GOKUL GLOBAL UNIVERSITY
Approved By Govt. of Gujarat
(Recognized by UGC under Section 22 & 2(f) of 1956)
(Gujarat Private State University Act 4 of 2018)

COURSE STRUCTURE

Bachelor of Engineering

Electrical Engineering

Under

Choice Based Credit System (CBCS)

Faculty of Engineeering
Hansaba College of Engineering & Technology
University Campus, State Highway-41, Siddhpur - 384151, Dist. Patan, Gujarat, INDIA
E: dean.fac.engg@gokuluniversity.ac.in W: www.gokuluniversity.ac.in M: +91 95109 73860

Program Outcomes (PO)

Engineering Graduates will be able to:

1. **PO-1: - Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **PO-2: -Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **PO-3: -Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **PO-4: -Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **PO-5: -Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **PO-6: -The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **PO-7: -Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **PO-8: -Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **PO-9: -Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **PO-10: -Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **PO-11: -Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **PO-12: -Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

1. **PSO1: -** Have a strong academic foundation in science, mathematics and electrical engineering necessary for a successful career in industry/research/higher education and will understand the professional responsibility in the modern electrical power and energy related industry through a global and rigorous education.

2. **PSO2: -** Possesses technical competence in the fields of electrical engineering and allied disciplines and will succeed in implementing engineering solutions that are technically sound and environmentally friendly.

Semester I

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Engineering Mathematics-I	FEB110001	5	3	2	0	5	70	30	30	20	150
2	Elements Of Mechanical Engineering	FEB110202	5	4	0	2	6	70	30	30	20	150
3	Communication Skill	FEB110003	4	3	1	0	4	70	30	30	20	150
4	Elements Of Electrical Engineering	FEB110304	5	4	0	2	6	70	30	30	20	150
5	Physics	FEB110005	4	3	0	2	5	70	30	30	20	150
6	Basic Workshop	FEB110206	2	0	0	4	4	0	0	50	50	100
Total			**25**	**17**	**3**	**10**	**30**	**350**	**150**	**200**	**150**	**850**

Semester II

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Engineering Mathematics - II	FEB120001	5	4	1	0	5	70	30	30	20	150
2	Basic Electronics	FEB120302	4	3	0	2	5	70	30	30	20	150
3	Computer Programming With C	FEB120403	5	4	0	2	6	70	30	30	20	150
4	Engineering Graphics	FEB120204	5	3	0	4	7	70	30	50	50	200
5	Environmental Science(Mandatory Course)	FEB120105	0	2	2	0	4	70	30	0	0	100
Total			**19**	**16**	**3**	**8**	**27**	**350**	**150**	**140**	**110**	**750**

Semester III

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Effective Technical Communication	FEB130001	3	2	0	2	4	70	30	30	20	150
2	Indian Constitution	FEB130002	0	2	0	0	2	50	0	0	0	50
3	Engineering Mathematics –III (Probability & Statistics)	FEB130301	4	3	0	2	5	70	30	30	20	150
4	Electrical Circuit Analysis	FEB130302	5	3	1	2	6	70	30	30	20	150
5	Analog & Digital Electronics	FEB130303	5	4	0	2	6	70	30	30	20	150
6	Control Systems Engineering	FEB130304	4	3	0	2	5	70	30	30	20	150
Total			**21**	**17**	**1**	**10**	**28**	**400**	**150**	**150**	**100**	**800**

Semester IV

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Essence of Indian Knowledge Tradition	FEB140001	0	3	0	0	3	70	30	0	0	100
2	Electrical Machines-I	FEB140301	5	4	0	2	6	70	30	30	20	150
3	Electromagnetic Fields	FEB140302	4	3	1	0	4	70	30	30	20	150
4	Internet of Things	FEB140303	5	4	0	2	6	70	30	30	20	150
	Power Plant Engineering	FEB140304										
5	Power Electronics- I	FEB140305	5	4	0	2	6	70	30	30	20	150
Total			**19**	**18**	**1**	**6**	**25**	**350**	**150**	**120**	**80**	**700**

Semester V

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Engineering Economics and Management	FEB150001	3	3	0	0	3	70	30	0	0	100
2	Electrical Machines – II	FEB150301	4	3	0	2	5	70	30	30	20	150
3	Power Electronics- II	FEB150302	4	3	0	2	5	70	30	30	20	150
4	Microprocessors	FEB150303	4	3	0	2	5	70	30	30	20	150
5	Elements of Electrical Design	FEB150304	3	2	0	2	4	70	30	30	20	150
6	Electrical Power Systems -I	FEB150305	4	3	0	2	5	70	30	30	20	150
Total			**22**	**17**	**0**	**10**	**27**	**420**	**180**	**150**	**100**	**850**

Semester VI

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Electrical Power Systems - II	FEB160301	4	3	0	2	5	70	30	30	20	150
2	Electrical Measurements	FEB160302	4	3	0	2	5	70	30	30	20	150
3	Electrical Drives	FEB160303	3	2	0	2	4	70	30	30	20	150
4	High Voltage Engineering	FEB160304	3	2	0	2	4	70	30	30	20	150
5	Electrical Machine Design- I	FEB160305	3	2	0	2	4	70	30	30	20	150
6	Cyber Security	FEB160001	3	0	2	2	4	0	0	80	20	100
Total			**20**	**12**	**2**	**12**	**26**	**350**	**150**	**230**	**120**	**850**

Semester VII

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Electrical Machine Design-II	FEB170301	3	2	0	2	4	70	30	30	20	150
2	Power System Protection	FEB170302	4	3	0	2	5	70	30	30	20	150
3	Signal and System	FEB170303	4	3	0	2	5	70	30	30	20	150
4	Inter connected power system	FEB170304	4	3	0	2	5	70	30	30	20	150
5	Project- I	FEB170305	6	0	0	12	12	0	0	80	20	100
Total			**21**	**11**	**0**	**20**	**31**	**280**	**120**	**200**	**100**	**700**

