

Curriculum Structure & Syllabi

(As per National Education Policy 2020)

of

B. Tech.

in

Electrical Engineering

(w.e.f. 2024-25)

Vision

Mission

Program Educational Objectives

Program Outcomes

Program Specific Outcomes

Overall Credit Structure

Curriculum

Syllabus



Offered By

**DEPARTMENT OF ELECTRICAL ENGINEERING
MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY (MMMUT)
GORAKHPUR-273 010, UP, INDIA
JULY 2024**

Department of Electrical Engineering

CURRICULA & SYLLABI

B. Tech. Electrical Engineering

Vision:

To develop intellectual potentials with excellence in electrical engineering & technology for the global needs.

Mission:

1. Empowering students with state-of-art knowledge, technological skills & ethics.
2. Provide research environment for sustainable technical growth in the area of power and energy.
3. Providing effective solutions for industries through research and consultancy.
4. Exposure to standard electrical safety measures and practices.
5. Encourage new and non-conventional energy technology for sustainable development and environmental stewardship.

Programme Educational Objectives (PEO)

- PSO-1 To provide technical knowledge in electrical engineering to excel in electrical utility & services.
- PSO-2 To nurture the students to become successful engineer with administrative acumen to ethically handle the critical situations timely.
- PSO-3 To prepare and motivate the students for higher education, research, and continuous learning in multi-disciplinary areas with innovative ideas for sustainable development.

Programme Outcome (POs)

Students will demonstrate the ability to-

- PO-1 Apply the knowledge of mathematics, science, and Engineering in all aspects of Electrical Engineering.
- PO-2 To formulate the techniques of using appropriate tools to analyze and/or fabricate electrical systems.
- PO-3 Design of different parts of electrical machines, drives & power system network.
- PO-4 Align with and upgrade to higher learning and research activities.
- PO-5 Model real life problems using different hardware and software platforms, both offline and in real-time.
- PO-6 Possess an appreciation of professional, societal, environmental, and ethical issues and proper use of renewable resources.
- PO-7 Develop the awareness about non-conventional sources of energy for sustainable development.

- PO-8 Promote the good practices of electrical engineering with high ethical values.
- PO-9 Work in a team and comprehend his/her scope of work, deliverables and issues in which help is needed by other members of the team.
- PO-10 To communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems.
- PO-11 To be familiar with project management problems and basic financial principles for a multi-disciplinary work such as biomedical instrumentation.
- PO-12 A recognition of the need for identifying contemporary issues due to changing technical scenario and an ability to engage in life-long learning to update himself/herself.

Programme Specific Outcome (PSOs)

- PSO-1 Apply the fundamentals of mathematics, science, and engineering knowledge to identify, formulate, design, and investigate complex engineering problems of electrical circuits, control systems, electrical machines, and power system.
- PSO-2 Apply the appropriate techniques and modern engineering hardware and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.
- PSO-3 Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

SYLLABUS AND CREDIT STRUCTURE FOR B. TECH. (ELECTRICAL ENGINEERING)

(SESSION 2024-2025 AND ONWARDS)

OVERALL CREDIT STRUCTURE FOR B.TECH. (ELECTRICAL ENGINEERING)

Credit Courses			
Core Courses (CC)		Electives Courses (EC)	
Category	Min. Credits	Category	Min. Credits
Basic Sciences & Maths (BSM)	20	Professional Electives (PE)/ Open Electives (OE)	36
Engineering Fundamentals (EF)	24		
Professional Skill (PS)			
Professional Core (PC)	48	Humanities & Social Science Elective (HSSE)	04
Management (M)	04		
Humanities & Social Science (HSS)	08		
Minor Project (P)	06		
Industrial Practice (IP) (In Industry)/ Major Project (MP) (In University)	10		
Sub-total	120	Sub-total	40
Grand Total	160		
Non-Credit Courses			
One Expert Lecture per semester for students (Mandatory). (BSM-1st year), (PC-2 nd Year), (T&P-3 rd Year)			Non-Credit
Social work/Training of at least 60 hours during break after first/ second semester (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).			Non-Credit
Industrial Training during the summer break after fourth semester (Mandatory).			Non-Credit
One -week workshop during the winter break after fifth semester on professional/ industry/ Social/ entrepreneurial orientation (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).			Non-Credit
Value Added Courses (VAC) / Audit Courses (AC) Two of the Value-Added Courses / Audit Courses are compulsory.			Non-Credit
Extracurricular Activities Courses (ECA) Two compulsory courses from the following S. No (ii) to (v) non-credit courses: (i) Induction Program (compulsory) (ii) Skill development (iii) Unity and Discipline (NCC or NSS) (iv) Sports, Cultural and Games (v) Personality Development			Non-Credit
Minor Degree (MD) from any Department and Micro Specializations (MS) within the Department			
<ul style="list-style-type: none"> • The total number of credits for graduation will be kept to minimum 160. The additional 18-20 credits required for Minor Degree Courses. • Micro specializations (MS) will be run by the department in order to aligned to industry careers or higher studies 			Offered as a Professional Electives (PE)

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SEMESTER WISE CREDIT STRUCTURE FOR B. TECH. (ELECTRICAL ENGINEERING)

