Laboratory

Course Outcomes:

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

1. Design basic circuits using diodes
2. Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
3. Design, simulate, built and debug simple combinational circuits using gates

List of Experiments:

1. Introduction to various electrical passive components such as Resistors, inductors and capacitors, introduction to active components, introduction to breadboard, Measurement of resistance using the colour code, series and parallel connection of the resistances and its implementation on breadboard. Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, Power supply.
2. To Design clipping circuits - Single ended clipping, Double ended clipping, and clamping circuits.
3. To observe the effect of Variation of Frequency and Load Regulation for Voltage Multiplier.
4. To observe the output voltage of a half wave rectifier and center tapped full wave rectifier with and without capacitor filter. Calculate V_{dc} and I_{dc}.
5. To observe Input and Output Characteristics of BJT in CE configuration and Find h parameters from characteristics.
6. To observe Transfer and Drain Characteristics of MOSFET and Find gm, rd and μ from characteristics.
7. To simplify and implement a Boolean function using k -map technique e.g. code converter
8. To design and implement logic using Multiplexers and Demultiplexer.

[ES-02] Engineering Mechanics

Teaching Scheme
Lectures: 2 hrs/ week
Self-Study: 1 hr/ week

Examination Scheme
Internal Test 1: 20 marks
Internal Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Apply Mechanics principles to find resultant and equilibrium of 2D force system
2. Evaluate forces in statically determinate trusses and cables using equations of static equilibrium
3. Apply laws of dry friction for engineering problems
4. Solve engineering problems on motion of a particle

Unit 1 **(7 hrs)**

Force system: Forces, Free-Body Diagrams, Moment, Couples, Resultant and Equilibrium of Two-dimensional force System, Equivalent Force system

Unit 2 **(7hrs)**

Structures in Equilibrium: Beams, Trusses, and Cables, Dry Friction for inclined planes, Belt friction

Unit 3 **(7 hrs)**

Motion of a Point: Position, Velocity and Acceleration, Straight Line motion, Curvilinear Motion, Cartesian coordinates, normal & tangential coordinates and, polar coordinates. Relative motion

Unit 4 **(7 hrs)**

Forces, Mass and Acceleration: Newton's second law, Work-Energy Principle, Impulse-Momentum Principle, Direct central impact.

Textbooks:

- Hibbeler R. C., "Engineering Mechanics - Statics", Prentice Hall ,14th Edition
- Hibbeler R. C., "Engineering Mechanics - Dynamics", Prentice Hall ,14th Edition
- Beer F. P., Johnston E. R. et al., "Vector Mechanics for Engineers: Statics Dynamics", McGraw-Hill Publication, 12th Edition

Reference Books:

- Meriam J. L., Kraige L. G., "Engineering Mechanics - Statics ", John Wiley and Sons, 8th Edition
- Meriam J. L., Kraige L. G., " Engineering Mechanics - Dynamics ", John Wiley and Sons, 8th Edition
- Bedford and W. Fowler, "Engineering Mechanics - Statics and Dynamics", Pearson Publications

Engineering Mechanics Laboratory

Teaching Scheme:
2 hr /week

Examination Scheme:
Mid Sem. Exam: 8 marks
End Sem. Exam: 12 marks

Course Outcomes:

Students will demonstrate the ability to:

1. Verify principles of mechanics through experiments.
2. Solve simple engineering problems using graphical solution techniques.
3. Solve simple engineering problems using computer programs.

Contents:

PART A: Experiments (Any six)

1. Verification of law of polygon of forces
2. Verification of law of moments
3. Study of Space force system
4. Determination of beam reactions
5. Belt friction
6. Determination of shear force and bending moment of beam
7. Verification of Newton's second law of motion
8. Curvilinear motion
9. Direct central impact

PART B: Assignments

There will be six assignments, based on graphical and computer solutions of Engineering Mechanics problems.Each assignment shall have a minimum of two problems.

[ES-03]Programming for Problem Solving

Teaching Scheme
Lectures: 2 hrs./week
Laboratory: 2 hrs./week
Self study: 2 hrs./week

Examination Scheme
Lab Assignmnents - 20 Marks
QuizI/II - 20 Marks
Practical Exam - 20 Marks
End Sem Exam -40 marks

Course Outcomes:

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

1. Represent real life data using data types and variables provided by programming language.
2. Write flow chart, using standard notation, for given problems.
3. Solve a given problem using expressions, conditional statements, arrays and loops.
4. Design a modular solution using functions, by breaking down the problem into parts, using programming language.
5. Demonstrate the ability to process files of various types.

Unit1 **(4 hrs)**

Basic programming constructs:

Understanding a problem: Framing a problem in simple terms – mathematical, graphical, other abstractions. Number systems.Syntax errors and runtime errors.
Manual solutions to real life problems.Algorithms, Properties/characteristics of Algorithms, Flowchart and Pseudo code, Algorithmic representation of the solutions
Basic steps in program execution: Editing, compiling/interpreting/running programs, OS view and programmer's view.

Unit 2 **(6 hrs)**

Introduction to problem solving using computers:

BasicProblems: Basic Data types (Numerical,String).Variables.Expressions.Statements.I/O statements for keyboard handling. Decision Making Statements (if-Statements, if-else Statements, Nested if Statements, Multi-way if-elif-else Statements), Conditional statements, Exchange values of two variables.Finding maximum of three numbers.