Semester VIII

Sr. No.	Subject Name	Subject Code	Credit	Teaching Scheme Per Week				Examination Marks				Total Marks
								Theory		Practical		
				Th	Tu	P	Total	E	M	V	I	
1	Power Quality and FACTS	FEB180301	3	2	0	2	4	70	30	30	20	150
2	Industrial Instrumentation	FEB180302	3	2	0	2	4	70	30	30	20	150
3	Computer Aided Design for Electrical Engineering	FEB180303	4	3	0	2	5	70	30	30	20	150
4	Project-II	FEB180304	6	0	0	12	12	00	00	80	20	100
Total			**16**	**7**	**0**	**18**	**25**	**210**	**90**	**170**	**80**	**550**

FEB110001: ENGINEERING MATHEMATICS-I

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Engineering Mathematics-I	**Course code**	FEB110001
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

- To recall and remember basics of matrices,integration, sequence and series and differential calculus.
- To understand the concepts of basic mathematical methods for matrices, integration, sequence and series and differential calculus.
- To apply methods to solve engineering problems.
- To analyze engineering problems and evaluate.
- To solve and evaluate the problems using matrices, integration, sequence and series and differential calculus.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	2	0	5	5	70	30	30	20	150

Details Syllabus

Sr.	Content	Total Hrs	% Weightage
1	Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, Taylor's and Maclaurian's theorems and their examples, Indeterminate forms and L' Hospital Rule, Improper integrals, Convergence and divergence of improper integrals, Beta and Gamma functions and their properties. Applications of definite integrals to evaluate surface areas and volumes of revolutions.	09	15%

2	Convergence and divergence of sequence, tests for convergence of sequence: The Sandwich Theorem, The continuous function theorem and bonded monotonic sequence Convergence and divergence of series, tests for convergence of Series: Comparison test, Cauchy's integral test, De' Alembert's ratio test, Cauchy's root test, Leibniz's rule for alternating series, Power series, Radius of convergence of power series, Taylor's and Maclaurian's series. Fourier Series of periodic functions, Fourier Series of even and odd functions, Half range sine and cosine series, Parseval's theorem.	10	25%
3	Limit and continuity of function of several variables, partial derivatives, directional derivatives, total derivatives, Chain rule, derivatives of implicit functions, Euler's theorem on homogeneous functions, Taylor's and Maclaurin's expansion for function of two variables, Extrema of function of several variables, Application of Lagrange method of undetermined multipliers, Tangent plane and normal line	10	25%
4	Multiple Integration: Double integrals, change of order of integration, Change of variables, Applications: areas and volumes Triple integrals, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Jacobian, Multiple integrals by substitution	08	15%
5	Algebra of Matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem	08	20%

Reference Books :

1. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendentals, 13e, Pearson, 2014.
2. Howard Anton, Irl Bivens, Stephens Davis,Calculus,10e,Wiley,2016
3. James Stewart, Calculus: Early Transcendentals with Course Mate, 7e, Cengage, 2012.
4. Elementary Linear Algebra, Applications version, Anton and Rorres, Wiley India Edition.
5. T. M. Apostol, Calculus, Volumes 1 & 2, Wiley Eastern

Suggested Readings:

1. Swaym video lecture.
2. Mathematics magazine

Online Resources:

1. http://nptel.ac.in
2. https://ocw.mit.edu/courses

https://www.edx.org

Lis of Practical / Activities :

1. Problems solving.
2. Tutorial solving.
3. Seminar by students

Course Outcome:

After completion of the course, the students will be able to:

CO-1: To apply differential and integral calculus to improper integrals and to determine applications of definite integral. Apart from some other applications they will have a basic understanding of indeterminate forms, Beta and Gamma functions.

CO-2: To apply the various tests of convergence to sequence, series and the tool of power series and fourier series for learning advanced Engineering Mathematics

CO-3: To compute directional derivative, maximum or minimum rate of change and optimum value of functions of several variables

CO-4: Mathematics has the potential to understand the core Technological studies

CO-5: To compute the areas and volumes using multiple integral techniques

CO-6: To perform matrix computation in a comprehensive manner

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	1	-	-	-	-	1	1	-	-	-	-
CO-2	1	1	2	-	2	-	-	-	-	-	-	-	-	-
CO-3	1	-	-	2	-	-	-	-	1	-	-	1	-	-
CO-4	-	2	-	-	1	-	-	-	-	1	-	-	-	-
CO-5	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO-6	2	-	-	1	-	-	-	-	2	1	-	1	-	-

FEB110202: ELEMENTS OF MECHANICAL ENGINEERING

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Elements Of Mechanical Engineering	**Course code**	FEB110202
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

- Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**Introduction:** Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.	4	25%
2	**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion	3	
3	**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process	5	

4	**Properties of Steam:** Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters	6	30%
5	**Heat Engines:** Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles	5	
6	**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, Functioning of different mountings and accessories	-	
7	**Internal Combustion Engines:** Introduction, Classification, Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies	4	20%
8	**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming	3	
9	**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistage	3	
10	**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners	4	25%
11	**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc)	3	
12	**Transmission of Motion and Power:** Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive	4	

List of suggested Practical: -

1. To understand construction and working of various types of boilers.
2. To understand construction and working of different boiler mountings and accessories.
3. To determine brake thermal efficiency of an I. C. Engine.
4. To understand construction and working of different types of air compressors.
5. To demonstrate vapour compression refrigeration cycle of domestic refrigerator OR window air
6. conditioner OR split air conditioner.

