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
JUNE 2025

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)

<table>
<tr><th colspan="4">Credit Courses</th></tr>
<tr><th colspan="2">Core Courses (CC)</th><th colspan="2">Electives Courses (EC)</th></tr>
<tr><th>Category</th><th>Min. Credits</th><th>Category</th><th>Min. Credits</th></tr>
<tr><td>Basic Sciences & Maths (BSM)</td><td>20</td><td rowspan="3">Professional Electives (PE)/ Open Electives (OE)</td><td rowspan="3">36</td></tr>
<tr><td>Engineering Fundamentals (EF)</td><td rowspan="2">24</td></tr>
<tr><td>Professional Skill (PS)</td></tr>
<tr><td>Professional Core (PC)</td><td>48</td><td>Humanities & Social Science Elective (HSSE)</td><td>04</td></tr>
<tr><td>Management (M)</td><td>04</td><td></td><td></td></tr>
<tr><td>Humanities & Social Science (HSS)</td><td>08</td><td></td><td></td></tr>
<tr><td>Minor Project (P)</td><td>06</td><td></td><td></td></tr>
<tr><td>Industrial Practice (IP) (In Industry)/ Major Project (MP) (In University)</td><td>10</td><td></td><td></td></tr>
<tr><td>Sub-total</td><td>120</td><td>Sub-total</td><td>40</td></tr>
<tr><td colspan="3">Grand Total</td><td>160</td></tr>
<tr><th colspan="4">Non-Credit Courses</th></tr>
<tr><td colspan="3">One Expert Lecture per semester for students (Mandatory).
(BSM-Ist year), (PC-2nd Year), (T&P-3rd Year)</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Social work/Training of at least 60 hours during break after first/ second semester (Mandatory) (Dean of Extension, Field Outreach and Alumni Relations).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Industrial Training during the summer break after fourth semester (Mandatory).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">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).</td><td>Non-Credit</td></tr>
<tr><td colspan="3">Value Added Courses (VAC) / Audit Courses (AC)
Two of the Value-Added Courses / Audit Courses are compulsory.</td><td>Non-Credit</td></tr>
<tr><td colspan="3">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</td><td>Non-Credit</td></tr>
<tr><td colspan="4">Minor Degree (MD) from any Department and Micro Specializations (MS) within the Department</td></tr>
<tr><td colspan="3">• 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</td><td>Offered as a Professional Electives (PE)</td></tr>
</table>

industry careers or higher studies	

DEPARTMENT OF ELECTRICAL ENGINEERING
MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY (MMMUT)
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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**

Second Year, Semester III

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-211	Complex Variables and Numerical Techniques	3	1	0	4
2.	EF	BEC-207	Digital Electronics	3	0	2	4
3.	PC	BEE-205	Analysis of Linear Systems	3	1	0	4
4.	PC	BEE-206	Fundamentals of DC Electrical Machines & Transformers	3	0	2	4
5.	PC	BEE-207	Electrical Measurement and Measuring Instruments	3	0	2	4
			Total	**15**	**2**	**6**	**20**
6.	VAC/AC	AUC-108	Intellectual Property Right	2	0	0	0
7.	ECA-III			**-**	**-**	**-**	0

Second Year, Semester IV

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	EF	BME-260	Fundamentals of Mechanical Engineering	3	0	2	4
2.	PC	BEE-255	Network Analysis & Synthesis	3	0	2	4
3.	PC	BEE-256	Fundamentals of AC Electrical Machines	3	0	2	4
4.	PC	BEE-257	Microprocessor	3	0	2	4
	Students may choose either PE-1 or PE-2 or Both PE-1 and PE-2.						
5.	PE 1	EEE-101	Linear Programming for Optimization	3	0	2	4

		EEE- 102	Fundamentals of Power Electronics	3	1	0	4
		EEE -103	Modelling And Simulation Techniques	3	0	2	4
		EEE -104	Power Electronics Systems and Grid Integration for Electric Vehicles	3	1	0	4
6.	PE 2	EEE-201	Special Electrical Machines	3	1	0	4
			Total	**15-18**	**0-2**	**8**	**20-24**
7.	VAC/AC	AUC-101	Constitution of India	2	0	**0**	0

*Student may choose PE-1 from other departments for minor degree.

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

ECA-III						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-II	ECA-201	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- II	ECA-221	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-II	ECA-222	2	0
4.	Open to all Branches	ECA	Games & Sports-II	ECA-231	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-II	ECA-232	2	0

ECA-IV						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-III	ECA-251	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)-III	ECA-271	2	0

3.	Open to all Branches	ECA	Unity and Discipline (NSS)-III	ECA-272	2	0
4.	Open to all Branches	ECA	Games & Sports-III	ECA-281	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-III	ECA-282	2	0

**Note: Detailed syllabus of Extra Curricular Activity (ECA) Courses is attached as Annexure-03.

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

S. No.	Subjects	Codes
1.	Constitution of India	AUC 101
2.	Indian Culture and Heritage	AUC 102
3.	Indian Architecture	AUC 103
4.	Indian Festivals	AUC 104
5.	Vaidic Mathematics	AUC 105
6.	Astronomy	AUC 106
7.	Arts of India	AUC 107
8.	Intellectual Property Right	AUC 108
9.	Human Rights	AUC 109
10.	Logical Research	AUC 110
11.	Professional Ethics	AUC 111
12.	Environmental Law	AUC 112
13.	Health Law	AUC 113
14.	National Cadet Corps	AUC 114
15.	Basics of Human Health and preventive medicines	AUC 115

SKILLS-ENHANCEMENT COURSES FOR EXIT (ELECTRICAL ENGINEERING):

2-Months internship for 6-Credits **OR** Two courses mentioned below of 4 to 6 credits.

A. After First Year: UG Certificate (Engg.).

The candidate should pass the following two additional courses (ITI Level) **OR** any two suitable skill-based courses to qualify for **UG Certificate (Engg.).**

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	BEE-162	Electrical Installation, Testing & Maintenance	2	0	2	3
2.	Skill Enhancement	BEE-163	Mini Project	0	0	6	3

OR

Equivalent skills-enhancement courses from MOOC/SWAYAM.

B. After Second Year: UG Diploma (Engg.).

The candidate should pass the following two additional courses **OR** any two suitable skill-based courses to qualify for **UG Diploma (Engg.).**

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	Skill Enhancement	BEE-257	Integrated Electrical Systems	2	0	2	3
2.	Skill Enhancement	BEE-258	Mini Project	0	0	6	3

SYLLABUS

First Year

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, practical work, record, viva voce, one Minor test 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 tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, one Minor test and one 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

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 9

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.

Unit 2: Atmospheric chemistry & Water Chemistry 9

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.

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, lndu 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, one Minor test and one Major Theory Examination

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, sprint, 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. Kerninghan 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, Addition 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, one Minor test and one Major Theory Examination
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 tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, one Minor test and one Major Theory Examination
Course Objectives	: The objectives of this course are to: -

The course aims-

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: -

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 ofCommunication- 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 NewDelhi.
11. Pandey, S.P., Singh, S. N. & Kumar, Raman, (2023) Exploring Digital Humanities: Challenges & Opportunities, MacBrain Publishing House, New Delhi.