Unit 3 **(6 hrs)**

Iterative Problems without arrays: Introduction to iterative constructions in language. Find Sum, average of a given set of numbers. Loop design techniques: While loop - *body, iterative step, loop condition.*Emphasis on while loop against for loop.Factorial. Sine function computation.Fibonacci sequence generation.Some problems to read data from files.
Array techniques: Arrays as homogenous collection of elements.Arrayproperties.Reversing elements of an array.Findingmaximum.Finding second maximum. Algorithms for substring search.
Search problems: linear search. linear search in sorted array. binary search.

Unit 4 **(4hrs)**

Modular Solutions

Functions: Introduction to functions.Importance of design of functions.Rewriting earlier solutions using functions.Taking care of all possible values of arguments, Parameters, return values, signature, local and global scope, Modular code, Reusability.

Unit 5 **(4 hrs)**

Recursion:

Basic rules of recursion: recursive formulation, terminating case, handle all cases, recursion leading to terminating case. Factorial: iterative vs. recursive.

Recursive formulation for: multiplication, gcd, towers of Hanoi, binary search. Recursion vs. iteration in general.When to use recursion.

Unit 6 **(4 hrs)**

Sorting: Insertion, Bubble, selection sorts

Textbooks:

- R. G. Dromey, "How to solve it by Computer", Pearson Education, ISBN 0-13-433995-9
- Maureen Sprankle, "Problem Solving and Programming Concepts", Pearson Education, ISBN-978-81-317-0711-1

Reference Books:

- Stephen G. Krantz, "Problem Solving Techniques" , Universities Press.
- Kernighan and Ritchie, "The 'C' programming language", Prentice Hall
- Reema Thareja, "Python Programming: Using Problem Solving Approach", Oxford University Press; First edition, 978-0199480173

Laboratory Course Outline

The course involves writing code for solved, unsolved and practice programming problems given in the lab manual.

List of suggested experiments

- Write a program to enter two numbers and perform all arithmetic operations.
- Program to find area of a triangle using Heron's Formula
- Take two integers as input and divide the first by the second. Prevent division by zero.
- Write a program to print `n' terms of an Arithmetic series, with the first term `a' and a constant difference `d'. Take `a,d,n' from user.
- Take a real value `x' from the user and find the value of tan (x), log (x), square root of x
- Write a program to display all the prime numbers between 1 and 100
- Write a program to take as input, 10 integers and put them in an array and display their values. Then, find the sum of all elements in the array and the position of the largest element. (Hint: use the logic of the algorithm to find maximum)
- Declare a 3x3 matrix. Initialise it to zero using nested loops. Then fill some user-

given values into it. Print the matrix in proper format to make sure the inputs are correctly taken.

- Write your own function to find the minimum element of an array of integers. (Input to the function is integer array, output is the position number of the minimum element)
- Declare an array of 10 integers. Declare a pointer and point it to the base of the array. Print all the elements of the array using this pointer and not using the original name of the array.
- Write a program to sort a given set of structures on a given key-pair, using bubble sort.
- Write a recursive function to raise a number to a given power.

The instructors are encouraged to update the list of assignments from time to time.

[HSMC-01]Indian Knowledge System

Teaching Scheme
Lectures: 2 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. *TBI*

Unit 1 **(4 hrs)**

Basics of Ancient Indian Knowledge and diverse fields from health (Yoga), Agriculture, performing arts etc.

Unit 2 **(8 hrs)**

Ancient Indian Knowledge in various Science streams like physics, chemistry, biology, forestry, mathematics etc.

Unit 3 **(8 hrs)**

Ancient Indian Knowledge in Civil Engineering, Metallurgy, Mechanical Sciences, Textile Technology etc

Unit 4 **(8 hrs)**

Ancient Indian Knowledge in Electrical, Electronics, Computational Studies, Instrumentation etc.

Reference Books:

- *TBI*

[CCA-01]Liberal Learning course - I

Teaching Scheme **Examination Scheme**

Practicals: 2 hrs./week *TBI*

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. *TBI*

Humanities & Social Sciences:

Agriculture, Defence, History, Holistic Health, Geography, Political Science, Interior Design etc.

Semester - II

[BS-04]Differential Equations, Complex Algebra

Teaching Scheme
Lectures: 2 hrs./week
Tutorial : 1 hrs / week
Self Study: 1 hrs / week

Examination Scheme
Internal Test : 20 marks
Tutorials: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. **Understand** basic concepts of complex number, Argand diagram, ODE and PDE
2. **List** types of ordinary differential equations and partial differential equations, **find** Laplace Transforms of simple functions
3. **Solve** different ODEs and PDEs, **find** square root of complex number, **find** solutions of quadratic equations in real and complex number systems
4. **Apply** concepts of Fourier Series to solve PDEs,
5. **Apply** concepts of complex numbers, ODE and PDE to solve real life application problems

Unit 1 **(12L+ 6T+6S)**

Ordinary Differential Equations: First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear; Higher order linear equations with constant coefficients Euler-Cauchy equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters);Applications to Initial and boundary value problems: Orthogonal Trajectories Newton's Law of Cooling, Statement of Newton's Law of Cooling, Applications of Newton's Law of Cooling, Growth and Decay, Kirchhoff's Law, Simple Electrical Circuits, Heat Flow Rectilinear Motion, Simple Harmonic Motion.

S: First order Ordinary Differential Equations - Variable Separable, Homogeneous, Linear

Unit 2 **(12L+ 6T+6S)**

Partial Differential Equations: Fourier Series; First order partial differential equations, Quasi-linear differential equations, second order differential equations and canonical form. Boundary value problem, fundamental solutions, Dirichlet principle, Poisson's formula, fundamental solution, initial boundary value problem by separation of variable method, boundary value problems: vibrations of a string, one dimensional heat equation, two-dimensional heat equation (Laplace Equation) under steady state conditions.