Category/Semesters	I	II	III	IV	V	VI	VII	VIII	Total
Basic Sciences & Maths (BSM)	8	8	0/4	4/0					20*
Humanities & Social Science (HSS)	4	4							08*
Humanities & Social Science Elective (HSSE)					4				04*
Management (M)						4			04*
Engineering Fundamentals (EF)	4	4	8/4	0/4					16*
Professional Skill (PS)	4	4							08*
Professional Core (PC)			12	12	12	12			48*
Professional Electives (PE)/ Open Electives (OE)				4-8	28-32				36*
Minor Project (P)						0	6		06*
Industrial Practice (IP) (in Industry)/ Major Project (MP) (In University)								10	10*
Total Credit	20*	20*	20*	20- 24*	16*- 32*	16*- 32*	6- 30*	10- 30*	160*
	80-84*				76-80*				
Total Courses Offered	05*	05*	05*	05*- 06*	04*- 08*	04*- 08*	00- 06*	00- 05*	36*

**Minor variation is allowed as per need of the respective disciplines.*

First Year, Semester I

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-110	Engineering Mathematics I	3	1	0	4
2.	BSM	BSM-140	Environmental Science and Green Chemistry	3	0	2	4
3.	EF	BEE- 110 / BEE-160	Basic Electrical Engineering	3	0	2	4
4.	PS	BEE-108	Electrical Wiring & Estimation	2	0	4	4
5.	HSS	BHS- 102/152	TW&PC	2	1	2	4
			Total	13	2	10	20
6.	ECA-I		Induction Program	-	-	-	0

Group-1: CSE, IT, CH, CE; Group-2: ECE, ECE (IOT), ME, EE.

First Year, Semester II

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-160	Engineering Mathematics II	3	1	0	4
2.	BSM	BSM-181	Engineering Physics	3	0	2	4
3.	EF	BCS-110/160	Introduction to C Programming	3	0	2	4
4.	PS	BEE-159	Basics of Electrical Machines & Protective Equipments	2	0	4	4
5.	HSS	BHS- 151	Universal Human Values: Understanding Harmony	3	1	0	4
			Total	14	2	8	20
6.	VAC/AC	BEE-161	Design Thinking in Electrical Systems	0	0	2	0
7.	ECA-II			-	-	-	0

List of Extra Curricular Activity (ECA) Courses

ECA-II						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-I	ECA-151	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)-I	ECA-171	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-I	ECA-172	2	0
4.	Open to all Branches	ECA	Games & Sports-I	ECA-181	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-I	ECA-182	2	0

List of Value-Added Courses (VAC)/Audit Courses (AC)

S. No.	Subjects	Codes
1.	Constitution of India	AUC01
2.	Indian Culture and Heritage	AUC02
3.	Indian Architecture	AUC03
4.	Indian Festivals	AUC04
5.	Vaidic Mathematics	AUC05
6.	Astronomy	AUC06
7.	Arts of India	AUC07
8.	Intellectual Property Right	AUC08
9.	Human Rights	AUC09
10.	Logical Research	AUC10
11.	Professional Ethics	AUC11
12.	Environmental Law	AUC12
13.	Health Law	AUC13
14.	National Cadet Corps	AUC14

15.	Basics of Human Health and preventive medicines	AUC15
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SYLLABUS

BSM-110 Engineering Mathematics I

Course category	: Basic Sciences & Maths (BSM)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	: The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Use of basic differential operators in various engineering problems.
2. Understand the concepts of limit theory and nth order differential equations and their applications to our daily life
3. Solve linear system of equations using matrix algebra.
4. Know about qualitative applications of Gauss , Stoke's and Green's theorem.
5. To know the applications of double and triple integration in finding the area and volume.
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I	9
Differential Calculus: Limit, Continuity and Differentiability, Mean value theorems. Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables.	
UNIT-II	9
Linear Algebra: Symmetric, Skew-symmetric matrices, Hermitian, Skew Hermitian Matrices, orthogonal and unitary matrices and basic properties, linear independence and dependence of vectors, Rank of Matrix, Inverse of a Matrix, Elementary transformation, Consistency of linear system of equations and their solution, Characteristic equation, Eigenvalues, Eigen-vectors, Cayley-Hamilton theorem, Diagonalization of matrices.	
UNIT-III	9
Multiple Integrals: Double and triple integrals, change of order of integration, change of variables. Application of multiple integral to surface area and volume. Beta and Gamma functions, Dirichlet integral.	
UNIT-IV	9
Vector Calculus: Gradient, Divergence and Curl. Directional derivatives, line, surface and volume	

integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs).

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.

BSM-140	Environmental Science and Green Chemistry
Course category:	Basic Sciences & Maths (BSM)
Pre-requisite Subject:	NIL
Contact hours/week	Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits:	4
Course Assessment methods:	Continuous assessment through home assignments, quizzes, minor tests, practical work, viva-voce, practical exam and major theory Examination
Course Objectives	Understanding the principles and concepts of Chemistry viz. Chemical Bonding, acidity and basicity, Atmospheric Chemistry & Water Chemistry, Spectroscopic analytical methods and Green Chemistry and solving industrial problems using solid foundation in Chemistry.
Course Outcomes:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course
	<ol style="list-style-type: none">1. To develop the concepts of basic chemistry.2. To make the students aware of global environmental issues e.g. global warming & Green house effect, Ozone depletion, pollution and its prevention and understand various aspects of atmospheric chemistry.3. To understand the analytical and conceptual skills required for environmental chemistry research.4. To understand water treatment for all types of uses and need to protect environment.5. To understand the specifications of pure water and its purification techniques.6. To develop the knowledge about Green Chemistry and Green Technology.