BSM-160 Engineering Mathematics II

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, practical work, record, viva voce, one Minor test 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. 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 (Frobeneous 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-131/181 ENGINEERING PHYSICS

Course category	:	Basic Sciences and Maths (BSM)
Pre-requisite Subject	:	Physics at 12thStandard
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, one Minor test 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-hormonic 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, Victorius Publishers, New Delhi.

BEE-110/160 **Basic Electrical Engineering**

Course category	:	Engineering Fundamentals (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, one Minor test and one Major Theory 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 tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, one Minor test 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 tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, one Minor test and one Major Theory Examination

Course O**bjective** : **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.

6

UNIT III

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, SF_6, 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 tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, one Minor test and one Major Theory Examination

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

Skill-Based Courses to Qualify for UG Certificate (Engg.) in Electrical Engineering

BEE-162: **Electrical Installation, Testing & Maintenance**

Course Name: Electrical Installation, Testing & Maintenance
Course Category: Skill Development
Mode: Theory+Practical
Contact Hours/week: Lecture 2, Tutorial 0, Practical 2
Credits: 2

Course Assessment Methods: Continuous assessment through assignments, attendance, quizzes and final theory examination and practical examination.

Course Objectives

- To develop foundational knowledge and practical competencies in electrical installation techniques, wire and cable selection, switching and control systems, and circuit protection devices.
- The course is designed to provide learners with the ability to select appropriate materials, tools, and safety practices while working on low-voltage electrical installations in residential, commercial, and light industrial settings.

Course Outcomes

After successful completion, the participants will be able to:

- Understand the construction, insulation types and applications of various wires and cables such as single-core, multicore, and flexible types.
- Demonstrate awareness of site selection, safety procedures, and the proper use of hand tools and electrical installation equipment.
- Calculate cable sizes using load, cable run length and derating factors to ensure safe and efficient operation.
- Differentiate between SWG and mm^2 standards and apply them to real-world installations.
- Identify different types of switches and explain their domestic and industrial applications.

Course Content

UNIT 1: Wires, Cables and Installation **(6)**

- Types of wires: Single core, multicore, flexible, twin and earth
- Cable insulation: PVC, XLPE, FRLS
- Difference between wires and cables
- Site selection and safety precautions.
- Tools and equipment used for installation & fault detection methods.

UNIT 2: Cable Sizing and Wire Gauge Selection **(6)**

- SWG vs mm^2 standards
- Cable size selection criteria
    - Load (kW/KVA to amps.)
    - Length of cable run (Voltage drop consideration)
- Derating factor and current carrying capacity.
- Common electrical hazards on-site
- Importance of earthing and types of earthing.
- Ambient temperature, cable grouping, laying condition.

UNIT 3: Switches and Control Devices **(6)**

- Types of switches
    - SPST, SPDT, DPST, DPDT, TPST,TPDT
    - Modular switches vs. traditional
    - Push button, toggle, rotary switched
- Application of each in domestic and industrial usage.
- Overview of switchgear classifications
- Standard and symbol used in switched gear

UNIT 4: Circuit Protection Devices (6)

- **Fuses :** Types (Rewirable, HRL cartridge), rating, advantages/disadvantages
- MCB, MCCB (Working principle)
- Single pole, double pole, triple pole MCBs
- Current rating, breaking capacity
- Overview of Relaying system

PRACTICALS

1. Demonstration of wiring MCB with load and neutral.
2. Identify and connect three types of switches in a demo board.
3. Select proper MCBs for a two room house with one Air Conditioning.
4. Wiring a miniature DB board setup for trainee.
5. Staircase wiring
6. Study of LT substation layout
7. Study of Pipe/Plate earthing

Text/Reference Books

- Electrical Installation Estimating and Costing, J.B. Gupta, S.K. Kataria & Sons.
- Testing, Commissioning, Operation and Maintenance of Electrical Equipment, S. Rao, Khanna Publishers.
- Electrical Installation Work, Brian Scaddan, Routledge (UK).

SECOND YEAR

BSM-211/261		**Complex Variables and Numerical Techniques**
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	:	Continuous assessment through tutorials, attendance, home assignments,

methods		quizzes and One Minor tests and One Major Theory Examination
Course Objectives		The course is aimed to develop the mathematical understand about Complex variables and complex functions and to acquire the skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Prove basic results in complex analysis.
2. Establish the capacity for mathematical reasoning through analysing, proving, and explaining concepts from complex analysis.
3. Solve the problems using complex analysis techniques applied to different situations in engineering contexts.
4. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
5. To study numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Functions of Complex Variable I: Complex differentiability, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Harmonic conjugates, Cauchy-Integral Theorem, Cauchy-Integral formula, Cauchy's integral formula for higher derivatives.

UNIT-II 9

Functions of Complex Variable II: Taylor's Series and Laurent Series, Zero's and Singularities of functions, Removable singularity, Poles and essential singularities, Residues, Cauchy's residue theorem., Residue theorem, Evaluation of the real integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ *and* $\int_{-\infty}^{+\infty} f(x)dx$.

UNIT-III 9

Numerical Techniques I: Solution of algebraic and transcendental equations by Bisection, Regula-Falsi, secant Method and Newton-Raphson methods. Newton's Gregory forward and backward interpolation, Lagrange's and Newton's divided difference method.

UNIT-IV 9

Integral Techniques II: Solution of system of linear equations by Jacobi, Guass-Siedel method and Crout's method. Numerical Integrations by Trapezoidal Rule, Simpson's one-third and three-eight rules. Solution of differential equations by Taylor, Picard, Euler, Modified Euler's Method, Runge-Kutta Fourth Order Methods, Milne's and Adam's predictor and corrector methods.

Books & References

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers.
2. Jain, Iyenger and Jain: Advanced Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. James W. Brown & R. V. Churchill: Complex variables and applications, Mcgraw-Hill Asia
4. R. K. Jain and Iyenger: Numerical Methods, Narosa Publications.
5. A. Greenbaum & T. P. Chartier, Numerical methods, Princeton University Press,

BEC-207 **Digital Electronics**

Course category	:	Engineering Fundamental
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, minor test and Major Theory & Practical Examination
Course Objectives	:	The course aims to provide knowledge of digital electronics, combinational and sequential circuits, state machines, and digital system design.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about basics of digital electronics and solving problems related to number systems and Boolean algebra.
2. Ability to identify, analyze and design combinational circuits.
3. Ability to identify, analyze and design sequential circuits.
4. To design, implement and evaluate various synchronous and asynchronous sequential circuits and applications.
5. Acquired knowledge about internal circuitry and logic behind digital systems.
6. Able to understand State machine design procedure with sequential PLDs.

Topics Covered

UNIT-I **9**

Digital system and Binary numbers: Signed binary numbers, Floating point number, Binary Codes, Cyclic codes, Error detecting and correcting codes, Hamming codes. NAND and NOR implementation, Minimization of circuit using K-map and Tabular method up to five variables, POS and SOP simplification, Logic family- TTL, DTL, ECL, CMOS, HMOS

UNIT-II **9**

Combinational Logic: Analysis and Design procedure for Combinational circuits, Binary adder/subtractor, Binary multiplier, Booth Algorithm, Magnitude comparator, Encoder/Multiplexer, Decoder/Demultiplexer.