References Books: -

1. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
2. Basic Mechanical Engineering by Pravin Kumar, Pearson
3. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi
4. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication
5. Introduction to Engineering Materials by B.K. Agrawal Tata Mcgraw Hill Publication, New Delhi

Course Outcomes: -

After learning the course, the students should be able to

CO1 To understand the fundamentals of mechanical systems

CO2 To understand and appreciate significance of mechanical engineering in different fields of engineering

CO3 Enhancement of fundamental knowledge of Thermodynamics

CO4 Enhancement of fundamental knowledge of Fluid Mechanics and I.C. Engines

CO5 Acquiring knowledge of materials and their properties for engineering applications

CO6 Evaluate properties of steam. Demonstrate various types of boilers and their relative merits and demerits. Learning problem solving in particular domain.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*														
	PO -1	**PO -2**	**PO -3**	**PO -4**	**PO -5**	**PO -6**	**PO -7**	**PO -8**	**PO -9**	**PO -10**	**PO -11**	**PO -12**	**PSO -1**	**PSO -2**	**PSO -3**
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	2	2	-	-	-	2	-	-	-	-	-	-	-	-	-
CO-3	2	-	1	1	-	-	-	-	-	-	-	-	-	-	-
CO-4	1	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO-5	1	-	-	-	1	1	1	-	-	-	-	-	-	-	-
CO-6		2	-	-	-	-	-	-	-	-	-	-	-	-	-

FEB110003: - Communication skill

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Communication skill	**Course code**	FEB110003
Course type:	Engineering Science	**Course credit:**	04

Course Objective:

- To enable understand.
- To speak
- To Read and write

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	1	0	4	4	70	30	30	20	150

Details Syllabus

Unit	Description in detail	Teaching Hours	Weightage
I	**Introduction:** Communication skills Process, types and levels of communication. Technical Communication and General Communication. Factors to be considered in technical communication Verbal and non-verbal communication (kinesics) Components of Non-verbal Communication (Kinesics) Barriers to effective communication. (Noise in oral and written communication) Communication across cultures.	11	25 %
II	**Presentation strategies for Communication:** Effective presentation strategies. Defining purpose, analysis of audience and locate, organizing contents. Preparing an outline of the presentation. Visual aids, nuances of delivery, Body language and effective presentation. Interviews Introduction, General preparations for an interview, Types of questions generally asked at the interviews. Types of interviews, Importance of nonverbal	11	25 %

	aspects.		
III	**Public Speaking Skill:** Group Discussions Introduction, Group discussions as a part of the selection process, guidelines for group discussion. Role functions in group discussion. Letter - Writing Business Letters, Structure and types of a business letter, Letter of Inquiry, Letters of complaint, regret and adjustment. Technical reports Introduction, types of reports, structure of reports, objectives and characteristics of reports.	11	25 %
IV	**Tools of Communication Skill:** Technical Proposals Definition, Purpose, Types, Characteristics, Structure, Style and appearance. Effective Reading Skills Purpose of reading, skimming and scanning. Tips for improving comprehension skills. Job application Essential parts - Cover Letter and the 'resume'. Types of 'resumes' (Curriculum Vitae) Chronological 'resume', functional 'resume'.	11	25 %

Reference Books :

1. Practical English Usage, Michael Swan, OUP. 1995
2. Remedial English Grammar, F.T. Wood, Macmillan. 2007
3. Oxford Language Reference, (Indian Edition) OUP
4. On Writing Well, William Zinsser, Harper Resource Book. 2001
5. Communication Skills, Sanjay Kumar and Pushp Lata, Oxford University Press. 2011
6. The Study of Language, George Yule, CUP, 4th Edition. 2010
7. A Course in English Phonetics, T R Kansakar, Orient Longman. 1998
8. Spoken English, R K Bansal and J B Harrison, Orient Longman. 2013

Suggested Readings :

1. Repedex
2. Conversations books
3. Oral communication skill - calameo
4. Effective communication development

Online Resources :

1. https://youtu.be/MUGmEKrZXIY
2. https://youtu.be/srn5jgr9TZo
3. https://youtu.be/hE6I9apUvrk

Practical / Activities :

1. At the Airport
2. At the Railway station
3. Admission inquiry
4. At College
5. At Hotel
6. In Bank
7. In Grocery Shop
8. In Library
9. In Mall

Course Outcome:

CO1: Understand the basics of communication and its significance to the career as an engineer.

CO2: Comprehend and express any idea/thought in an effective manner using the four basic communication skills: Listening, Reading, Speaking, Writing (LSRW).

CO3: Make effective presentation, face job interview and participate in group communication fruitfully.

CO4: Handle various professional communication situations more impressively and effectively.

CO5: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	1	1	-	1	-	-	2	2	1	-	-	-
CO-2	1	1	-	-	-	1	1	1	1	1	-	1	-	-
CO-3	1	1	-	-	-	2	-	1	-	2	-	2	-	-
CO-4	-	-	-	1	-	-	1	2	1	-	1	1	-	-
CO-5	1	2	-	1	-	2	1	-	-	1	-	1	-	-

FEB110304: Elements of Electrical Engineering

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Element of Electrical Engineering	**Course code**	FEB110304
Course type:	Engineering Science	**Course credit:**	05