Unit 1: Basic Chemical Concepts

Periodic properties of elements, Ionization potential, electron affinity and electronegativity; mole concept, molarity and normality, Chemical Bonding – MO Theory, MO diagram of diatomic molecules, hydrogen bonding, electrophiles, nucleophiles, inductive effect and mesomeric effect. Reaction Mechanism. Acidity and basicity - Concept of pH.

9

Unit 2: Atmospheric chemistry & Water Chemistry

The atmosphere of Earth, layers of atmosphere and temperature inversion, Air pollution, Global warming and Greenhouse effect. Acid rain and Ozone layer depletion. Chemical and photochemical Smog.

Sources of water, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Hardness of water, Softening of water by Zeolite process, Lime Soda process, Ion exchange process and Reverse osmosis.

9

Unit 3: Spectroscopic analytical methods

9

Absorbance, Transmittance and Beer-lamberts Law. Basic principles of UV-Visible spectroscopy, Fluorescence spectroscopy, Infrared spectroscopy, NMR Spectroscopy. Use of these instrumental techniques for monitoring of environmental pollution.

Environmental problems posed by the use of non-biodegradable polymers widely used in day-to-day life. Incineration as the key method for disposal of polymeric waste. Bio-degradable polymers.

Unit 4: Green Chemistry

9

Green Chemistry and Green Technology: New trends in Green chemistry; Green Chemistry Methodologies-Microwave heating, ultrasound technique. Green Chemical Synthesis Pathways; Green reagents, Green solvents.

Experiments:

1. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
2. Determination of alkalinity in the given water sample.
3. Determination of chloride content in the given water sample by Mohr's method.
4. Determination of percentage of available chlorine in bleaching powder sample.
5. Determination of iron content in the given sample using $K_3[Fe(CN)_6]$ as an external indicator.
6. Determination of Electrical conductivity/TDS of a given water sample using conductivity meter.
7. Determination of dissolved Carbon Dioxide of given water sample.
8. Determination of the biochemical oxygen demand of sewage influent.
9. To calculate the lambda max of the given compound by using UV-Visible spectrophotometer.
10. Determination of nickel / cobalt / copper solutions by UV-visible spectrometry.
11. Examples of Green Synthesis /Reactions.
12. Determination of Turbidity of Water
13. Iodoform test
14. Synthesis of a polymer Bakelite or Polyacrylic acid.

Books & References

1. A Text Book of Environment and Ecology, Shashi Chawla, Tata McGraw Hill
2. Environmental Studies, Raj Kumar Singh, Tata McGraw Hill
3. Engineering Chemistry, Wiley India
4. Engineering Chemistry, Tata McGraw Hill
5. Organic Chemistry, Morrison & Boyd, 6th edition, Pearson Education
6. Fundamentals of Environmental Chemistry, Manahan, Stanley E., Boca Raton: CRC Press LLC.
7. Environment and Ecology, R K Khandal, Wiley India
8. An Introductory Text on Green Chemistry: For Undergraduate Students, Indu Tucker Sidhwani, Rakesh K. Sharma, Wiley
9. A text book of Green Chemistry, Shankar Prasad Deo and Nayim Sepay, Techno World Publication.
10. Introduction to Green Chemistry, John Andraos, Albert S. Matlack, CRC Press.

BCS-110/160**Introduction to C Programming**

Course category:	Engineering Fundamental (EF)
Pre-requisite Subject:	NIL
Contact hours/week:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits:	4
Course Assessment methods:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, Viva-voce, two tests and One Major Examination (T & P)

Course Objective: The course covers the basics of programming and demonstrates fundamental programming techniques, customs and terms including the most common library functions and the usage of the pre-processor. The salient features of course objectives are given below.

1. To develop C Programs using basic programming constructs
2. To develop C programs using arrays and strings
3. To develop applications in C using functions and structures

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Basic terminology used in computer programming.
2. Programs development in C Language by writing, compiling, and debugging.
3. Design of programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure, and union.
4. Difference between call by value and call by reference.
5. Dynamic memory allocations and use of pointers.
6. Basic operations on a file.
7. Basics of dynamic memory.

UNIT-I**9**

Basics of programming: Approaches to Problem Solving, Concept of Algorithm and Flow Charts, Types of Computer Languages: Machine Language, Assembly Language and High-Level Language, Concept of Assembler, Compiler, Linker, and Loader. Data types, Storage Classes: Auto, Extern, Register and Static. Operators, Expressions, Operator Precedence and Associativity.

Fundamentals of C Programming: Structure of C Program, Writing and Executing the First C Program, Components of C Language, Standard I/O, Formatted I/O. Conditional Program Execution: Applying if and switch Statements, Nesting if and else. Program Loops and Iterations: Use of while, do while and for Loops, Multiple Loop Variables, Use of break and continue Statements, goto Statement.

UNIT-II**9**

Arrays: One Dimensional, Multidimensional Array and Their Applications, Declaration and Manipulation of Arrays.

Strings: String Variable, String Handling Functions, Array of Strings.

Functions: Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions. Storage Classes revisited.

UNIT-III**9**

Pointers: Pointer Variable and its Importance, Pointer Arithmetic Pointers and Arrays, Pointer and Character Strings, Pointers and Functions, Array of Pointers, Pointers to Pointers.

Structure: Declaration and Initialization of Structures, Structure as Function Parameters, Structure Pointers.

Union: Declaration and Initialization of Unions, Union as Function Parameters, Union Pointers.