UNIT-III **9**

Sequential logic: Sequential circuits, Latches, Flip-flops, Conversion of flip-flops, Analysis of clocked sequential circuits, State reduction and assignments. Registers and counters: Shift registers, Asynchronous counter, Synchronous counter, Sequential circuit analysis and design procedure, Circuit with latches, Hazards.

UNIT-IV

Memory and programmable logic: Read only Memory, Read/Write Memory-SRAM and DRAM. Programmable Logic Devices, -PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs: Introduction, to field programmable gate arrays (FPGAs).

LIST OF EXPERIMENTS

1. Design and verification of following arithmetic circuits using 74xx family ICs.
   i) Half adder and Full adder

ii) Half subtractor and full subtractor

2. To perform the code conversion- binary to gray and gray to binary and its truth table verification.
3. To design a combinational logic circuit using 74xx family ICs and its truth table verification in both SOP and POS forms.
4. Realization of 2:4 decoders and 4:2 encoder circuit and verification of its truth table.
5. To design and verify the truth table of multiplexer and demultiplexer circuits.
6. To design a 1-bit comparator using 74xx family ICs and to study the performance of4- bit comparator IC7485.
7. Design and verification of basic Flip-Flops using 74xx family ICs and master-slave JK flip-flop using IC7476
8. To realize and verify the truth table of shift register-SIPO/SISO and PISO/PIPO.
9. Design and verification of asynchronous counter design and Mod-n counter.
10. To realize and verify the truth table of synchronous counter design

Books & References

1. Hill & Peterson, "Switching Circuit & Logic Design", Wiley
2. Mano, M. Morris. Digital design. Pearson Educación, 2002.
3. Digital principle and applications Malvino and Leach-(TMH)

BEE-205 **ANALYSIS OF LINEAR SYSTEMS**

Course category : Program Core (PC)

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 One Minor Test and One Major Theory Examination.

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

1. Analyse as well as synthesize Continuous and discrete signals, classification & identification of different signals/ models.
2. Acquire the knowledge of analogous electrical systems of different non-electrical systems.
3. Application of Fourier-series and Fourier Transform for the analysis of periodic & aperiodic signals.
4. Application of Laplace Transform for the analysis of continuous-time systems.
5. Modelling and system analysis through State variable.
6. Application of Z-Transform for the analysis of discrete-time systems.

Topics Covered

UNIT-I **9**

Introduction to continuous time signals and systems:

Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics. Classification of continuous time signals, Signal analysis and synthesis, Classification of continuous time systems.

Introduction to discrete time signals and systems:
Basic discrete time signals with their mathematical representation and characteristics. Classification of discrete time signals, Discrete signal analysis and synthesis, Classification of discrete time systems

UNIT-II **9**

Laplace Transform Analysis:
Laplace Transformation, some basic Theorems, Gate function, Laplace Transform of periodic functions, Waveform synthesis and Laplace Transform of complex waveforms, Initial and Final Value Theorems, Inverse Laplace Transform, Convolution Theorem, Impulse Response, Superposition Integral, Application of Laplace Transform to solution of systems and network problems,

UNIT-III **9**

Z-Transform Analysis:
Concept of Z-Transform, Z-Transform of common functions, Properties of Z-Transform, Some basic Theorems, Inverse Z-Transform, Initial and Final Value theorems, Analysis of Linear Time Invariant systems in Z-domain, Pulse Transfer Function.

UNIT-IV **9**

State Variable Analysis:
Introduction, State Space representation of linear systems, Transfer Function and state Variables, State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems, Applications of State-Variable technique to the analysis of linear systems

Books & References

1. Choudhary D. Roy, "Network & Systems", Wiley Eastern Ltd.
2. Donald E. Scott, "Introduction to circuit Analysis" Mc. Graw Hill
3. B.P. Lathi, "Linear Systems & Signals" Oxford University Press, 2008.
4. I.J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, "Signals and Systems, "Tata Mc. Graw Hill, 2001.
5. Taan S. Elali & Mohd. A. Karim, "Continuous Signals and Systems with MATLAB" 2nd Edition, CRC Press.

BEE 206	**Fundamentals of DC Electrical Machines & Transformers**
Course category	: Engineering Fundamentals (PC)
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, practical work record, viva voce and one Minor test and one Major Theory & Practical Examination.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course 1. Acquire knowledge about the fundamental principles and classification of electromagnetic machines. 2. Ability to understand electro-mechanical energy conversion process of rotating electrical machines in

singly exited & doubly excited magnetic system.

3. Ability to learn basic concept of design, working & performances of DC Machines as Generator.
4. Ability to solve theoretical & numerical problems related with DC Machines as Generator.
5. Ability to learn basic concept of design, working & performances of DC Machines as Motors and
   solve theoretical & numerical problems.
6. Ability to know constructional details, working principle & Performances of single Phase & three phase transformer.

Topics Covered

UNIT-I **9**

Principles of Electro-mechanical Energy Conversion

Introduction, Flow of Energy in Electromechanical Devices, Energy & Co-energy in magnetic systems, Singly Excited and Doubly excited Magnetic field Systems; derivation of mechanical force, magnetic energy and torque in magnetic field system, generated EMF and torque in rotating electrical machines

UNIT-II **9**

D.C. Generator

Construction of DC Generator, parts of dc generator, armature winding, types of dc generators, Emf and torque equation, Armature Reaction, Commutation process, Interpole and Compensating Windings, Performance Characteristics of D.C. generators under no load and loaded conditions.

UNIT-III **9**

D.C. Motor

DC motors, operating characteristics of D.C. motors, back EMF and torque equation, DC motor starters, Speed control of D.C. motors, losses, Efficiency and various Testing on D.C motors. Concept of Brushless DC motor.

UNIT-IV **9**

Transformer:

Construction& working of single-phase transformer, types of transformer, equivalent circuit models, efficiency, voltage regulation, various testing methods, Single phase auto transformers, efficiency, merits & demerits and applications of auto transformer. Construction, working and classifications of three phase transformers, phasor groups, Inrush current & harmonics in three phase transformers, three winding transformers, Parallel operation of transformers.

List of Experiments

1. To obtain magnetization characteristics of a d.c. shunt generator
2. To obtain load characteristics of a d.c. shunt generator.
3 To obtain efficiency of a dc shunt machine using Swinburn's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine
5. To obtain speed-torque characteristics of a dc shunt motor and series motor.
6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control
7. To obtain speed control of dc separately excited motor using Ward-Leonard.
8. To study polarity and ratio test of single phase and 3-phase transformers
9. To obtain equivalent circuit, efficiency and voltage regulation of a single transformer using open

circuit and short Circuit test.

10. To obtain efficiency and voltage regulation of a single-phase transformer by Sumpner's test.
11. Study of 3-phase to 2-phase conversion by Scott connection.