Course Objective: Students are expected to learn the fundamentals of electrical engineering that will help them apply these concepts in everyday life. The course is divided into two parts: DC Circuit and AC Circuit. The course also discusses three-phase supplies that are used in many commercial, industrial, and agricultural applications. Considering the widespread use of batteries, a special unit of batteries has been introduced.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage
I	**Introduction Of D.C. Circuits:** Introduction, Ohm's Law, Application of Kirchhoff's Law, Nodal Analysis, Mesh Analysis, Series-Parallel of Resistance, Ideal and Practical Energy Sources, Line Regulation and Load Regulation, Source Transformation, Star-Delta Transformation, Temperature Co-efficient **Batteries and Fuel Cell:** Introduction of Batteries; The Simple cell, E.M.F and internal resistance of a cell; Primary and Secondary cells, Cell capacity; Types & Specifications of Batteries; Charging & Discharging of Battery; Safe disposal of Batteries; Fuel cell: Principle & Types of fuel cell.	10	18 %
II	**Electrostatic &Capacitor:** Electric charge and Laws of electrostatics; Definitions - Electric field, lines of force, electric field intensity, electric flux and flux density; Electrostatic induction; Gauss's law and its application; Dielectric strength; Capacitor; Capacitor in series and parallel, Energy stored in a capacitor.	14	25 %

	Electro Magnetics: Faradays Laws; Lenz's Law; Fleming's Rules; Effect of magnetic field on current carrying conductor; Magnetic circuits; Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Inductance in series and parallel; Hysteresis and Eddy current losses; Energy stored in magnetic fields		
III	**Single Phase A.C. Circuits:** Generation of sinusoidal voltage, Definition of average value, root mean square value, form factor and peak factor; Phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, R-L, R-C and R-L-C circuits; Concepts of Real power, Reactive power, Apparent power and Power factor, Series, Parallel and Series - Parallel circuits; Power in AC circuit, Power factor improvement; Resonance in series and parallel circuits, Q-factor, Bandwidth and Selectivity. **Three Phase A.C. Circuits:** Necessity and Advantages of three phase systems, Generation of three phase power, Phase sequence, Balanced supply and Balanced load; Relationship between line and phase values of balanced three phase circuit; Power Measurement in balanced three phase circuits. Measure 3-Phase power bye watt-mater methods.	15	50 %
IV	**Electrical Wiring & Illumination:** Types of wires and cables; Types of Connectors & Switches; System of wiring, domestic and industrial wiring; Simple control circuit in domestic installation. Types of lamps, fixtures & reflectors; Illumination schemes for domestic, industrial & commercial premises; Lumen requirements for different categories **Safety & protection:** Safety precautions in handling electrical appliances; Electric shock, First aid for electric shock other hazards of electrical laboratories & safety rules; Grounding & Earthling - Importance of grounding and earthing, equipment for grounding, Methods of earthling; Circuit protection devices: Fuses, MCB, ELCB & Relays.	04	07 %

Reference Books:

1. B.L. Theraja (2012), Electrical Technology, Vol – 1, S. Chand.
2. D.P. Kothari and I.J. Magrath (2013), Theory and Problems in Basic Electrical Engineering, Prentice Hall, India.
3. Parker Smith (2003), Problems in Electrical Engineering, CBS Publishers

List of Practical / Activities:

1. To perform Ohms Law
2. To perform Kirchhoff's Law.
3. To study about different types of Fuel Cell and Battery
4. To perform R-L Series circuit
5. To study Resonance in AC-RLC series Circuit

6. To study about Star-Delta connection.
7. To study about power measurement using Two Watt-Meter Method.
8. To Study about MCB, ELCB and Fuse.
9. To study about different types of cable.

To study about different types of Fuel Cell and Battery.

Suggested Readings:

5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
6. Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press

Online Resources:

4. Preparation of videos for showing real life applications, Preparation of animations for understanding the concepts,
5. Preparation of Pictures with annotations to explain the concepts.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Understand electrical current, potential difference, power and energy, sources of electrical energy, resistance and its behavior with temperature.

CO-2: Use the Ohm's Law and the Kirchhoff's Law and star delta transformation for solving resistive series, parallel and series-parallel circuits.

CO-3: Define Electric field, lines of force, electric field intensity, electric flux, flux density and permittivity. Capacitor, charging and discharging phenomena of capacitors and calculations of capacitance for capacitors connected in series and parallel circuits.

CO-4: Understand Concepts of Real power, Reactive power, apparent power and Power factor and perform calculations of these quantities for series and parallel R-L-C circuits.

CO-5: Understand the importance of safety and the precaution to be taken while working with electrical equipment and accessories. Understand the working principle, usage and construction of circuit protection devices such as fuse, MCB, ELCB & Relays

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	-	2	3	-	-	-	1	-	-	1	-	3	1
CO-2	2	-	-	-	-	-	-	-	1	-	-	-	-	2
CO-3	1	1	-	-	1	-	-	-	-	-	-	-	2	1
CO-4	-	-	2	-	-	-	-	-	-	-	1	-	-	-
CO-5	2	-	-	-	-	1	-	-	-	-	-	-	1	1

FEB110005: PHYSICS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Physics	**Course code**	FEB110005
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

- To recall and remember basics of physics
- To understand the concepts of semiconductor material and its property. Also study the superconductivity of material.
- To apply theory on practical basis.
- To analyze the lows and to see how they use it.
- To solve the problems and make easy to our life.

.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage
I	**SEMICONDUCTORS** Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.	10	27%

II	**ELECTRONIC MATERIALS:** Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons	9	22%
III	**LIGHT SEMICONDUCTOR INTERACTION** Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.	6	17 %
IV	**Measurements** Four-point probe and Van Der Pauw measurements for carrier density, Resistivity and hall mobility, Hot-point probe measurement, capacitance-voltage, measurements, Parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis spectroscopy, absorption/transmission.	7	17 %
V	**Superconductivity** Introduction of Superconductivity, Properties of superconductor, Effect of magnetic field, Meissner effect, Pressure effect, Impurity effect, Isotopic mass effect, Mechanism of Superconductivity : BCS Theory, Penetration depth : Magnetic field, Josephson's junction and its application, Application of superconductors	6	17%

Reference Books:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford
5. University Press, New York (2007).

6. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
7. Engineering Physics by Dattu R Joshi, McGraw hill Publications.

Suggested Readings:

1. Online course: “Semiconductor Optoelectronics” by M R Shenoy on NPTE
2. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta On NPTEL

Online Resources:

1. The Flying Circus of Physics 2ndedition by Jearl Walker, Wiley India
2. Six Ideas that shaped physics by Thomas A Moore, Mc Graw Hilleducation
3. http://www.howstuffworks.com/--Tech stuff
4. How things works by Louis A Bloomfeild, Wiley Publications
5. Physics of Everyday Phenomena by W. Thomas Griffith, Juliet Brosing, McGraw Hill Education

List of Experiments:

1. To measure the dielectric constant of a material
2. To study the Hall-Effect.
3. To study the I-V Characteristic of Silicon diode.
4. To study the I-V Characteristic of Zener diode.
5. To study the I-V Characteristic of LED.
6. To determine the efficiency of given solar cell.
7. To measure the Resistivity & Band gap of Germanium Crystal (N-type) by Four Probe Method.
8. To measure the numerical aperture of optical fiber.
9. To Study of propagation& bending loss in optical fiber.
10. P-N Junction diode as Bridge Rectifier.
11. Energy gap of Semiconductor
12. Study of cathode ray oscilloscope
13. Time constant of an R-C circuit.
14. L-C-R Circuit.
15. Logic Gates

16. Virtual Laser Optics Lab

17.Virtual Solid-State Physics Lab

18. Virtual Harmonic Motion & Waves Lab

19.Virtual Optics Lab

20. Virtual Modern Physics Lab

21.Virtual Physical Sciences Lab

Course Outcomes: -

CO-1: The student will demonstrate the ability to think in core concept of their engineering application studying various topics involved in branch specific applications.

CO-2: The student will demonstrate understanding of basic theory, properties and applications of Superconductivity.

CO-3: The student will gain knowledge of basic theoretical and mathematical concept of electronic materials.

CO-4: The student will demonstrate understanding of basic principles, properties and applications associatedwith semiconducting materials.

CO-5: The student will demonstrate understanding of basic theory and properties associated with optoelectronic materials.

CO-6: The student will demonstrate understanding of basic principles, properties, type and application Lasers.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	1	1	-	-	-	-	-	-	1	-	-	-
CO-2	1	2	1	1	-	1	-	-	-	-	1	-	1	1
CO-3	-	1	1	1	1	-	1	-	1	1	-	1	-	-
CO-4	2	-	1	-	-	1	-	-	-	-	1	-	-	-
CO-5	1	2	-	1	1	1	-	-	-	1	-	-	1	-
CO-6	2	-	1	1	1	1	-	-	-	1	-	1	-	-

FEB110206: BASIC WORKSHOP

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	I

Course title:	Basic Workshop	**Course code**	FEB110206
Course type:	Engineering Science	**Course credit:**	03

Course Objective:

- To impart knowledge, with respect to concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions.
- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	0	0	100

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**Introduction:** Workshop layout, Importance of various sections/shops of workshop, Types of jobs done in each shop, General safety rules and work procedure in workshop	6	15
2	**Fitting:** Select appropriate fitting tools for the Required application, Prepare the simple jobs as per specification using fitting tools, Safety precautions	8	20
3	**Tin Smithy:** Demonstration of various tin smithy tools and sheet metal operations such as shearing, bending and joining, Preparation of tin smithy job, Safety precautions	6	15
4	**Carpentry:** Types, sketch, specification, material, applications and methods of using of carpentry tools-saws, planner, chisels, hammers, pallet, marking gauge, vice, try square, rule, etc, Types of woods and their applications, Types of carpentry hardwires and	8	20

	their uses, Demonstration of carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, etc, Preparation of wooden joints, Safety precautions.		
5	**Pipefitting:** Types, specification, material and applications of pipe fittings, Types, specifications, material, applications and demonstration of pipe fitting tools, Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling, etc, Preparation of pipe fitting jobs	6	15
6	**Metal joining:** 1Select appropriate equipment and consumables for required application, Prepare the simple jobs as per specification using proper metal joining and cutting method, Safety precautions	6	15

References Books: -

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
3. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
4. Principles and Practices of Management by L.M.Prasad
5. Principles of Management by Tripathy and Reddy
6. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

Course Outcomes:

CO-1: The course is intended to provide basic understanding of Economics and Management to engineering students with following aspects: To impart knowledge, with respect to concepts, principles and practical applications of Economics,

CO-2: Which govern the functioning of a firm/organization under different market conditions. To help the students to understand the fundamental concepts and principles of management

CO-3: basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing

CO-4: Understand major principles of economic analysis for decision making among alternative courses of action in engineering.

CO-5: Apply cost estimation and alternative analysis techniques for engineering applications.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*														
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**

CO-1	3	-	-	-	1	3	2	2	2	2	1	-	-	-	-
CO-2	3	2	-	1	-	1	-	1	2	-	-	3	-	-	-
CO-3	3	-	1	-	2	-	-	-	-	3	-	-	-	-	-
CO-4	3	-	2	-	1	-	3	1	1	-	-	2	-	-	-
CO-5	2	2	2	1	-	2	2	1	2	2	-	-	-	-	-
CO-6	2	2	2	1	-	-	1	1	-	1	-	-	-	-	-

FEB110007: INDUCTION PROGRAM

Initial Phase (First Day)

Following are the activities to be carried on the first day:

- Orientation Programme
- Know your Department/Institute
- Know your university
- Know hostel and other amenities
- Information about Student Diary and Induction Program

Regular phase (13 Days)

The Regular Phase consists of 13 days, each day is of 6 hours. It covers all the 8 different activity modules. For each module, the objectives, suggested activities and guidelines are provided herewith. Institute can use additional relevant activities in additional in suggested activities for each of the phases.