UNIT-IV

9

Dynamic Memory Allocation: malloc, calloc, realloc, free functions.

File Management: Defining and Opening a File, Closing a File, Input/ Output Operations in Files. The Pre-processor Directives, Macros. Command Line Arguments. Introduction to Graphics Programming.

EXPERIMENTS

1. Write programs to print statements in sequential order using simple printf, scanf input/output functions.
2. Write programs to implement if-else condition (simple as well as nested) on suitable problems.
3. Write a program to implement switch-case conditional logic on suitable examples.
4. Write programs to implement for, while and do-while loop control statements on suitable problems.
5. Write programs to implement 1D & 2D array concepts on suitable problems such as sorting of elements, searching of element, matrix addition, subtraction, multiplication etc.
6. Write programs to implement string related concepts such as sorting of a string, finding its length, reversing, concatenation, comparing two strings etc.
7. Write programs to implement concept of user defined functions (call by value, call by reference, recursive calling etc.) on suitable examples.
8. Write programs to implement concepts of pointer.
9. Write programs to implement the concept of structure and union.
10. Write programs to implement dynamic memory allocation functions (calloc, malloc, free, realloc)
11. Write programs to implement file handling concepts such as reading from a file, writing to a file using file related functions (fclose, fopen, sscanf, sprintf, fread, fwrite, getc, putc, getw, putw etc.)

Textbooks

1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 7th Edition, Pearson.
2. Schildt, Herbert, Complete Reference with C, Tata McGraw Hill.
3. Kernighan and Ritchie, The C programming Language, 2nd Edition, Prentice Hall.
4. Richard Bird, Introduction to Functional Programming using Haskell, 2nd Edition, Prentice- Hall International, 1998.

Reference Books

1. Greg Michaelson, An Introduction to Functional Programming Through Lambda Calculus, Dover Edition, Addison Wesley Publication.
2. Samuel P. Harbison, and Guy L. Steele Jr., C-A Reference Manual, Fifth Edition, Prentice Hall, 2002.

BEE-108

ELECTRICAL WIRING & ESTIMATION

Course category	: PS
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 2, Tutorial: 0, Practical: 4
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, Viva-voce, two tests and One Major

Examination (T & P).

- Course Objective** : **1.** To demonstrate and understand the Service mains, meter board and distribution board, concealed and conduit wiring, switching control schemes.
2. To demonstrate and understand the protective devices: fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock, necessity of Earthing.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understanding of the basics of power electronics and its usages in electronic circuit controls.
2. To identify and understand the problem in the various type of household electronic circuits.
3. Identify dysfunctional components through visual inspection and by use of multi-meter.
4. To understand, various electronic & electrical components, materials and their specific properties & usages. Hands on activities of Electrical wiring.
5. Basics of earthing phenomena in home wiring and any premises. Protection of human body from electric shocks and utility of MCB and fuses.
6. Basic principles Fan windings and small motor windings. Learn different types of Joints of cable and overhead conductor and analyze different types of wiring and Safety measures.

Topics Covered

UNIT-I	6
Understanding the electrical properties of Resistor, Capacitor and Inductor. Study of various electrical tools and symbols. Different types of conductors and cables. Basics of Electrical Wiring-Star and delta connection.	
UNIT-II	6
Safety aspects of electrical systems, types of cables/wires and switches, fuses & fuse carriers, isolator, two-way switches, relays, circuit breakers, insulation, overload devices. Ground-fault protection. Earthing, grounding and isolating.	
UNIT-III	6
AC and DC Voltmeter, Ammeter, Wattmeter and Energy meter. Household wiring of power distribution, main switches.	
UNIT-IV	6
Electricity billing, uninterruptible power supply. Basic repairing process of domestic appliances.	

List of Experiments:

1. Introduction of Tools, Electrical Materials, Symbols.
2. To perform single way wiring system.
3. To perform two-way wiring system.

4. To perform staircase wiring system.
5. Design of earthing system.
6. To repair a fan and its winding.
7. Design of single-phase motor winding.
8. To perform tube light wiring.
9. To perform different types of cable joints

Books & Reference Books:

1. Electrical Wiring Estimating and Costing by S. L. Uppal. Khanna Publishers.
2. Practical Handbook on Electric Motors, Starters and Controllers by M.P. Krishna Pillai, Standard Publishers Distributers.
3. Advanced Home Wiring by Black & Decker, 5th Edition, Editors of Cool Spring press

**BHS- 102/152 TECHNICAL WRITING AND PROFESSIONAL COMMUNICATION
(TW&PC)**

Course Category	: HSS
Prerequisite subject	: None
Number of Credits	: 4
Contact Hours/Week	: Lectures: 2, Tutorial: 1, Practical: 2
Course Assessment Methods	: Continuous assessment through One test, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.
Course Objectives	: The objectives of this course are to: - The course aims- <ol style="list-style-type: none"> 1. To sensitize the students to understand the role and importance of communication for personal and professional success. 2. To enable the learners to enhance their writing skills in techno-cultural and professional echo-system. 3. To equip learners to differentiate technical writing from general writing. 4. To equip them with technical writing skills. 5. To enable learners to exhibit knowledge, skills, attitude and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.
Course Outcomes	: The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: - <ol style="list-style-type: none"> 1. Overcome the problems she/he shall faces in oral and written communication. 2. Acquire knowledge of and methods for using technical communication, such as reports, proposals, technical letters, etc. 3. Use and Practice compositions correctly. 4. Give presentations in different sessions and make self-appraisal. 5. Learn and understand the various facets of Communication

Skills, such as (LSRW) Listening, Speaking, Reading, and writing, and identify, formulate, and solve real-life problems with a positive attitude; also inculcate, the habit of learning and developing communication and soft skills.