Text Books:

1. I. J. Nagrath & D. P. Kothari," Electrical Machines", Tata McGraw Hill
2. Ashfaq Husain," Electrical Machines", Dhanpat Rai& Sons
3. U.A Bakshi and M.V Bakshi, "Electromechanical Energy Conversion-I", Technical Publication Pune,
4. B.R. Gupta &Vandana Singhal, "Fundamentals of Electrical Machines, New Age International Publication
5. Fitzerald, A.E., Kingsley and S. D. Umans "Electric Machinery", MC Graw Hill.

Books & References

6. Irving L. Kosow, "Electric Machine and Transformers," Prentice Hall of India.
7. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
8. P. S. Bimbhra, "Electrical Machinery", Khanna Publisher

BEE-207	**Electrical Measurement & Measuring Instruments**
Course category	: Program Core (PC)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through attendance, home assignments, practical work, record, viva voce and One minor test and One Major Theory & Practical Examination.
Course Outcomes	: The student are expected to be able to demonstrate the following knowledge, skill and attitudes after completing this course 1. Basic concept of measurement, instrumentation, working & performances of different kind of measuring instruments 2. Ability to analyze performance characteristics of measuring instruments. 3. Ability to know, working principle & Performances of AC Bridges 4. Ability to understand construction, principle of operation, working and applications of waveform analyzers and spectrum analyzers. 5. Ability to understand construction, principle of operation, working and applications of harmonic distortion analyzers. 6. Ability to understand construction, principle of operation, working and measurements of Cathode Ray Oscilloscope (CRO).

Topics Covered

UNIT-I 9

Fundamentals of Measurement Systems

Philosophy of measurement, methods of measurements, classification of measurement system, functional elements of measurement, units, dimensions & standards, static performance characteristics, errors analysis, loading effect of instrument, uncertainty in compound quantity, histogram, deviation, dispersion,

standard deviations, variance, Gaussian's distribution curve analysis.

UNIT-II 9

Analog Measurement of Electrical Quantities

Types of measuring instruments, secondary instruments, essentials components of instruments, design of sprigs, pivot & jewels, Ammeters & Voltmeters; moving coil, moving iron, electrodynamic, electrostatic, rectifier & thermocouple type, Measurement of power, wattmeter, Measurement of energy, induction type energy meter, errors & remedies in wattmeter and energy meter, frequency meters.

UNIT-III 9

Instrument Transformers & A.C. Bridges

Instrument Transformer (CT &PT) and their applications in the extension of instrument range, Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges.

UNIT-IV 9

Magnetic Measurement & Digital Measurement of Electrical Quantities

Flux meter**,** determination of hysteresis loop, measurement of iron losses**.** Concept of digital measurement, block diagram study of digital voltmeters (DVM), Spectrum analyzers, Wave Analyzer and Harmonics distortion analyzer; Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its components**,** application of CRO in measurement, Lissajous Pattern.

List of Experiments

(Note: Minimum 8 experiments are to be performed**)**

1. Calibration of ac voltmeter and ac ammeter.
2. Calibration of single of induction type energy meter with the help of wattmeter.
3. Extension of range instruments using CT & PT.
4. Determination of iron loss using Lloyd Fisher's square method.
5. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
6. Measurement of power and power factor of a load using three voltmeter methods.
7. Measurement of low resistance by Kelvin’s double bridge.
8. Study of Maxwell’s inductance bridge.
9. Study of Schering bridge.
10. Study of Hay's bridge.
11. Study of Anderson's bridge.
12. Study of Owen's bridge.

Textbooks:

1. E.W. Golding & F.C. Widdis, “Electrical Measurement &Measuring Instrument”, A.W. Wheeler& Co. Pvt. Ltd. India.
2. A.K. Sawhney, “Electrical & Electronic Measurement & Instrument”, Dhanpat Rai& Sons India.

Books & References

1. E.O. Decblin, “Measurement System – Application & design”, McGraw Hill.
2. Forest K. Harries, “Electrical Measurement”, Willey Eastern Pvt. Ltd. India.
3. M.B. Stout,“Basic Electrical Measurement” Prentice hall of India.

4. W. D. Cooper," Electronic Instrument & Measurement Technique "Prentice Hall International.
5. B.C. Nakra & K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
6. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria & Sons

BME-260 **Fundamentals of Mechanical Engineering**

Course category : Engineering Fundamentals (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 and one Minor tests and One Major Theory & Practical Examination

Course Objectives : This course introduces basic fundamentals of mechanical engineering and their applications in solving engineering problems based on the concepts of thermodynamics, engine, measurement, engineering materials, mechanical properties and testing etc.

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

1. The knowledge of basic laws of thermodynamics; steam generation and its properties; refrigeration cycles, properties and machines; and reciprocating engine such as two/four strokes IC engines.
2. The knowledge of measuring instruments, types of transducers for measurement of different geometrical parameters.
3. The knowledge of various engineering materials and their applications.
4. The ability to understand different types of stresses, Hooke's law and its applications.
5. Understand the different mechanical properties and testing of engineering materials.
6. The knowledge of different types of beams, shear force and bending moment diagrams for statically determinate beams, stresses in simple bending of beams and torsion in circular shafts.

Topics Covered

UNIT-I 9

Thermodynamics

Thermodynamics laws, Enthalpy, Entropy, Steam properties, Steam processes at constant pressure, volume, enthalpy and entropy, Classification of steam boilers, boiler mounting and accessories, Refrigeration, Basics of Vapour compression and vapour absorption system, Coefficient of performance (COP), Refrigerants properties.

Reciprocating Machines

Carnot cycle, Otto and Diesel cycles, Working of two and four strokes petrol and diesel engines.

UNIT-II 9

Measurement & Metrology

Introduction to measurement and measuring instruments, Types of sensors and transducers and their

characteristics, measuring error uncertainty analysis, Temperature, pressure, velocity, flow, strain, force and torque introduction of dial gauges, slip gauges and sine bar

Engineering Materials

Classification of materials, Ferrous and nonferrous metals, Composition of cast iron, carbon steel, alloy steel and their applications, Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. properties and its applications.

UNIT-III 9

Simple Stress and Strain

Introduction, Normal and shear stresses, Poisson's ratio, Elastic constants and their relationships, Hooke's law, Deflection of bars of uniform and varying cross-sections, Strain energy in due to static loading, Stress-strain diagrams for ductile and brittle materials

Mechanical Properties and Testing

Strength, Stiffness, Malleability, Ductility, Brittleness, Toughness, Hardness, Fracture, Fatigue & creep.