Module Name	Objectives	Suggested Activities
1.Physical Activity **(24 hours)**	1. Improve bone health 2. Improve 3. Understand the anatomy, basic biomechanical principles 4. Examine the effect of nutrition, rest and other lifestyle factors that contribute to the better health.	1. Running/Jogging 2. Brisk Walk 3. Cycling 4. Heavy yard work 5. Swimming 6. Yoga/Pranayam 7. Aerobics 8. Outdoor Sports/Indoor Games(In addition to cricket, Volleyball, Badminton, Chess, Carom, Table Tennis, Other games like Critical Thinking, Math skill developing Games, Memory Games can be included.) 9. Calculate Body mass index of each students and explain their fitness level from it. 10. Tree Plantation 11. Gardening

Guidelines:

- Half an hour Yoga/Pranayam followed by physical activities including various games.
- Refer this link for Yoga/Pranayam https://s3-ap-southeast-1.amazonaws.com/ministry- of-yoga/images/1528106718.pdf

Module Name	Objectives	Suggested Activities

2. Creative Arts **(12 hours)**	1. Develop creativity and imagination through a range of complex activities. 2. Improve the student's ability to control materials, tools and techniques. 3. Develop increasing confidence in the use of visual and tactile elements and materials.	1. Make a model of any physical object related to Engineering Design 2. Crafting 3. Painting 4. Sculpture 5. Pottery 6. Music 7. Dance

Guidelines:

- Use any activities leading to creative thing and practice.
- Show the video demonstrating the creative ideas and thinking.
- Show the video demonstrating phenomenon performance using innovation in different areas of humanity and social science.
- Demonstrate the story of leaders with the context of how with their creative vision, with all odds they achieved success.

Module Name	**Objectives**	**Suggested Activities**
3. Universal Human Values **(12 hours)**	1. Impart universal human values in students. 2. Enable students to live in harmony within themselves, with family, with society and the nature 3. Initiate the process of self exploration and self investigation within themselves about their understanding	1. Showing Motivational Movies. 2. Social Activities like visit of orphanage, old age home, blind peoples' school etc. 3. Swachchhata Mission Activities. 4. Awareness regarding environmental issues and remedies. 5. Spread awareness about blood donation, organ donation, precaution to avoid malaria in monsoon etc. 6. Discuss autobiography of legendary persons who practiced universal human values in their life and work. 7. Conduct universal human values group discussions.

Guidelines:

- Use the materials and activities covered in AICTE Guidelines. The faculties trained from institute will take leadership role to rollout it at institute level.

Module Name	Objectives	Suggested Activities
4. Literary **(12 hours)**	1. Inculcate the habit of active (or interactive) consumption of the best content available in literature. 2. Develop thinking skills. 3. Improve reading abilities and attitude.	1. Digital literacy and use of Internet 2. Basic Mathematics for Solving Real World Problems 3. Use of Scientific Calculator in Engineering 4. General Knowledge Quiz Competition 5. Vedic Mathematics 6. Reading/writing/speaking/listening 7. Debating/Elocution 8. Enacting a play 9. Book review

Guidelines:

- Use the video lectures to literate students in different skills needed for day-to-day life and need.
- Motivate students to create the nature of inquiry and reading habits.
- Arrange the various competitions like Elocution, Essay writing, Storytelling, Book reviews etc.
- Writing the review of the well known books, movies etc and sharing.

Module Name	Objectives	Suggested Activities
5. Proficiency modules **(6 hours)**	1. Determining English proficiency level of students and mentoring accordingly. 2. Learn the mining vocabulary, idioms, and expressionsand understand their meanings in context. 3. Develop ability to write a paragraph about general topics by using the English language correctly. 4. Realize the importance of English language as a global business language.	1. English general diagnostic test to determine student's English proficiency level. 2. Mentoring students to improve in English proficiency according to his/her proficiency level based on test.

Guidelines:

- An MCQ test of **45 minutes** should be conducted covering basic grammar and vocabulary.
- Group the students in three groups based on test result in three proficiency levels:
  - Unsatisfactory
  - Satisfactory
  - Good
- Following activities are to be used to uplift proficiency levels of students.
  - Motivational movies, documentary
  - Language games
  - Essay/story writing
  - Ice breaking games.
- Separate set of activities from suggested list should be used for different groups.

Module Name	Objectives	Suggested Activities
6. Lectures by Eminent people **(3 hours)**	1. Motivation through knowing experience of successful person. 2. Meet and interact with eminent personalities of different fields.	1. To conduct lecture by eminent people. 2. Interaction with leaders, experts, entrepreneurs, contributors and successful personalities

Guidelines:

- 3 expert lectures each of 1 hour per week.
- Multiple divisions can be combined in an expert lecture.
- External expert should be invited.
- Expert can be from academic, industry, research organization, social organization etc.
- An individual successful person in any of the field can be invited.
- The aspect to be addressed may be social / economical / engineering / entrepreneurship/ spiritual/ humanity science.

Module Name	Objectives	Suggested Activities

7. Visit to Local Area and Industry **(1 Full day)**	1. To familiarize students with the local area. 2. Sensitise with the different aspects of the life including social services and heritage	1. A full day visit covering at least 2 or 3 places. 2. List of possible places A. Centre of excellence B. Elite Academic Institutes C. Research institute D. Hospitals E. Industry visit D. Heritage places

Guideline and References:

- Institute can arrange visit to public, social or specifies places to give insight of the activities and overall socio-economic contribution of such places.
- The uniqueness or impact of such visits should be highlighted.