Unit 1: Language and Communication

(6)

Language Vs communication: Communication as coding and decoding – signs, symbols & pictograph – verbal and non-verbal symbols – Language & communication; Types of Communication- functional, situational, verbal, and non-verbal, interpersonal, group, interactive, public, Mass Communication. Thinking and Articulation, critical, creative aspects of articulation.

Skills of Language Acquisition: Natural Language Acquisition Skills: Listening, Speaking, Reading & Writing {LSRW}; Language Acquisition Through Training: Listening, Speaking, Reading, Writing, Grammar & Vocabulary {LSRWGV}

Phrase, Clause & Sentence in Professional Drafting-Simplicity, Clarity and Conciseness of a Presentation, Differentiating between Professional and Creative Writing, Blending of Artistic/Professional Writing, Avoiding gender, racial, and other forms of bias in Professional Writing. Pre-writing, Drafting, and Re-writing.

Unit 2: Towards Technical Writing

(6)

Technical Paper Writing: Professional Paper Elements-Front Matter of a Paper, Main Text of a Paper, End Matter of a Paper: Organizing References and Bibliography, Order of a thesis and Paper Elements, Concluding Remarks. **Methods of Research Paper Writing:** Identification of Author and His Writing-Author's name and Affiliation, Joint Authorship of a Paper, Identification of Writing- Title, Keywords, Synopsis, Preface and Abstract. Drafting Research Article & Methodology.

Thesis/Dissertation Writing: Thesis Elements-Front Matter of a Thesis, Main Text of a Thesis, End Matter of a Thesis, Specimen—Thesis and Research Paper, Chapters and Sections-Introductory Chapters and Sections, Statement of the Problems, Plan and Scope, Core Chapters and Sections- Theoretical Analysis and Synthesis, Basic Assumption and Hypothesis.

Professional Presentation & Seminar Delivery Tools: Designing the Presentation; Establishing the Objectives. Making Professional PowerPoint Presentations, Signaling Structure of Presentation through Sentences and Crisp Phrases, Preparing Notes for Professional/Technical Presentation, Text Animation, White Board, Flip Charts, Diagrams, Preparing Cards. Seminar Presentations: Purpose modes and methods. Nascent Emerging Platforms for On-line Presentations viz. Zoom, Webex, Team & Meet etc.

Unit 3: Drafting Skills & Career Correspondence

(6)

Professional Drafting: Letters vs. e-mails, Formal and Informal emails, Parts of e-mails, Types of e-mails, Managing tone of E-mails and business Letters, Examples of Letters and E-mail, Professional Correspondence through E-mail, Job Applications and cover Letters. Introduction to DOs (Demi- Official Letters)

Career & Correspondence: Developing a Professional C.V, Bio Data & Resume. Report Writing, Kinds of Reports, Length of Report, Parts of a Report, Terms of Reference, Collection of Facts, Outlines of Report, Examples of Report, Technical Proposal, Elements of Proposal, Examples of Proposal, drafting of proposal.

Unit 4: Professional Practices with ICT Interface

(6)

Conducting Professional Meeting: Pre-meeting Preparation, During Meeting: Action Taken Report (ATR) & New Agenda Points, Post Meeting Follow ups. Notice, Circular, Agenda & Meeting Minutes.

Introduction to Generation–Z, Cyber Identity & Professional Netiquettes for Netizens: Drafting E-mails, Blogs on social media, Videoconferencing. Managing Profiles on social media. What to Write and Share on social media. Telephone Etiquettes & Phubbing.

List of Practical:

1. Introduction to Vowel and Consonant Sounds
2. Monophthongs and Diphthongs
3. Syllable, Word Stress & Intonation
4. Harnessing Non-verbal Communication Skills in Cross-Cultural Environment for the establishment of an ideal Ecosystem to ensure Professional Success
5. Developing Speech, and Proofreading the Same
6. Argumentative Skills & Group Dynamics
7. Preparing CV, Biodata & Resume
8. Types of Interview and Interview Skills
9. GD, PI & Telephonic Interview
10. Presentation Skills, Extempore, Debate and Video Conferencing
11. Netiquettes while Writing Blogs on social media.
12. Ethical Usages of Generative AI

Text / Reference Books

1. Acharya Anita. (2012) Interview Skills- Tips & Techniques. Yking Books, Jaipur.
2. Basu, B. N., (2008) Technical Writing. PHI Learning Pvt. Ltd., New Delhi.
3. Chauhan, N. K & Singh, S. N. (2013) Formal Letters, Pankaj Publication International, New Delhi.
4. Chhabra T.N. (2018) Business Communication. Sun India Publication New Delhi.
5. Dubey Arjun et.al. (2016) Communication for Professionals. Alfa Publications, Delhi.
6. Gibaldi, Joseph (2021). The MLA Handbook for Writers of Research Papers. Ed. IXth, Modern Language Association of America, NY, US.
7. Gurumani, N. (2010) Scientific Thesis Writing and Paper Presentation, MJP Publishers, Chennai.
8. Hamilton Richard. (2009) Managing Writers. Penguin, India.
9. Mc Graw S. J. (2008) Basic Managerial Skills for All. Ed. 08th, Prentice Hall of India, New Delhi.
10. Murphy & Hildebrandt. (2008) Effective Business Communication. Tata McGraw Hill New Delhi.
11. Pandey, S.P., Singh, S. N. & Kumar, Raman, (2023) Exploring Digital Humanities: Challenges & Opportunities, MacBrain Publishing House, New Delhi.