UNIT-IV 9

Beams

Introduction, Classification of beams, types of loading, Free body diagram, Shear force and bending moment, Analysis of beams, Shear force and bending moment diagrams for statically determinate beams, Simple bending theory, Stress of beams of different cross sections

Torsion of Circular shafts

Introduction, Torsion of circular shafts, Shear stress due to torsion, Polar modulus, Power transmission

List of Experiments:

(Note: Minimum 8 experiments are to be performed)

1. Tensile strength test on universal testing machine.
2. Compressive strength test on universal testing machine.
3. Impact test on Impact testing machine.
4. Hardness testing on Vicker/Brinell hardness testing machine.
5. Stiffness test on spring testing machine.
6. Study of two stroke engine model.
7. Study of four stroke engine model.
8. Deflection on bending of simple supported and cantilever beams.
9. Determination of COP of vapour absorption system.
10. Determination of COP of vapour compression refrigeration system.
11. Study of steam boilers model.
12. Study of domestic refrigerator

Textbooks and References:

1. Basic and Applied Thermodynamics-P. K. Nag (Tata McGraw Hill)
2. Basic Thermodynamics- Cengel(Tata McGraw Hill).
3. Applied Thermodynamics-Onkar Singh (New Age International)
4. Material Science-V. Raghvan (Prentice Hall India Limited)
5. Elements of Materials science and Engineering-Van Vlash (Jhon Wiley & Sons)
6. Mechanical Measurement-G. Beckwith Thomas (Narosa Publishing House)
7. Mechanical Measurement – Sirohi (New Age Publications)
8. Strength of Materials-S. Ramamurtham (Dhanpat rai Publishing Co.)
9. Strength of Materials-R. K. Rajput (S. Chand)

BEE-255		**NETWORK ANALYSIS AND SYNTHESIS**
Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through, assignments, practical work, record, and viva-voce, and two minor tests and one major theory examination, and one major practical examination
Course Outcomes	:	After completing this course, the students are expected to be able to demonstrate the knowledge, skills and attitudes as following 1. Able to apply the network theorems for D.C. and A.C. networks. 2. Able to analyse two-port networks. 3. Able to understand the concept of graph theory and its applications. 4. Able to understand the concept of network functions and their characteristics. 5. Able to synthesize two-elements (L-C, R-C, and R-L) networks. 6. Able to understand the basic concepts of filters and their applications.

Topics Covered

UNIT-I 9

Network Theorems:

Fundamentals to network analysis, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Reciprocity theorem, Compensation theorem, Substitution theorem, Millman's theorem, and Tellegen's theorem. Problems with ac and dependent sources.

UNIT-II 9

Two Port Networks:

Characterization of LTI two port networks, two port network parameters, Z, Y, ABCD, A'B'C'D', h and g parameters, reciprocity and symmetry. Inter-relationships between the network parameters, inter-connections of two port networks, ladder and lattice networks, T & Π representation of networks.

UNIT-III 9

Introduction to Graph Theory:

Introduction to graph theory and applications; network graph, definitions, tree, co-tree, link, basic loop and basic cut set, incidence matrix, tie set matrix, and cut set matrix; duality, mesh and nodal analysis using network graph.

Network Functions:

Concept of complex frequency, transform impedances, network functions of one-port and two-port networks, concept of poles and zeros, properties of driving point and transfer functions, basics of time response and stability from pole zero plot.

UNIT-IV 9

Network Synthesis:

Fundamentals to network synthesis; Positive real function, definition and properties; properties of LC, RC and RL driving point functions; Foster first and second forms, and Cauer first and second forms of network realizations; synthesis of LC, RC and RL driving point immittance functions.

Introduction to Filters:

Introduction to filters, basic concepts, types, and applications.

List of Experiments:

(Note: Minimum 8 experiments are to be performed**)**

1. Verification of Thevenin's Theorem.
2. Verification of Norton's Theorem.
3. Verification of Superposition Theorem.
4. Verification of Maximum Power Transfer Theorem.
5. Verification of Reciprocity Theorem.
6. Verification of Tellegen's Theorem.
7. To determine Z and Y parameters of a T two-port network.
8. To determine ABCD parameters of a π two-port network.
9. To measure input impedance and output impedance of a two-port network.
10. Verification of network parameters properties for a cascade connected two-port networks.
11. To perform T-π, and Star-Delta Transformations.
12. To plot frequency response of a series resonant circuit using MATLAB.
13. To plot frequency response of a parallel resonant circuit using MATLAB.
14. To synthesize a RC network for a given driving point function.

Textbooks:

1. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India.
2. D. Roy Choudhary, "Networks and Systems", Wiley Eastern Ltd.
3. C.L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2007.
4. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co.

Books & References

1. Donald E. Scott: "An Introduction to Circuit analysis: A System Approach", McGraw Hill Pub.
2. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis", Wiley Eastern Ltd.
3. N.C. Jagan and C. Lakshminarayana, "Network Analysis" B.S. Publications, 2008.
4. K.S. Suresh Kumar, "Electric Circuits and Networks" Pearson Education, 2009.
5. A. Ramakalyan, "Linear Circuits: Analysis and Synthesis" Oxford University Press, 2005.

BEE-256	**Fundamentals of AC Electrical Machines**
Course category	: Program Core (PC)
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, practical work, record, viva voce, one Minor test and one Major Theory & Practical Examination.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course 1. Ability to learn basic concept of design, working & performances of three phase Synchronous Generator. 2. Ability to solve theoretical & numerical problems related to three phase Synchronous Generator. 3. Ability to learn basic concept of design, working & performances of

three phase Synchronous Machines as Motors.
4. Ability to solve analytically numerical problems related to three phase Synchronous Motors.
5. Ability to know constructional details, working principle & Performances of Single-Phase Electric Motors
6. Ability to understand working, operating characteristics & applications of Single-phase Electric Motors

Topics Covered

UNIT-I 9

Synchronous Generator

Constructional features, types of Synchronous Generator, EMF Equation, Armature reaction, O. C. & S. C. tests, Voltage Regulation and its calculations by different methods, Parallel Operation of synchronous generators, synchronization of Synchronous generators, synchronizing power and torque coefficients, concept of X_d, and Xq. Two Reaction Theory, Power flow equation of Synchronous Generators.

UNIT-II 9

Synchronous Motor

Synchronous Motor**,** power flow and torque equation, Effect of varying field current at different loads, V-Curves, Hunting, damper windings, synchronous condenser, applications of synchronous motor. Power flow equations of Synchronous Motor. Concept of Permanent Magnet Synchronous Motor (PMSM)

UNIT-III 9

Three phase Induction Motor

Constructional features, rotating magnetic field, working principle, Phasor diagrams, equivalent circuits, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, losses, efficiency, starting methods, various speed control techniques, Deep bar and double cage Induction Motors, Cogging & Crawling effects, Doubly fed Induction Motor.

UNIT-IV 9

Single phase Electric Motors

Single-phase Induction motors, construction & working, equivalent circuits, no load and blocked rotor tests, starting methods, Shaded pole motors, Repulsion motor, Reluctance motor, Hysteresis motor, A.C. series motor, Universal motor

EXPERIMENTS

1. To perform no load and blocked rotor tests on a three-phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three-phase induction motor and draw: Torque -speed characteristics
3. To perform no load and blocked rotor tests on a single-phase induction motor and determine equivalent circuit parameters and efficiency.
4. To study speed control of three phase induction motor by (i) pole changing (ii) supply voltage and (iii) frequency control method
5. To study speed control of three phase slip ring induction motor by rotor emf injected method.
6. To perform open circuit and short circuit tests on a three-phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging by (i) Synchronous Impedance method and (ii) MMF method.
7. To perform V-curves and inverted V-curves of a three-phase synchronous motor.
8. To determine X_d and X_q of a three-phase salient pole synchronous machine using the slip test and draw the power-angle characteristics.
9. To study synchronization of an alternator with the infinite bus by using
   (i) dark lamp method

   (ii) two bright and one dark lamp method.
10. To study speed-torque characteristics of three phase slip ring induction motor and effects of additional resistance, or capacitance in the rotor circuit.
11. To study VSI based slip power recovery scheme of three phase induction motor
12. To study performances of three phase Induction Generator.