S: two-dimensional heat equation (Laplace Equation) under steady state conditions

Unit 3 **(4L+ 2T+2S)**

Complex Number Systems: Introduction to complex numbers as ordered pairs of reals. Representation of complex numbers and polar representation in a plane, Argand diagram; Algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number. Properties of polar and exponential form, Triangle inequality; Quadratic equations in real and complex number systems and their solutions; The relation between roots and coefficients, nature of roots, the formation of quadratic equations with given roots.

S: The relation between roots and coefficients, nature of roots, the formation of quadratic equations with given roots.

Textbooks:

- Erwin Kreyszig , "Advanced Engineering Mathematics", Wiley eastern Ltd ,10th edition

Reference Book:

- Maurice D. Weir, Joel Hass, Frank R. Giordano , "Thomas' Calculus ", 14th edition Pearson Education
- K.D Joshi , "Calculus for Scientists and Engineers" , CRC Press
- Sudhir Ghorpade and BalmohanLimaye , "A course in Calculus and Real Analysis"1st edition, Springer-Verlag, New York
- P.N. Wartikar and J.N. Wartikar , "Applied Mathematics" Pune VidhyarthiGrihaPrakashan Pune ,Vol.1 (Reprint July 2014)

Note 1 :

- To measure CO1, questions may be of the type- define, identify, state, match, list, name etc.
- To measure CO2, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.
- To measure CO3, questions will be based on applications of core concepts.
- To measure CO4, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.
- To measure CO5, some questions may be based on self-study topics and also comprehension of unseen passages.

[BS-05] Engineering Physics

Teaching Scheme
Lectures: 2 hrs./week
Practicals: 2 hrs./week
Self Study: 1 hrs / week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Apply the concepts of Quantum mechanics to one dimensional motion of electrons
2. Classify solids on the basis of Band theory and to calculate carrier concentrations
3. Evaluate the electrical conductivity and identify the type of semiconductor
4. Implement the fundamentals of LASER for different applications

Unit 1 **(8hrs)**

Quantum Mechanics: Matter waves, Properties of matter waves, Physical significance of wave function. Schrödinger's time dependent and time independent equations, Operators, Eigen values and Eigen functions, Expectation values, Applications of Schrödinger's equation; Motion of a free particle, Electron in an infinite deep potential well (rigid box), Electron in a finite deep potential well (non-rigid box)

Unit 2 **(7 hrs)**

Solid State Physics: lattice parameters, Miller indices, inter planer distance of lattice plane, density of crystals (linear, planar and volume), S*ö*mmerfield's free electron theory, Density of states (3D), Fermi-Dirac probability function, Nearly free electron theory (E-k curve), classification of solids on the basis of band theory

Unit 3 **(8 hrs)**

Semiconductor Physics: Electron and hole concentrations in semiconductors, intrinsic density, intrinsic andExtrinsic conductivity, Position of Fermi level in intrinsic and extrinsic semiconductors, Law of mass action, Temperature variation of carrier concentration in extrinsic semiconductors, Electrical conduction in extrinsic semiconductor, Hall Effect

Unit 4 **(7hrs)**

Laser Physics: Introduction to laser, Spontaneous and stimulated emission of radiations, Thermal equilibrium, Condition for Light amplification, Population inversion, Pumping (Three level and four level pumping), Optical resonator, Laser beam characteristics, Ruby laser, Nd-YAG Laser, He-Ne Laser, Semiconductor Laser, Engineering applications of Laser (Fiber optics, Laser material interaction)

Suggested learning resources:

1. Introduction to quantum mechanics / David J. Griffiths
2. A text book of Engineering physics, Avadhanulu and Kshirsagar, S. Chand Pub.
3. Concepts of Modern Physics, Arthur Beiser; Tata McGraw – Hill Edition.
4. Introduction to Solid State Physics, Charles Kittel, Wiley.
5. Solid State Physics, S. O. Pillai, New Age International Publishers.
6. Solid state electronic devices, Ben G. Streetman, Sanjay Banerjee Pearson Prentice-Hall.

7. LASERS Theory and Applications, K. Thyagarajan, A. K. Ghatak; Macmillan India Ltd.
8. Mechanical Vibrations Theory and Applications, Francis S. Tse, Ivan E Morse, Rolland T. Hinkle

Engineering Physics Laboratory

Course Outcomes:

Students should be able to

1. calculate energy gap, carrier concentration and mobility of the given material.
2. verify quantum mechanical phenomena.
3. Estimate the size of the object using Laser diffraction.
4. Determine the magnetic susceptibility and dielectric constant of the material

List of Experiments:

1. Frank-Hertz Experiment
2. Planck's Constant
3. To determine the wavelengths of light of a given source using diffraction grating
4. Band gap of a semiconductor by four probe method
5. Hall effect in Semiconductor
6. Magnetoresistance measurement of semiconductor
7. To determine the reverse saturation current and material constant of PN Junction
8. To determine the dielectric constant of material
9. Study of Biot-Savart's law
10. Measurement of magnetic susceptibility by Quinke's method

Course Objectives:

1. To provide an experimental foundation for the theoretical concepts introduced
2. To achieve hands-on experimental skills and the study of practical applications will bring more confidence.