BSM-160

Course category

Pre-requisite Subject

Contact hours/week

Number of Credits

Course Assessment

methods

Course Objectives

Engineering Mathematics II

: Basic Sciences & Maths (BSM)

: NIL

: Lecture : 3, Tutorial : 1 , Practical: 0

: 4

: Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination

: The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering

subjects.
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To solve the ordinary differential equations.
2. To solve the partial differential equations using Lagrange and charpit's method.
3. To solve and understand the properties of Bessel's and Legendre's differential equation.
4. Application of partial differential equation in real life problems
5. To solve ODE and PDE with the help of Laplace transform
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Ordinary Differential Equations I: Linear differential equations with constant coefficients (n^{th} order), complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

UNIT-II 9

Ordinary Differential Equations II: Series solution of second order differential equations with variable coefficient (Frobenius method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

UNIT-III 9

Partial Differential equations: Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.

UNIT-IV 9

Laplace Transform: Laplace Transform, Laplace transform of derivatives and integrals. Unit step function, Laplace transform of Periodic function. Inverse Laplace transform, Convolution theorem, Applications to solve simple linear and simultaneous differential equations and Partial Differential Equations.

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.
5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.

BSM- ENGINEERING PHYSICS

131/181

Course category : Basic Sciences and Maths (BSM)
Pre-requisite Subject : Physics at 12th Standard
Contact hours/week : Lecture : 3, Tutorial : 0 , Practical: 2
Number of Credits : 4
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives : Understanding of the principles and concept of Optics, Quantum Mechanics, Fiber Optics, Electrodynamics and Physics of Advanced Materials.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attributes after completing this course.

1. Understand the basics principles of Optics and its applications in Engineering and Technology.
2. Compare and understand the uses of various lasers in different fields of Engineering.
3. Know the knowledge of Optical Fibre and their applications in Photonics.
4. Understand the principles of Quantum Mechanics and their applications in Engineering and Technology.
5. Know the principles of Electrodynamics and their applications in Engineering and Technology.
6. Understand the basic properties of advanced materials and their engineering applications.

UNIT-I: Optics:

9

Interference: Interference of light, Interference in thin films, Newton's rings. Refractive index and wavelength determination.

Diffraction: Fresnel and Fraunhofer class of diffraction. Resultant of n-harmonic waves, single, double and N- slit diffraction, Diffraction grating, Grating spectra, Dispersive power.

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Retardation Plate, Polarimeter.

Laser: Spontaneous and stimulated emission of radiation, Population inversion, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers, and laser applications.

UNIT-II : Quantum Mechanics and Fiber Optics:

9

Quantum Mechanics: de Broglie waves, Davisson-Germer experiment, Concept of Phase and Group velocities, Uncertainty principle and its applications, Derivation of time independent and time dependent Schrodinger wave equations. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a particle in one dimensional infinite potential well.

Fiber Optics: Fundamentals of optical fiber, Acceptance angle and cone, Numerical aperture, Single and Multi-Mode Fibers, Step index and graded index fiber, Propagation Mechanism in optical fibers.

UNIT-III: Electrodynamics:

9

Scalar and Vector fields, Gradient, Divergence and curl, Concept of displacement current, Maxwell's equation in differential and integral forms, Physical significance of each equation.

Maxwell's equation in free space, Velocity of electromagnetic wave, Transverse nature of the electromagnetic wave, Poynting vector, Maxwell's equations in dielectric and conducting medium, and skin depth.

UNIT-IV: Physics of Advanced Materials:

9

Concept of energy bands in solids, Semiconducting materials, Concept of direct and indirect band gap in semiconductors, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials, Temperature dependence of resistivity in superconducting

materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, London Equations, BCS theory (Qualitative), Introduction of nanoscience, Nanotechnology and its applications.

EXPERIMENTS

1. To determine the specific resistance of a given wire using Carrey Foster's Bridge.
1. To determine the wavelength of sodium light using Newton's Ring experiment.
2. To determine the wavelength of spectral lines of white light using plane diffraction grating.
3. To determine the specific rotation of cane sugar solution using polarimeter.
4. To study the variation of magnetic field along the axis of current carrying circular coil.
5. To study the Hall's effect and to determine Hall coefficient in n type Germanium.
6. To study the energy band gap of Germanium using four probe method.
7. To determine the height of Tower by Sextant.

Books & References

1. Optics- Ajoy Ghatak, Tata McGraw-Hill
2. Optics- N. Subrahmanyam, Brij Lal, M.N. Avadhanulu, S. Chand
3. Quantum Mechanics: Theory and Applications- Ajoy Ghatak, Tata McGraw-Hill
4. Fiber optics and laser Principles and Applications-Anuradha De, New Age International
5. Optical Fibers and its application as sensors by R. K. Shukla, New Age International.
6. Introduction to Electrodynamics by David J. Griffiths, Pearson
7. Physics of Semiconductor Devices, by S. M. Sze, Wiley
8. Concepts of Modern Physics by Arthur Beiser, Tata MCGraw Hill.
9. Introduction to Solid State Physics by C. Kittel, Wiley.
10. Engineering Physics by B. K. Pandey and S. Chaturvedi, 3e Cengage Learning Pvt. Limited, India.
11. Engineering Physics by H. K. Malik and A. Singh Tata MCGraw Hill.
12. Advanced Practical Physics Vol. I and Vol. II by D. K. Dwivedi, Victorious Publishers, New Delhi.