Text Books

1. D.P. Kothari & I.J. Nagrath, "Electric Machines", Tata McGraw Hill
2. Ashfaq Hussain "Electric Machines" Dhanpat Rai & Company, New Delhi
3. U.A Bakshi, M.V Bakshi, "Electromechanical Energy Conversion-II, Technical Publications Pune.

Books & References

1. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers
2. P.S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers
3. M.G. Say, "Alternating Current Machines", Pitman & Sons

Fitzerald, A.E., Kingsley and S.D. Umans "Electric Machinery", McGraw Hill.

BEE-257		**Microprocessor**
Course category	:	Program Core (PC)
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, practical work, record, viva voce, one Minor test and one Major Theory & Practical Examination.
Course Objectives		The students should be able to use and apply:

1. The hardware knowledge of 8085 microprocessor
2. The programming skill on 8085 microprocessor-based applications along with peripheral interfaces
3. The knowledge on intel 8086 microprocessor architecture and operation.

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

1. Microcomputer systems and its associated hardware
2. Detailed architecture of the Intel 8085microprocessor.
3. Operation and control, instruction set and interrupts of the microprocessor
4. Assembly language programming with the 8085 microprocessors
5. Intel 8255 and 8254 peripheral interfaces
6. Architecture and operation of the intel 8086 microprocessor

Topics Covered

UNIT-I 9

Introduction to Microcomputer Systems and Hardware: History of Computers, Computer Languages, Large computers to Single-Chip-Microcomputers, Evolution of Microprocessors, Microprocessor Architecture and Its operations, memory, Input/Output, Interfacing Devices.

Intel 8085 Microprocessor: Pin configuration, internal architecture, control and status signals, interrupts, bus timings, de-multiplexing of address bus, generating control signals, ALU, Flag register.

UNIT-II 9

Operation and Control of Microprocessor: Decoding and executing an instruction, op-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.

Instruction Set: Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro-RTL and micro RTL flow chart of few typical instructions; unspecified flags and instructions.

Interrupts: Interrupt structure of 8085 microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; handling multiple interrupts.

UNIT-III 9

Assembly Language Programming for 8085 microprocessor Assembler directives, simple examples; Subroutines, parameter passing to subroutines, programming techniques with looping, counting and indexing, counter and timing delays.

Programmable Peripheral Interface: Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature.

Programmable Interval Timer: Intel 8253/8254, pin configuration, internal block diagram of counter and modes of operation, counter read methods.

UNIT-IV 9

16-bit Microprocessor: Architecture of Intel 8086 (Bus Interface Unit, Execution Unit), register organization, memory addressing, memory segmentation, operating modes, addressing modes, instruction set, hardware and software interrupts, responses and types.

Experiments:

Perform at least any ten experiments from the following:

1. To become familiar with 8085 microprocessor training kit/Software Simulator and execute following programs.
   - Add two 8 bit numbers stored in register B & C store result in register D.
   - Subtract 8 bit data stored at memory location 4021h from data stored at memory location 4020h. Store result at memory location 4022h.
   - To perform OR operation between accumulator and register B. Store result in register C.
2. To become familiar with 8085 microprocessor simulator and simulate following programs using simulator
   - Write a program to interchange content of register B and C
   - Subtract content of register E from register B.
   - Complement content of accumulator and display result on output port PORT2.
   - Perform logical OR operation between register B and C, logical AND operation between accumulator and register B.
3. Write a program to transfer set of data from memory location 2050-205Fh to 2060-206Fh
4. Write a program to find smallest number from given set of data stored at location 2040h to 205Fh
5. Write a program to find negative numbers in given set of data stored at the location 2050h to 205Fh
6. Write program to arrange an array of data in ascending order
7. Write a program to multiply two 8 bit numbers stored at the location 2100 and 2101. Store result at memory location 2102h
8. Write program to divide 16 bit number stored at memory location 2100h and 2101h by 8 bit number stored at memory location 2102h. Store the quotient in memory locations 2110h and 2111h, remainder at memory location 2112h.
9. Write a program to convert hexadecimal number into equivalent BCD number
10. Write a program to check parity of data stored at memory location 2100. Move content EEh to register B, if parity is even and 00h if parity is Odd.
11. To interface Programmable peripheral interface (PPI) IC-8255 with 8085 Microprocessor in Mode 0.
12. To generate square wave on port pin PC7 of 8255 in BSR mode.

Text Books:

1. Gaonkar, Ramesh S, "Microprocessor Architecture, programming and applications with the 8085" Pen ram International Publishing 5th Ed.
2. Uffenbeck, John, "Microcomputers and Microprocessors" PHI/ 3rd Edition.
3. Ray, A.K. &Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.
4. Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.

Reference Books:

5. Brey, Barry B. "INTEL Microprocessors" Prentice Hall (India)
6. Aditya P. Mathur, "Introduction to Microprocessor" Tata McGraw Hill
7. M. Rafiquzzaman, "Microprocessors- Theory and applications" PHI
8. B. Ram, "Advanced Microprocessor & Interfacing" Tata McGraw Hill
9. Renu Singh &B.P.Singh, "Microprocessor and Interfacing and applications" New Age International
10. Hall D.V., "Microprocessors Interfacing" Tata McGraw Hill
11. Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family" Prentice Hall (India)

EEE 101	**Linear Programming for Optimization**
Course Category	**:** Professional Elective (PE)
Pre-requisites	**:** NIL
Contact Hours/Week	**:** Lecture: 3, Tutorial: 0, Practical: 2
Credits	**:** 4
Course Assessment Methods	• Continuous Assessment: Tutorials, Assignments, Attendance, Quizzes, One Minor Test • Final Evaluation: One Major Theory Examination
Course Outcomes (COs)	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand fundamental concepts of Matrix algebra, matrices, determinants, and linear transformations**.**
2. Apply matrix operations, eigenvalues, eigenvectors to solve systems of linear equations and Formulating LP Problems.
3. Formulate real-world optimization problems using linear programming (LP) techniques.
4. Solve LP problems using graphical and simplex methods and its application in industry/electrical system.