[ES-04] Basic Electrical Engineering

Teaching Scheme
Lectures: 2 hrs./week
Practicals: 2 hrs./week
Self Study: 1 hrs / week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. analyze AC and DC circuits
2. apply the principles of electric and magnetic circuits to solve engineering problems
3. compute the efficiency and regulation of a single-phase transformer
4. select motors for specific industrial applications
5. use relevant protective devices for electrical installations
6. measure various quantities by using common electrical measuring instruments

Unit 1 **(6 hrs)**

DC Circuits: Electrical circuit elements (R, L, and C), voltage and current sources, Kirchhoff's laws, analysis of simple DC circuits: Superposition, Thevenin and Norton theorems, Maximum Power Transfer theorem, Star-Delta transformation

Unit 2 **(6 hrs)**

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R-L, R-C, R-L-C combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections, three-phase power, concept of electric grid

Unit 3 **(6 hrs)**

Magnetic Circuits and Transformers: Magnetic materials, B-H curve, hysteresis loop, series and parallel magnetic circuits, ideal and practical transformer, equivalent circuit, losses in transformers, regulation, and efficiency. Autotransformer and three-phase transformer connections

Unit 4 **(6 hrs)**

Rotating Electrical Machines: Construction, types, characteristics and applications of DC motors, three-phase induction motors

Unit 5 **(6 hrs)**

Electrical Wiring and Safety: Types of wires and cables, Copper conductor sizes and rating, earth wires, Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), Lightning protection. Types and characteristics of Batteries, elementary calculations for energy consumption, and battery backup, inverter, UPS types and specifications

Electrical safety: Electrical safety measures, safety practices, Earthing and its importance, first aid treatment after electrical shock

Textbooks:

- D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2nd Edition 2019
- D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 4th Edition, 2019

E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2010

Reference Books:

- Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 2nd Edition, 2015.
- L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2nd Edition, 2003.

Experiments:

1. Overview of the Basic Electrical Engineering Lab (Equipment available: universal trolley, meters, transformers, loads, etc.) and safety precautions.
2. Verification of Network Theorems:
3. Connect a simple DC circuit with two loops and more than one source and measure all the branch currents and node voltages.
4. Solve the same circuit applying Thevenin's, Norton's, and Superposition Theorems.
5. Measure the voltage, current, and power in the R-L, R-C, and R-L-C series circuits and observe the phase difference between voltage and current using CRO.
6. Connect the three-phase induction motor in star and delta and measure the line and phase voltages and currents to verify the relationship between line and phase quantities.
7. Evaluation of Relative permeability and Magnetic reluctance of a 3-Limb core using an exciting coil of unknown number of turns.
8. Flux diversion in the 3-Limb core by generating circulating currents in short-circuited conductor loop placed around the central limb.
9. Determine the efficiency and regulation of a single-phase transformer by direct loading.
10. Starting, reversing and speed control of DC motor.
11. Starting and reversing of three-phase induction motor and measurement of slip at different load conditions.
12. Connect the single-phase load bank through a switch-fuse unit, MCB and ELCB and check their operation in case of overload, short circuit, and earth leakage.

[ES-05]Engineering Drawing and Computer Graphics

Teaching Scheme
Lectures: 1 hrs./week
Practicals : 4 hrs/week
Self Study: 1 hrs / week

Examination Scheme
Test I - 15 Marks
Test II - 15 Marks
End Sem Exam - 50 marks
Practical Exam – 20 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Familiarize with different drawing tools, technical standards and procedures for construction of different geometries and engineering objects.
2. Develop the ability to visualize and communicate three dimensional shapes and their sections by representing three-dimensional objects into two-dimensional views using concept of orthographic projection.
3. Apply the visualization practices to draw isometric projection from a given orthographic views.
4. Draw the development of lateral surfaces of assembly and cut sections of different geometrical solids for engineering applications.
5. Draw 2D and 3D drawings using computer aided drafting tool

Unit 1 **(2 hrs)**

Introduction to Engineering Drawing: Drawing tools, drawing standards, line conventions, lettering , systems and rules of dimensioning

Unit 2 **(4 hrs)**

Orthographic Projections: Principles of Orthographic Projections, types of orthographic projections–First angle and third angle projections, Obtaining orthographic projections of given solids and machine elements by using first angle projection method along with sectional views. Basic drawing commands and its applications to draw 2D views using CAD software

Unit 3 **(4 hrs)**

Isometric Projections: Principles of Isometric projection – Isometric and natural Scale, Isometric views of simple and compound solids, drawing isometric views from given orthographic views. Basic drawing commands and its applications to draw 3D views using CAD software

Unit 4 **(4 hrs)**

Development of lateral surfaces (DLS) of solids

Industrial applications of development of lateral surface, methods of development, development and antidevelopment of lateral surfaces for cut section of Prism, Pyramid, and Cone

Textbooks:

- N.D.Bhatt, "Elementary Engineering Drawing", Charotar Publishing House, Anand (India)
- M.L.Dabhade, "Engineering Graphics" I, Vision Publications, Pune
- Dhananjay Jolhe , "Engineering Drawing", Tata McGraw Hill publishing company Ltd., New Delhi

Reference Books:

- Warren Luzzader, "Fundamentals of Engineering Drawing", Prentice Hall of India, New Delhi.
- Shah, M.B. & Rana B.C.), "Engineering Drawing and Computer Graphics", Pearson Education
- Agrawal B. & Agrawal C. M. , "Engineering Graphics", Tata McGraw Publication
- Suraj Singh , " Civil Engineering Building Practice ",

Practical Sessions

To draw 02 examples on each assignment on A3 size drawing sheet

Assignment 1:

Draw orthographic views of any machine elements along with sectional view.