BEE-110/160

Basic Electrical Engineering

Course category	: Engineering Fundamentals (EF)
<i>Pre-requisite Subject</i>	: NIL
Contact hours/week	: Lecture: 3, Tutorial: 0, Practical: 2
<i>Number of Credits</i>	: 4
Course Assessment methods	: Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Minor tests and One Major Theory & Practical Examination.
Course Objectives	: 1. To demonstrate and understand the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context. 2. To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits used in electrical engineering and apply the basic concepts in Electrical engineering for multi-

disciplinary tasks.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits & DC network theorems.
2. Understand the fundamental behaviour of AC circuits and solve AC circuit problems.
3. Apply the knowledge gained to explain the behaviour of the circuit at series & parallel resonance of circuit & the effect of resonance.
4. Classify different electrical measuring equipment's and understanding their principles.
5. Understand the basic concepts of magnetic circuits.
6. Explain construction and working principle of transformer.

Topic Covered

UNIT I

D C Circuit Analysis and Network Theorems:

9

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem.

UNIT II

9

Introduction to AC Circuits:

AC fundamentals, Analysis of single phase series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit.

Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, three-phase power, and its measurement.

UNIT III

9

Measuring Instruments:

Fundamentals of measurement & instrumentation, Units, Dimensions and Standards. Error Analysis, types of errors & its analysis. Measuring instruments, construction and working principles of PMMC, Moving Iron and Electro-dynamometer type voltmeters & ammeters, Use of shunts and multipliers.

UNIT IV

9

Magnetic Circuits and Transformers:

Magnetic circuit concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.

EXPERIMENTS

1. Verification of Kirchhoff's Law.
2. Verification of Norton's Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Verification of Series R-L-C circuit.

7. Verification of Parallel R-L-C circuit.
8. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
9. To perform O.C. and S.C. test of a single-phase transformer.

Textbooks:

1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Principles of Electrical Engineering, V. Del Toro; Prentice Hall International.
3. Electrical and Electronics Technology, Edward Hughes; Pearson.
4. Basic Electrical Engineering, D P Kothari, I.J. Nagarath; Tata McGraw Hill
5. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.

BHS- 101/151 Universal Human Values: Understanding Harmony

Course Category	: HSS
Prerequisite subject	: None
Number of Credits	: 4
Contact Hours/Week	: Lectures: 3, Tutorial: 1, Practical: 0
Course Assessment Methods	: Continuous assessment through One test, teacher's assessment (quiz, tutorial, assignment, attendance), and One Major Theory Examination.
Course Objectives	: The objectives of this course are to: -

1. Develop a holistic perspective in students based on self-exploration about themselves (human being), family, society and nature/existence.
2. Develop understanding (or developing clarity) in students about harmony in the human being, family, society and nature/existence.
3. Strengthen self-reflection in students.
4. Develop commitment and courage in students to act.

Course Outcomes : The students will be able to demonstrate the following knowledge, skills, and attitudes upon completion of the course: -

1. Ability to understand the interconnectedness of humanity and nature as well as the importance of values in interpersonal relationships.
2. Ability to recognize their role as global citizens and understand the importance of actively contributing to the betterment of society through responsible actions.
3. Ability to engage in critical reflection on their own values and beliefs, challenging assumptions and biases to foster personal growth and development.
4. Ability to appreciate and respect diversity thereby promoting communication and conflict resolution skills, promoting dialogue and understanding in resolving interpersonal and intergroup conflicts.

Unit 1**9**

Introduction to Values: origin, definition, meaning, and types of values; Values in Education System; difference between Values, Morals, and Ethics; Self-Exploration—what is it? - Its content and process; ‘Natural Acceptance’ and ‘Experiential Validation’ as the process for self-exploration; Continuous Happiness and Prosperity- A look at basic human aspirations; Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority; Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario; Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Unit 2**9**

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’; Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility; Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer); Understanding the characteristics and activities of ‘I’ and harmony in ‘I’; Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail; Programs to ensure Sanyam and Health.

Unit 3**9**

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship; Understanding the meaning of Trust; Difference between intention and competence; Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship; Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals; Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit 4**9**

Understanding the harmony in the Nature; Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature; Understanding Existence as Co-existence of mutually interacting units in all-pervasive space; Holistic perception of harmony at all levels of existence; Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics.

Text & Reference Books:

1. Andrews, C. (2006). *Slow is beautiful*. New Society Publishers.
2. Gandhi, M. K. (1909). *Hind Swaraj or Indian Home Rule*. Navjeevan Trust.
3. Gandhi, M. K. (2009). *An Autobiography or The Story of My Experiments with Truth* (Mahadev Desai, Trans.). Navjeevan Mudranalay. (Original work published 1925).
4. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). *A Foundation Course in Human Values and Professional Ethics*. Excel Books.
5. Govindrajan, M., Senthilkumar, S., & Natarajan, M. S. (2013). *Professional Ethics and Human Values*. Prentice Hall India.
6. Kumarappa, J. C. (2017). *Economy of Permanence*. Sarva Seva Sangh Prakashan.
7. Naagarazan, R. S. (2022). *A Textbook on Professional Ethics and Human Values*. New Age International.