Topics Covered

UNIT-I Matrix Algebra for Optimization **9**

Vectors, Matrices, and Matrix Operations, Rank, Determinants, and Inverse Matrices, Eigenvalues/Eigenvectors & Positive Definite Matrices, Solving Linear Systems (Gauss Elimination, LU Decomposition)

UNIT-II Introduction to Linear Programming (LP) **9**

Formulating LP Problems (Objective Functions, Constraints), Graphical Method for 2-Variable LP, Standard & Canonical Forms of LP, Duality & Economic, Interpretation of Dual Variables

UNIT-III Simplex Method & Sensitivity Analysis **9**

Simplex Algorithm (Tableau, Pivoting, Optimality Conditions), Big-M & Two-Phase Simplex Methods, Sensitivity Analysis (Shadow Prices, Range of Optimality), Degeneracy & Unbounded Solutions

UNIT-IV Applications of LP in Industry/Electrical Systems **9**

Production Planning & Resource Allocation, Transportation & Assignment Problems, Optimal Power Flow (DC Approximation), Network Flow Optimization (Shortest Path, Max Flow)

List of Experiments:

1. To Find the rank of a given matrix.
2. To Compute determinant and inverse of a square matrix.
3. To Find eigenvalues and eigenvectors of a matrix.
4. To Check whether a matrix is positive definite.
5. To Perform LU decomposition of a matrix.

6. To find Matrix Operations and Solving Linear Equations
7. To find Graphical Solution of a 2-Variable Linear Programming Problem
8. To Use of MATLAB () to Solve a Linear Programming Problem
9. To perform Simple Sensitivity Test – Change RHS Value and Compare
10. To find Simple Resource Allocation Problem

Books & References

1. B V. Ramana: Numerical Methods for Engineers and Scientists; (McGraw Hill)
2. J. K. Sharma: Operations Research: Theory and Applications; (Macmillan)
3. K. B. Datta : Matrix Algebra for Engineers – (PHI Learning)
4. Qingkai Kong, Timmy Siauw, Alexandre Bayen: Practical Optimization with Python (Cambridge University Press)
5. Dimitris Bertsimas and John N. Tsitsiklis: Introduction to Linear Optimization – (Athena Scientific)

EEE 102	**Fundamentals of Power Electronics**
Course Category	**:** Professional Elective (PE)
Pre-requisites	**:** NIL
Contact Hours/Week	**:** Lecture: 3, Tutorial: 1, Practical: 0
Credits	**:** 4
Course Assessment Methods	• Continuous Assessment: Tutorials, Assignments, Attendance, Quizzes, One Minor Test • Final Evaluation: One Major Theory Examination
Course Outcomes (COs)	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Understand the operating principles and characteristics of power semiconductor devices.
2. Analyse controlled rectifiers for performance, THD, and power factor.
3. Design and evaluate DC-DC converters for various load conditions.
4. Examine inverter topologies and apply PWM techniques for efficient power conversion.

Topics Covered

Unit I: Introduction to Power Semiconductor Devices **9**

Characteristics of SCR, MOSFET, IGBT, GTO. Device ratings and switching characteristics. Turn-on and turn-off methods for SCR. Gate drive and snubber circuits. Heat sinking and thermal design of devices. Comparison of device types and switching speed

Unit II: Controlled Rectifiers **9**

Single-phase and three-phase rectifiers (half and full controlled), Performance parameters, power factor, and THD, Freewheeling effect and effect of source impedance, Controlled converter waveforms and analysis, Applications in battery chargers and DC drives

Unit III: DC-DC Converters **9**

Buck, Boost, Buck-Boost, Cuk converters, Continuous and discontinuous modes of operation, Practical Design of inductors and capacitors. Efficiency analysis and performance comparison, Isolated converters (Flyback, Forward)

Unit IV: DC-AC Inverters **9**

Single-phase and three-phase bridge inverters, PWM techniques: sinusoidal PWM, space vector PWM, Harmonic reduction methods, Current source inverters (CSI), Overmodulation and inverter protection, Applications in UPS and motor drives

Books & References

1. **M. H. Rashid**, *Power Electronics: Circuits, Devices and Applications*, Pearson Education
2. **Ned Mohan, Tore M. Undeland, William P. Robbins**, *Power Electronics: Converters, Applications, and Design*, Wiley
3. **P. S. Bimbhra**, *Power Electronics*, Khanna Publishers

EEE-103		**MODELLING AND SIMULATION TECHNIQUES**
Course Category	:	Professional Elective (PE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial:0, Practical: 2
No of Credits	:	4
Course Assessment Methods	:	Continuous assessment will be carried out through tutorials, practical work, attendance, home assignments, quizzes, one minor test, one major theory examination, and a practical examination.
Course Objectives	:	Study of system behavior using mathematical models and computer simulations to analyze, predict, and optimize real-world dynamic processes.
Course Outcome	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand various modelling techniques and perform simulation of continuous and discrete systems.
2. Analyse dynamic responses using transfer functions and frequency domain tools like Bode plots.
3. Apply fuzzy logic concepts for intelligent control system design.
4. Explore neural network architectures and their application in modelling and decision-making tasks.

Topics Covered

Unit I: Introduction to modelling and simulation **9**

Modelling: Model classification, Mathematical, physical, and analog models, Basic of Estimation, Experimental nature of simulation, steps involved in simulation studies, Validation of simulation models, computer simulation of continuous & discrete systems.

Unit II: Dynamic Response **9**

Dynamic response of 1st order system and 2nd order system, performance measures for 2nd order system, system transfer function, transfer function of 1st and 2nd order system Block diagram algebra, signal flow diagram, state variable formulation, frequency & time domain analysis and bode plots.

Unit III: Simulation Techniques **9**

MATLAB & Simulink, Modelling and Simulation of electrical systems, Selected tool boxes for electrical systems, verification, and validation of simulation model.

Unit IV: Parameter Estimation & system Identification **9**

Introduction to System Identification and Parameter Estimation, Time Domain Functions, Open and Closed Loop Systems, SISO systems, Multivariable systems, Linear and nonlinear Models, Estimation of Model Parameters, least squares method, Recursive least squares method, Kalman filter.

List of Experiments:

1. To implement Regula Falsi method to solve algebraic equations.
2. To implement numerical integration to solve algebraic equations.
3. To implement Gauss-Siedel method for solution of simultaneous equations.
4. To implement Runge-Kutta method of order four to solve differential equations.
5. To implement Euler's method to find solution of differential equations.
6. To find optimum solution to problem parameters.
7. To find derivatives of static displacements and stresses.
8. To write Computer based algorithm and program for solution of Eigen-value problems.
9. Reduction of size of an optimization problem using reduced basis technique.
10. To find Derivatives of Eigen-values and Eigen vectors.

Textbooks:

1. Programming with MATLAB for Scientists: A Beginner's Introduction, E. Mikhailov Eugeniy, CRC Press; 1st edition, February 2, 2018.
2. MATLAB an Introduction with Applications, Rao V. Dukkipati, New Age International Publisher.
3. MATLAB for Engineers, Holly Moore, Pearson, 5th Edition, 2018
4. MATLAB: A Practical Introduction to Programming and Problem Solving, Stormy Attaway, Butterworth-Heinemann, 4th Edition, 2018
5. Essential MATLAB for Engineers and Scientists, Brian Hahn and Daniel T. Valentine, Academic Press, 6th Edition, 2016

EEE-104	**Power Electronics Systems and Grid Integration for Electric Vehicles**
Course Category	Professional Elective (PE)
Pre-requisites	NIL
Contact Hours/Week	Lecture: 3, Tutorial: 1, Practical: 0
Credits	4
Course Assessment Methods	• Continuous Assessment: Tutorials, Assignments, Attendance, Quizzes, One Minor Test • Final Evaluation: One Major Theory Examination

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:
CO1: Select and analyze semiconductor devices for EV systems.
CO2: Design and simulate converters and inverters used in EVs.
CO3: Implement and tune control algorithms in both analog and digital domains.
CO4: Integrate power electronics into EVs, renewable systems, and smart grid infrastructure.