Assignment 2:

Draw isometric view for given orthographic views.

Assignment 3:

Draw the development and antidevelopment of lateral surfaces of solids.

Assignment 4: (Programme specific assignment, One example only)

- Draw a plan, elevation, section of single storeybuilding.(For Civil Engineering)
- Conventional representation of piping layouts, pipe fittings, valves, joints. Stuffing box & glands, Expansion joints etc(For mechanical , Manufacturing , Metallurgy and Robotics and Automation)
- Engineering drawings such as complex circuits/schematic/layout drawings, process flow diagrams (PFDs), sensor diagrams(SDs) and piping and instrumentation diagrams(P & IDs) (For Electrical , Electronics and Instrumentation Engineering)

Complete the following assignment by using CAD software (04 exampleseach)

Assignment 1:

Draw orthographic views of any machine elements along with sectional view.

Assignment 2:

Draw isometric view for given orthographic views.(3D drawings)

Assignment 3: (Programme specific assignment, One example only)

- Draw a plan, elevation, section of single storey building. (For Civil Engineering)
- Conventional representation of piping layouts, pipe fittings, valves, joints. Stuffing box & glands, Expansion joints etc(For mechanical , Manufacturing , Metallurgy and Robotics and Automation) (For Electrical , Electronics and Instrumentation Engineering)
- Engineering drawings such as Complex circuit/schematic/layout drawings, process flow diagrams (PFDs), sensor diagrams (SDs) and piping and instrumentation diagrams (P&IDs)

[PCC-01] Fundamentals of Measurement and Sensors

Teaching Scheme
Lectures:2 hrs./week
Practicals: 2 hrs./week

Examination Scheme
Test I - 20 Marks
Test II - 20 Marks
End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. List different types of sensor/measuring instruments used for displacement, velocity, acceleration, force and torque.
2. Define and describe working principles and characteristics of the sensors and Measuring Instruments.
3. Implement and sketch the electronic signal processing for the sensors
4. Select and defend suitable sensor/measuring system for a specific application

Unit 1 **(7 hrs)**

Introduction of measuring Systems: Concepts and terminology of measurement system, transducer, sensor, range and span, classification of transducers, static and dynamic characteristics, selection criteria, sources of errors and their statistical analysis, standards and calibration. Introduction to Mesh analysis, nodal analysis and One port and two port networks

Unit 2 Resistance, Inductance & Capacitance Measurement: **(7 hrs)**

Wheatstone bridge, design, arrangement of ratio arms, sensitivity, errors, null type and deflection type, calibration adjustment, Kelvin bridge, Kelvin double bridge, series ohmmeter, shunt ohmmeter, DMM. Maxwell's bridge: design and applications, Hay's bridge: design and applications, Schering bridge: design and applications, LCR Q-meter

Unit 3 **(7 hrs)**

Displacement Measurement: Resistive: Potentiometer, Linear and rotary, Loading Effect types of strain gauges. Inductive: LVDT and Eddy current type Transducers. Capacitive: Capacitance pickups, Differential capacitive cells. Piezoelectric, Ultrasonic transducers and Hall effect transducers Optical transducers. Precision measuring instrument (gauges), Angular measurement: Combination protractor, universal bevel protractor, sine bar, clinometers, optical prism method

Unit 4 **(7 hrs)**

Velocity and Acceleration measurement: Standards, working principle, types, materials, design criterion: Moving magnet and moving coil, Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, stroboscopes and stroboscopic method, Shaft speed measurement.

Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type

Unit 5 **(5 hrs)**

Force and torque measurement: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, 4th ed., 2016

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999
- A. J. Bouwens, "Digital Instrumentation", McGraw-Hill, 6th reprint, 2008
- H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 4th ed., 2017
- Albert D. Helfrick, William David Cooper, "Modern electronic Instrumentation and Measurement Techniques" Prentice Hall, Second ed., 1990

List of Experiements:

1. Determination of admittance and impedance of one port network.
2. Design and implementation of resistance measurement such as Wheatstone bridge, LCR meter, V-I Method.
3. Design, implementation of series and shunt ohmmeters. Evaluate its performance characteristics.
4. Characterization and calibration of potentiometer as displacement sensor. Study of loading effect on potentiometer (linear and rotary).
5. Characterization and calibration of LVDT based displacement measurement system.
6. Characterization of strain gauge using cantilever beam.
7. Characterization and calibration of piezoelectric measurement system.
8. Measurement using proximity sensors (inductive/Capacitive) for an application

[VSEC-01]Data Visualization and Pre-processing

Teaching Scheme	**Examination Scheme**
Lectures:1 hrs./week	Test I - 20 Marks
Practicals: 2 hrs./week	Test II - 20 Marks
Self Study: 2hrs / week	End Sem Exam - 60 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Identify the importance of data visualization and preprocessing
2. Select and use appropriate visualization Techniques
3. Apply data visualization techniques for analyzing the data
4. Interpret results of exploratory data analysis
5. Apply different preprocessing techniques on data

Unit 1 **(3hrs)**

Fundamentals of Data Visualization: Overview of data visualization and its importance, Principles of visual perception and cognition, Acquiring and Visualizing Data,Choosing appropriate visualizations for different data types, Simultaneous acquisition and visualization , exploratory data analysis techniques, Applications of DataVisualization