8. Rolland, R. (2010). *Life of Vivekanad* (4th Ed.). Advait Ashram.
9. Schumacher, E. F. (1973). *Small is beautiful. A study of Economics as if people mattered*. Blond & Briggs.
10. Suresh, J., & Raghavan, B. S. (2003). *Human Values and Professional Ethics*. S Chand.

BEE- 159 Basics of Electrical Machines & Protective Equipments

Course category : PS
 Pre-requisite Subject : NIL
 Contact hours/week : Lecture: 2, Tutorial: 0, Practical: 4
 Number of Credits : 4
 Course Assessment methods : Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Minor tests and One Major Theory & Practical Examination.

Course Objective : **1.** To demonstrate and understand the basic principle of operation and construction of different types of electrical measuring instruments.
2. To demonstrate and understand the applications of different types of protective schemes.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understand the basic concepts of DC machines.
2. Acquire knowledge about characteristics and its applications.
3. Understand the basic concepts of AC (single-phase and three-phase) machines.
4. Classify and compare different types of AC machines.
5. Student gains knowledge on different Protective Equipments of Power Systems.
6. Different applications of the relays, circuit breakers, grounding and able to understand the Recovery and Restricting effects of power system.

Topic Covered

UNIT I **6**

DC Machines:

Concept of electromechanical energy conversion DC machines: Types, EMF equation of generators and torque equation of motor, Characteristics, and applications of DC generators & motors.

UNIT II **6**

AC Machines:

Three Phase Induction Motor: Types, Principle of operation, Torque-slip characteristics, and its applications.

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

UNIT III **6**

Protective Relays:

Introduction to protection system and its elements, Functional Characteristics of protective relaying, Protective zones, Primary and Backup protection, desirable qualities of protective relaying, basic terminology sealing/auxiliary relay. Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay.

UNIT IV

6

Circuit Breakers:

Introduction to circuit breakers. Constructional features and operation of different types of circuit breakers like Air, Bulk Oil, Minimum Oil, Air Blast, SF₆, and Vacuum Circuit breakers, Ratings & Testing of Circuit Breakers

List of Experiments:

1. To draw the magnetization characteristics of separately excited dc motor.
2. To perform the external load characteristics of dc shunt motor.
3. To study running and speed reversal of a three phase induction motor and record speed in both directions.
4. To study Impedance, MHO and Reactance type distance relays.
5. To study the working and principle of operation of Buchholz relay.
6. To study the IDMT over current relay and determine the time current characteristics.
7. To study percentage differential relay.
8. To study Impedance, MHO and Reactance type distance relays.
9. To understand the protection scheme of substation through visit to local high voltage substation and to sketch labelled schematic diagram/single line diagram of it.

Textbooks:

1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.
3. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
4. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
5. B.Bhalja, R.P. Maheshwari& N. G. Chothani, Protection & Switch Gear, Oxford University Press.
6. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc. Graw Hill

BEE - 161

Design Thinking in Electrical Systems

Course category:	VAC/AC
Pre-requisite Subject:	NIL
Contact hours/week:	Lecture: 0, Tutorial: 0, Practical: 2
Number of Credits:	1
Course Assessment methods:	Continuous assessment through attendance, practical work, record, Viva-voce

Course Objective

The course is designed to give an in-depth understanding on various aspects of innovation, creativity, evolving electrical systems modules/products for various applications inculcate the knowledge, incubation and the entrepreneurship in any role you're in.

1. Continuously produce breakthrough ideas
2. Catalyze design thinking in your daily routine
3. Unlock the innovative capacity of your team
4. Build a lifelong practice of creative problem-solving

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Explain the fundamentals of Design Thinking and innovation.
2. Analyse the model action plan.
3. Describe the principles of innovation and idea generation for product design.
4. Apply design thinking techniques for given tasks and in solving problems in various sectors.

UNIT-I

Design Thinking: Introduction to design, history & importance of design thinking, elements, components, and principles of fundamental design. Design Thinking Framework/Methods - Empathise –Define – Ideate – Prototype – Test- System Module Development Methodology. Tools of design thinking - person, customer, journey map, brainstorming, product development.

UNIT-II

Innovation: Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Teams for innovation, Measuring the impact and value of creativity, Innovation Management- Changing Management Paradigms-Design Thinking related Electrical Engineering Solutions for Industry and Society.

UNIT-III

Product Design: Problem formation, Introduction to product design (for eg. SMPS, UPS, Electrical Charger for various devices etc.), Product strategies, Product value, Product planning, Product specifications.

UNIT-IV

Design Case Studies: Study of electric bell, charger, UPS, SMPS, inverter, battery in various electric appliances, power supply and ideate, incubate for entrepreneurship.

Textbooks

1. Change by Design, Tim Brown, Harper Bollins (2009)
2. Design Thinking in the Classroom by David Lee, Ulysses Press
3. Electrical Wiring, Estimating and Costing by S. L. Uppal, Khanna Publication
4. Electrical Installation Estimating & Costing by J. B. Gupta, S. K. Kataria & Sons Publication

Reference Books

1. Design the Future, Shrutin N. Shetty, Notion Press
2. Universal Principles of Design- William Lidwell, Kritina Holden, Jill Butter, Rockport Publishers.
3. The Era of Open Innovation – Henry W. Chesbrough, MIT Sloan, Management Review.
4. Product Design and Manufacturing, A. K. Chitale and R.C. Gupta, Prentice Hall