Module Name	Objectives	Suggested Activities
8. Innovation **(3 hours)**	1. Introduce the student about innovation in different fields 2. Make students aware about innovative and modern practices and products in their own branch 3. Create awareness about support available for start-up and innovation	1. Lectures by senior faculties. 2. Showing videos demonstrating innovation. 3. Introducing innovative technology/products. 4. Awareness regarding SSIP Scheme of Government of Gujarat 5. Awareness about Government initiatives in areas of innovations and supports for start- up, Incubation, Entrepreneurship etc.

Guideline:

- Video lectures from leaders and innovators.
- TeDx Talks.
- Government Policy documents for different schemes.

Closing Phase (Last Day)

The closing phase is the last day of the Induction Program and covering conclusion and summary of the Induction Program.

Conclusion and summary:

- Guiding students for preparation of student report about Induction Program.
- Instruct students regarding submission and examination of the Induction Program.
- Address by HODs/Senior faculties regarding branch/discipline and career option in respective branch.
- Introduce about the engineering and its importance in life and their responsibilities towards the society.

FEB120001: ENGINEERING MATHEMATICS – II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	II

Course title:	Engineering Mathematics – II	**Course code**	FEB120001
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

1. To develop logical understanding of the subject.
2. To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields.
3. To make aware students about the importance and symbiosis between Mathematics and Engineering.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	2	0	5	5	70	30	0	0	100

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	Vector Fields, Vector derivatives, Arc length, Curvature and Torsion, Gradient of Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	09	25%
2	Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier Integral transform, Fourier Cosine Integral and Fourier Sine Integral	10	25%

3	First order ordinary differential equations, Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	**06**	**10%**
4	Ordinary differential equations of higher orders, Second order linear homogeneous differential equations with variable coefficients, Cauchy-Euler equation, Existence and Uniqueness of solution, Linear Dependence and Independence of solution, Wronskian, Non homogeneous Ordinary differential equations, method of undetermined coefficient, method of variation of parameters	**11**	**25%**
5	Series solution of Ordinary differential equations, Power series solutions; Legendre's equation, Legendre polynomials, Frobenius method, Bessel functions of the first kind and their properties	**09**	**15%**

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley and Sons.
2. Peter O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
3. Dennis G. Zill, 4th edition, Advanced Engineering Mathematics, 4th Edition, Jones and Bartlett Publishers.
4. Maurice D. Weir, Joel Hass, Thomas' Calculus, Early Transcendental, 13e, Pearson, 2014.

Course Outcomes:-

After completion of the course, the students will be able to:

CO-1: To apply mathematical tools needed in evaluating vector calculus and their usage like Work, Circulation and Flux

CO-2: To apply the Laplace transform as tools which are used to solve differential equations and Fourier Integral representation

CO-3: To apply effective mathematical tools for the solutions of first order ordinary differential Equations

CO-4: To apply effective mathematical methods for the solutions of higher order ordinary Differential equations

CO-5: To implement the solution for engineering problem

CO-6: To use series solution methods and special functions like Bessel's' functions

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	1	-	-	-	-	1	1	-	-	-	-
CO-2	1	1	2	-	2	-	-	-	-	-	-	-	-	-
CO-3	1	-	-	2	-	-	-	-	1	-	-	1	-	-
CO-4	-	2	-	-	1	-	-	-	-	1	-	-	-	-
CO-5	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO-6	2	-	-	1	-	-	-	-	2	1	-	1	-	-

FEB120302: BASIC ELECTRONICS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	II

Course title:	Basic Electronics	**Course code**	FEB120302
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Understand the basic concepts and importance of electronics in various application.
- Learn about essential electronic components such as resistors, capacitors, inductors, diodes, and transistors
- Understand Kirchhoff's laws (Kirchhoff's current law and Kirchhoff's voltage law) and their application in circuit analysis.
- Solve simple circuits using Kirchhoff's laws.
- Understand the basics of impedance, phasors, and AC circuit behavior.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Sr. No.	Topic	Teaching Hrs.	Weightage (%)
1	**Circuit Concepts:** Electrical Quantities and Electrical Elements, Lumped Circuit and distributed circuit Elements**,** Kirchhoff's Laws**,** Meters and Measurements**,** Analogy between Electrical and other Non-Electrical Physical Systems**,** A case study. **Circuit Analysis Techniques:** Thevenin and Norton Equivalent Circuits, Reciprocity and Maximum Power Transfer Theorem, Node-Voltage and Mesh-Current Analysis, Superposition and Linearity, Star to Delta and Delta to Star Transformation, Computer Aided Circuit Analysis, A Case	**14**	**25**

	Study.		
2	**Analog Building Blocks and Operational Amplifiers Basic ideas:** The Amplifier Block, Ideal Operational Amplifier block diagram and its characteristics, Parameters of Operational Amplifiers, Applications of Operational Amplifiers, A case study. **Digital Building Blocks:** Digital System Building Blocks, Digital System Components, Computer Systems, Computer Networks, A case study	**16**	**30**
3	**Signal Processing:** Signals and Spectral Analysis, Modulation, Sampling and Multiplexing, Interference and Noise, A case Study **Communication Systems**: Waves, Transmission Lines, waveguides and Antenna, Fundamentals Analog Communication Systems, Digital Communication Systems, Optical Communication Systems, Satellite Communication Systems, Wireless Communication Systems, A Case Study	**14**	**25**
4	**Basic Control Systems:** Feedback Control Systems, Digital Control Systems, A Case Study	**6**	**20**

Text Books

1. U.A. Patel, “Elements of Electrical & Electronics Engineering”, Atul Prakashan
2. B.L.Thereja,”Electrical Technology “, S. Chand Volume-I
3. B.L.Thereja,”Electrical Technology “, S. Chand Volume-II.