Unit 2 **(4 hrs)**

Data Visualization Techniques: Graphs and charts for categorical data, bar charts, gantt charts, stacked bars , line plots, scatter plots, area chart , pie chart and bubble charts, heatmaps, treemaps,box and whisker plots, histograms, word cloud , geo maps,interactive data visualization

Unit 3 **(3 hrs)**

Introduction to Dashboard Design: Introduction to dashboard design principles, exploring different types of dashboards, defining the purpose and objectives of the dashboard, data visualization style guide, visual hierarchy and layout design, performance and optimization of dashboard, dashboard deployment and distribution, dashboard evaluation methods

Unit 4 **(4hrs)**

Introduction to Data Pre-Processing : Importance and role of data preprocessing, challenges and issues in real-world datasets, preprocessing techniques- aggregation, sampling, dimentionality reduction, feature selection, discretization, data quality and cleaning techniques,handling missing data and outliers, data normalization and standardization, handling time series data

Textbooks:

- Schwabish, Jonathan, " Better data visualizations: A guide for scholars, researchers, and wonks" . Columbia University Press, 2021
- Salvador García, Julián Luengo, and Francisco Herrera , "Data Preprocessing in Data Mining" , Springer , 2014

Reference Books:

- Min Chen,Helwig Hauser, Penny Rheingans, "GerikScheuermann,'Foundations of

Data Visualization",Springer, 2020
- Andy Kirk, "Data Visualisation: A Handbook for Data Driven Design" , SAGE Publication, 2019
- Alexandru C. Telea, "Data Visualization: Principles and Practice", CRC Press, 2014
- Stephen Few, "Information Dashboard Design: Displaying Data for At-a-Glance Monitoring", Analytics Press; 2nd edition , 2013
- Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008
- Pang-Ning Tan,MichaelSteinbach,Vipin Kumar "Introduction to Data Mining", Pearson Addison-Wesley, Second Edition

Laboratory Experiments

Course Outcomes:

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

1. Classify and transform the given data into visual presentation using visualization tools
2. Prepare dashboard to visualize summarized data
3. Perform pre-processing operations on data

List of Experiments:

1. Download any free data set (from tableau/kaggleetc)in excel format and prepare the following:
   bar charts, area chart ,pie charts ,line plots,scatter plots
2. Download any free data set andprepare the following:
   Heat map,Tree map,Histogram
3. Study of any of the visualization tools like
   Tableau,Power BI,Domo,Excel
4. Use of Python libraries such as Matplotlib, Seaborn, Plotly to visualize data in the given dataset
5. Prepare a Dashboard using any one soursesoftware
   e.g. Tableau, Microsoft POWER BI, Google data Studio
6. Install WEKA on your system and study different features
7. Use WEKA tool for feature extraction and filtering

Resources:

- Kalilur Rahman, 'Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh,BPB Publication, 2021
- Ryan Sleeper, 'Practical Tableau'O'Reilly Media Inc, 2018
- Bostjan Kaluza, 'Instant Weka How-to', Packt Publishing, 2013

[HSMC-02A]Communication Skills

Teaching Scheme
Lectures: 1 hr./week

Examination Scheme
Test I - 30 Marks
Test II - 30 Marks
End Sem Exam -40 marks

Course Outcomes:
At the end of the course, students will demonstrate the ability to

1. Recall and use basic language skills-listening, speaking, reading and writing and attempt tasks using grammar and vocabulary efficiently
2. Understand the concepts/ principles of communication skills and structure conversations effectively
3. Develop the knack to make their point of view clear to the audience and portray their communicative competence efficiently in front of a large audience on a variety of relevant situations
4. Analyze, apply and present themselves competently in all formal spheres

Unit1 **(2hrs)**
Introduction to English for Engineers : Varieties and Registers of EnglishEnglish for Specific Purposes (ESP): Business English

Unit 2 **(4 hrs)**
Foundation of Communicative and Linguistic Ability Development: Types of Communication, Process of Communication, Barriers and ways to overcome them, Common Challenges: Phonological, Syntactic, Semantic and Pragmatic Errors

Unit 3 **(4 hrs)**
Advanced Speaking Skills: Nuances of Speaking Skills/ Public Speaking, Group Communication, Presentation Skills: The 4 P's of Presentation, Do's and Don'ts, Techniques for Effective Delivery

Unit 4 **(4 hrs)**
Business Writing Development: Techniques of Writing: Note-making, Drafting, Editing, Paraphrasing and Proof-reading, Business Letters, Emails and Brief Reports

[HSMC-02B]Practicals
Activity and Exposure Oriented T & L Methodology

Teaching Scheme
Practial:2 hrs./week

Examination Scheme
Test I - 30 Marks
Test II - 30 Marks
End Sem Exam - 40 marks

Unit 1 **(2 hrs)**
Foundation of Language Learning Skills: Receptive Skills: Listening and Reading; Productive Skills: Speaking and Writing; Grammaticality and Appropriateness; Vocabulary Development

Unit 2 **(4 hrs)**

Listening Skills: Stages of Listening (pre, while and post), Strategies to Develop Active Listening Skills, Problematic Sounds for Indian Users

Unit 3 **(4 hrs)**

Speaking Skills: Oral Communication, Sounds in English, Pronunciation, Stress, Intonation and Pauses, Formal and Informal Expressions, Situational Conversations, Group Discussion

Unit 4 **(4hrs)**

Reading and Writing Skills: Reading Techniques: Scanning and Skimming, Active Reading; Common Problems in Reading; Stages of Writing (pre, while and post), 7 Cs of Effective Communication; Letter/ Email writing- drafting, editing, summarizing

[CCA-02]Liberal Learning course - II

Teaching Scheme **Examination Scheme**

Practicals: 2 hrs./week *TBI*

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. TBI

Performing Arts:

Music (Vocal), Music (Instrumental), Dance, Photography, Painting, Theatre & Film Appreciation, Clay Art & Pottery etc.