Topics Covered

Unit I:

Power Semiconductor Devices and Converters: Characteristics and operation of SCR, MOSFET, IGBT, GTO, Turn-on/turn-off techniques, device ratings, and switching characteristics, Gate drive circuits and snubber design, Single-phase and three-phase controlled rectifiers, Buck, Boost, Buck-Boost, and Cuk DC-DC converters, Isolated topologies: Flyback and Forward converters

Unit II:

Inverters and Advanced Power Converter Topologies: Single-phase and three-phase DC-AC bridge inverters, PWM techniques: Sinusoidal PWM and Space Vector PWM, Harmonic reduction and current source inverters (CSI), Multilevel inverter topologies: Diode-clamped, Flying capacitor, CHB, Resonant converters: Series, Parallel, LLC and soft-switching (ZVS, ZCS), Matrix and Modular Multilevel Converters (MMC): Principles and applications

Unit III:

Control and Modulation in Power Converters: Classical control techniques: PI, PID, PR controllers, Voltage and current loop design with stability analysis, Digital control: PWM generation, ADC sampling, DSP/microcontroller implementation, Dead-time and delay compensation, Modulation strategies: Carrier-based PWM, SVM, multicarrier PWM, Control of resonant, bidirectional, and isolated converters; PFC techniques

Unit IV:

Applications in EVs, Renewables, and Smart Technologies: Power electronics in electric vehicle drive-trains and converter design, Battery charging systems and regenerative braking in EVs, Renewable energy interface: Grid-connected PV, wind, MPPT algorithms, VFDs, soft starters, and servo drive applications in industrial automation, Power electronics in smart grids, distributed generation, and SSTs, IoT-enabled converters, cloud-based monitoring, and EV-grid integration

Books & References

1. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications, 4th Edition, Pearson Education, ISBN: 978-9332542603 (Indian Edition).
2. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
3. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management

Strategies", Springer, 2015.
4. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
5. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

EEE-201	**Special Electrical Machines**
Course category	: Program Elective-2 (PE-2)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	: 4

Course Objectives

To impart knowledge on the following Topics

1. Construction, principle of operation, control and performance of stepping motors.
2. Construction, principle of operation, control and performance of switched reluctance motors.
3. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
4. Construction, principle of operation and performance of permanent magnet synchronous motors.
5. Construction, principle of operation and performance of other special Machines.

Course Outcomes :

1. Ability to construct, principle of operation, switched reluctance motors.
2. Ability to acquire knowledge of the construction and operation of stepper-switched reluctance motors.
3. Ability to acquire knowledge of the construction and operation of permanent magnet brushless D.C. motors and permanent magnet synchronous motors.
4. Ability to select a special Machine for a particular application.

Topics Covered

UNIT-I 9

SYNCHRONOUS RELUCTANCE MOTOR: Principle of operation and Characteristics-Applications.

SWITCHED RELUCTANCE MOTORS (SRM): Constructional features –Principle of operation-Torque prediction–Characteristics, Steady state performance prediction – Analytical Method – Power controllers – Applications.

UNIT-II 9

STEPPER MOTORS: Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

UNIT-III 9

PERMANENT MAGNET BRUSHLESS D.C. MOTORS: Fundamentals of Permanent Magnets-Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Power Converter Circuits - Characteristics and control- Applications.

PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM): Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - performance

characteristics – Applications.

UNIT-IV 9

OTHER SPECIAL MACHINES: Constructional features – Principle of operation and Characteristics of Hysteresis motor–Linear Induction motor-Repulsion motor- Applications.

Books & References

1. K. Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
4. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
5. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
6. T.J.E. Miller,'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
7. R. Srinivasan, 'Special Electrical Machines', Lakshmi Publications

Skill-Based Courses to Qualify for UG Diploma (Engg.) in Electrical Engineering

BEE-257 Integrated Electrical Systems

Course Name: Integrated Electrical Systems
Course Category: Skill Development
Mode: Theory +Practical
Contact Hours/week: Lecture 2, Tutorial 0, Practical 2
Credits: 2
Course Assessment Methods: Continuous assessment through assignments, attendance, quizzes and final theory examination and practical examination

Course Objectives:

- To provide foundational knowledge in power electronics, power systems, control systems, and electrical measurements.
- To familiarize students with the essential components and functioning of integrated electrical systems in practical environments.
- To develop basic analytical and troubleshooting skills across different electrical subsystems.

Course Outcomes:

- Understand the principles and applications of power electronic devices.
- Describe the basic structure and operation of electric power systems.
- Understand basic control theory and its applications in electrical systems.

- Operate and interpret readings from standard electrical measuring instrument

Course Content

Unit 1: Basics of Power Electronics **(6)**

- Introduction to Power Electronics and its applications.
- Overview of Semiconductor Devices: Diodes, SCR, TRIAC, MOSFET, IGBT.
- Rectifiers (Half wave, Full wave, Bridge) – working and waveforms.
- Basics of Inverters and Converters.

Unit 2: Basics of Power System **(6)**

- Introduction to Electrical Power Generation (Thermal, Hydro, Nuclear, Solar).
- Transmission & Distribution – basic structure and components.
- Single Line Diagram of Power System.
- Types of Substations.

Unit 3: Basics of Control System **(6)**

- Introduction to Control Systems – Open Loop & Closed Loop.
- Block Diagram Representation of Control Systems.
- Transfer Function and Feedback.
- Application of Control Systems in Electrical Engineering.

Unit 4: Smart Energy Meter & Transducers **(6)**

- Basics of Energy Metering
  - Concept of energy metering (kW, kWh, units)
  - Single-phase vs. three-phase energy meter
- Smart Energy Meters , Features of smart meters, Advantages over traditional meters
- Electrical Transducers(Definition , classification and applications), Difference between sensor, transducer and pick-ups.
- Special Transducers

Recommended Books:

- Power Electronics – P.S. Bhimbra / M.H. Rashid
- Power System Engineering – I.J. Nagrath & D.P. Kothari
- Control Systems Engineering – Nagrath & Gopal / Benjamin C. Kuo
- A Course in Electrical and Electronic Measurements and Instrumentation – A.K. Sawhney
- Basic Electrical Engineering – V.K. Mehta & Rohit Mehta

Practical / Lab Experiments

1. Study and Characteristics of Power Semiconductor Devices
2. **Single Phase Full-Wave Bridge Rectifier using SCRs at various** firing angles.
3. **Study of Various Protection Devices.**

4. Circuit Breaker, Fuse, Isolator (Demonstration or simulation-based).
5. **Study of Open Loop and Closed Loop Systems**.
6. Working of overcurrent /Undervoltage relay
7. Measurement of non-electrical parameters using transducers