Exit Option

To qualify for Certification, Common at the School Level

Note: Exiting students need to take one SEC from his/her discipline and the other of his/her choice.

[VSEC-] Instrumentation Workshop

Teaching Scheme
Theory: 28 hrs
Practical: 17 hrs

Examination Scheme
Test and hands on practice - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Describe working principles of various transducers/sensors
2. Interpret the characteristics of the transducers/sensors
3. List various standards used for selection of transducers/sensors
4. Select transducers/sensors for specific applications
5. Examine the operation of the final control elements, pneumatic and hydraulic components generally used in plants

Unit1 **(7 hrs)**

Temperature: Temperature scales, classification of temperature sensors, standards, working principle, types, materials, Non electrical sensors (thermometer, thermostat), electrical sensors (RTD, thermocouple, thermistor)

Unit 2 **(7 hrs)**

Pressure and Level: Definition, pressure scale, standards, working principle, types, materials, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, capacitive (delta cell), high-pressure sensors, low-pressure sensors, Standards, working principle, types, materials, design criterion: float, displacers, bubbler, ultrasonic, microwave, radar, resistance, thermal, solid level detectors.

Unit 3 **(7 hrs)**

Flow: Standards, working principle, types, materials, and design criterion: primary or quantity meters (positive displacement flow meter), secondary or rate meter (obstruction type, variable area type), electrical flow sensors (turbine type, electromagnetic type, and ultrasonic type), Flow switches

Unit 4 **(7 hrs)**

Actuators and accessories: Operation of control valve, Classification of control valves, Pneumatic Supply and its components: Filter Regulator Lubricator (FRL), Single acting & Double acting cylinder, Special cylinders, Operation of Direction Control valves, Types of pilot signal, operation of speed regulators, pressure control valve, Special valves like quick exhaust, pressure, time delay valve, Standard Symbols for pneumatic components, Hydraulic supply: reservoir, Types of filters, Function of accumulators, Hydraulic Actuators, Operation of Direction Control Valve, Standard symbols for hydraulic components

Textbooks:

- A. K. Sawhney, "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 12th ed., 2005.
- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by,

Tata McGraw Hill Education, 4th ed., 2016.

- Pneumatic Instrumentation by Majumdhar, TMH
- D.V.S. Murthi, "Instrumentation and Measurement Principles", PHI, New Delhi, Second ed. 2003.

Reference Books:

- E.O. Doebelin, "Measurement Systems", McGraw Hill, 6th ed., 2017.
- D. Patranabis, "Principle of Industrial Instrumentation", Tata McGraw Hill, 2nd ed., 1999.
- Control Valve Handbook, Fisher Controls International, Inc. third Edition, 2001

List of Experiements:

- Measure inner and outer diameter of pipe using vernier calipers & compare it with standards.
- Measure thickness of the metallic sheet with micrometer & compare it with standards.
- Identify different electronic components viz. Resistor, Capacitor, Inductor, transformer, fuse, diode, transistor.
- Identify various resistors tyopes andMeasure value of given resistor & compare it with theoretical value obtained using colour code.
- Identify various capacitors viz paper , silvered paper, mica, silvered mica, ceramic plastic foil,electrolytic
- Identify various inductors viz fixed and variable inductors.
- Identify Piezo electric crystal & study it's application
- Wire instrument panel with various accessories as per instrument hook-up diagram.
- Wire the MCB, ELCB to supply electrical power to instrument panel.
- Wire the MCB, ELCB, contactor, starter to supply electrical power to motor drive panel as per given wiring diagram for one application.
- Dismantle & assemble valve to identify it's components as per sketch .
- Dismantle, assemble & calibrate pressure gauge.
- Install any one instrument using screw type connection and flange type connection.
- Test pressure/flow/level/temperature switch.
- Study and operate mechanical switches, and electromechanical switches.
- Study and operate special components like DCVs, FRL, flow control valves, pressure regulating valve, exhaust valve, displays, relays and other accessories
- Implementation of Pneumatic circuits
- Implementation of hydraulic circuits
- Test proximity & limit switch.

[VSEC-] Printed Circuit Board (PCB) Design and Production

Teaching Scheme
Theory: 28hrs
Practical: 17hrs

Examination Scheme
Test and hands on practice - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. Understand basics of PCB designing.
2. Apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
3. Develop a PCB for any application provided.

Unit 1 **(6 hrs)**

Introduction to PCB designing concepts: Fundamental of electronic components, basic electronic circuits, Need for PCB, Types of PCBs: Single and Multilayer, Technology: Plated Through Hole, Surface Mount. PCB Material, Electronic Component packaging, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, Design Issues: Transmission line, Cross talk and Thermal management.

Unit 2 **(4 hrs)**

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

Unit 3 **(8 hrs)**

Introduction to Electronic design automation(EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.

Unit 4 **(5 hrs)**

Introduction to PCB Prototyping and Production:PCB Prototyping: CNC Machine, Photo-Lithography process, Screen Printing process and chemical etching. PCB Mass Manufacturing Process: Gerber Generation, CAM, panelization, cleaning, drilling, plating, screen printing, etching, automated optical inspection, tinning, solder resist, legend printing, pcb testing.

Unit 5 **(5 hrs)**

PCB Technology Trends: Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

PCB Design and Production Laboratory

List of Experiments:

Part A: Hands on experience experiment on PCB design which includes

- Study on types of PCB layers, through Hole and SMD Components.
- Schematic Creation and simulation of an electronic circuit
- Mapping Components of an electronic circuit
- Set Parameters for PCB Design.
- Laying Tracks on PCB.
- Create PCB Layout of an Electronic Circuit.
- Create Device Model and simulation

Part B: Hands on experience experiment on PCB production using SMT Line Setup that consists ofSolder Paste Printer (SPP), Screen Printing Process-Stencil Design, Solder paste Inspection (SPI), Pick and place Machine (PPM), Pick and place Feeders, Heads and Nozzles, P & P Programming concepts, Reflow Oven (RO), Reflow Heating Process, Reflow Solder Defects, Reflow profiling, Automatic Optical Inspection(AOI).

Textbooks:

- R. S. Khandpur, "Printed circuit board design ,fabrication assembly and testing", Tata McGraw Hill 2006.

Reference Books:

- Clyde F. Coombs, Jr, Happy T. Holden,"Printed Circuits Handbook", McGraw-Hill Education, 6th edition, 2016.
- Elaine Rhodes, "Developing Printed Circuit Assemblies: From Specifications to Mass Production", 2008.
- C. Coombs, "Printed Circuits Handbook", McGraw-Hill Professional, 6th edition, 2007.
- D. Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall, 2003.
- Open source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/

[VSEC-]Electrical Workshop

Teaching Scheme
Theory: 15hrs
Practical: 30hrs

Examination Scheme
Test and hands on practice - 100 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to

1. locate and repair faults in domestic and industrial wiring installations.
2. rewind small transformers.
3. wire up control panels for industrial applications.
4. construct and test small electronic circuits.
5. install an inverter/UPS, and batteries.
6. connect the solar panel to AC and DC loads in a standalone system.

Experiment 1:

Practice with various measuring instruments and tools for testing and maintenance.

- Use of a series test lamp, continuity tester, Megger, multimeter, phase sequence indicator, CRO, lux meter, etc.
- Use of personal protective equipment, hand tools and safety practices.

Experiment 2:

Prepare the test board/extension board and mount accessories like lamp holders, various switches, sockets, MCBs, indicating lamps, etc.

- Identify various electrical accessories and their ratings.
- Select the correct size of board to mount the specified accessories.
- Position the accessories and mount them on board.
- Wire up and test the test board or extension board.

Experiment 3:

Testing and fault detection of domestic and industrial wiring and repair.

- Detect and repair open circuit faults in domestic or industrial wiring.
- Detect and repair short circuit faults in domestic or industrial wiring.
- Detect and repair earth faults in domestic or industrial wiring.

Experiment 4:

Practice wiring a 415 V, 3 HP, 3-phase induction motor as per IE rules.

- Read and interpret the name plate details of the motor.
- Determine the size of the cable.
- Select suitable ICTP/MCB, DOL starter and other accessories.
- Calculate the size and length of conduit.
  Make connections and adjust the overload relay as per the motor rating.
- Start and stop the motor using the starter.

Experiment 5:

Practice winding a small transformer.

- Dismantle the transformer core.
- Measure and determine the size of winding wire for primary and secondary winding.
- Take the dimensions of a bobbin and prepare the bobbin from suitable materials.
- Wind the primary and secondary windings using a winding machine.
- Stack the laminations and fasten them.
- Terminate the winding ends on a terminal board.

Experiment 6:

Control panel wiring for simple control applications like forward, reverse, star-delta starters, and sequential control of motors.

- Study power and control circuit diagrams.
- Mount various control elements like contactors, relays, timers, circuit breakers, sensors, measuring instruments, etc.

- Mount the DIN rail and arrange the wiring by routing, bunching, and tying.
- Test the control panel.

Experiment 7:

Make a printed circuit board for a small electronic circuit.

- Prepare the layout of the PCB and transfer it to the copper-clad board.
- Punch component mounting holes.
- Paint and etch the copper-clad board.
- Drill holes, mount, and solder components.
- Test the circuit.

Experiment 8:

Installation and connection of an inverter or UPS with a battery for domestic wiring.

- Select the rating of the inverter or UPS for a given load and backup.
- Select a suitable place for the installation of an inverter and batteries in the house.
- Install the inverter and batteries and make connections to the load.
- Test the installation under the ON/OFF condition of the supply.

Experiment 9:

Connect the solar panel to the given AC and DC load.

- Select a suitable rating for the solar panel, charge controller, batteries, inverter, MCB, cables, and connectors for the given ac and dc loads.
- Install solar panels on the rooftop with a proper tilt angle.
- Make connections using standard cables and connectors.
- Test the installation for performance.

Experiment 10:

Service and repair of domestic appliances like electric iron, electric kettle, cooking range and geyser.

- Connect and test the given appliance for its functioning.
- Dismantle the appliance.
- Trace and identify (or locate) the faults.
- Replace the faulty parts, assemble the appliance, and test its functioning.

Experiment 11:

Plan and execute an illumination scheme for a given room according to the working situation.

- Design an illumination scheme for a given room and situation.
- Use the open-source software available for the design of illumination schemes.

Experiment 12:

Installation, testing, and maintenance of batteries

- Use of various types of cells.
- Grouping cells for specified voltage and current.

- Practice battery charging.
- Routine, care, maintenance, and testing of batteries.

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