Reference Books

1. V.N. Mittal,” Basic Electrical Engineering”, Tata Mc Graw hill, New Delhi.
2. V.K.Mehta,” Principles of Power Systems “, Pub. By Chand.
3. D.P. Kothari and I.J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
4. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
5. L.S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
6. V.D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

List of Suggested Experiments:

1. The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency. Following is the list of Practical’s.

Sr. No.	Practical/Exercise	Apprx. Hrs. Required
1	To study and perform practical on series connection of Resistance	2
2	To study and perform practical on Parallel connection of Resistance	2
3	To study and Perform Half wave Rectifier	2
4	To study and Perform Full wave Rectifier	2

5	To study and verify Reciprocity Theorem	2
6	To study and verify Maximum Power Transfer Theorem	2
7	To study about block diagram of Op-Amp	2
8	To study and perform inverting Op-Amp	2
9	To study and perform Non-inverting Op-Amp	2
10	To study about logic gates	2
11	To study and perform Half adder	2
12	To study and perform Full adder	2
13	To study and perform AM modulation and demodulation	2
14	To study and perform FM modulation and demodulation	2

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Understand & apply fundamental electrical laws and circuit theorems to electrical circuits.

CO-2: Analyse single phase and three phase AC circuits.

CO-3: Design simple combinational and sequential functions using gates and flip-flops.

CO-4: Comprehend electrical installations, their protection and personnel safety.

CO-5: Explain the organization of computer systems and computer networks:

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	-	1	-	-	-	-	-	-	-	1	-	-	1
CO-2	1	-	3	-	-	1	-	-	-	-	-	-	-	1
CO-3	1	2	-	1	1	-	-	-	-	-	-	-	1	-
CO-4	2	-	1	-	-	-	-	-	1	-	-	-	-	1
CO-5	1	2	1	-	-	-	-	-	-	-	-	-	2	1

FEB120403: COMPUTER PROGRAMMING WITH C

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	II

Course title:	Computer Programming With C	**Course code**	FEB120403
Course type:	Engineering Science	**Course credit:**	05

Course Objective

- An introduction to computer concepts, logic, and computer programming. The major objective is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types. The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Hours	Weightage
I	**Introduction to Computer and Programming:** Introduction, Architecture and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high level programming, Algorithms, Flowchart, Programming Languages, Types of Languages **C Fundamentals:** Features of C Language, Basic Structure of C Program, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Declaration of Storage Classes ,Operators and Expressions,	**10**	**20%**

	Managing Input and Output Operations		
II	**Control Structure in C:** Simple if Statement nested if, if-else, Nesting of if Else, The Else if Ladder, switch-case, Looping constructs: for, while, do-while, Nesting Looping , break and continue, goto statement. **Arrays and String:** One-dimensional arrays, Multi-dimensional arrays, String variables, Arithmetic Operations on Characters, Comparison of Strings, Table of Strings, String Storage, Built-in-string functions	**10**	**23%**
III	**Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing **Recursion:** Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort , Merge sort.	**9**	**22%**
IV	**Pointers:** Introduction, Understanding of pointers, Accessing the address of a variable, Declaring and initializing pointers, Accessing a variable through its pointers, Pointers expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and Character Strings, Pointers on pointers, Pointer as function argument, Functions returning pointer, Pointers to functions, Pointers and structures. **Dynamic Memory Allocation:** Introduction to Dynamic memory allocation, malloc, calloc and realloc	**8**	**19%**
V	Structure and Unions: Introduction, Structures definition, Giving values to members, Structure initialization, Comparison of structure variables, Arrays of structures, Arrays within structure, Structure and function, Unions, Size of structures, Bit fields. File Management: Introduction, Defining and opening a file, Closing a file, Input/output operations on files, Error handling during I/O operations, Random access to files, Command line arguments.	**8**	**16%**

Reference Books:

1. Programming in ANSI C by Balagurusamy, 7th Ed., Tata McGraw Hill
2. Programming with C, Second edition, by Gottfried, Tata McGraw-Hill Publishing
3. Company Limited.
4. Let Us C by YashvantKanetkar, 12th Ed., BPB Publication
5. Programming in C by Ashok N. Kamthane, 2nd Ed., Pearson Education
6. Let us C, Yashavant P. Kanetkar, BBP Publications, Delhi

7. "Computer programming", Pearson Education, 2007 by Ashok N. Kamthane.
8. Computer Concepts and Programming in C, R.S. Salaria, Khanna Publishing.

Course Outcome:

After learning the course the students should be able to:

CO-1: Understand the fundamentals and structure of a C programming language

CO-2: Apply the loops, arrays, functions and string concepts in C to solve the given problem

CO-3: Apply the pointers and text input output files concept to find the solution for the givenapplications.

CO-4: Use the Enumerated, Data types, Structures and Unions

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO-2	-	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	-	3	1	-	-	-	-	-	-	-	-	3	2	-
CO-4	1	3	-	-	-	-	-	-	-	-	-	-	2	-

FEB120204: ENGINEERING GRAPHICS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	II

Course title:	Engineering Graphics	**Course code**	FEB120204
Course type:	Engineering Science	**Course credit:**	05

Course Objective

- Engineering Graphics is the language of communication for Engineers. Engineering Graphics course provides tools and techniques of communication for various fields of Engineering.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
03	00	04	04	05	70	30	30	20	150

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**INTRODUCTION TO ENGINEERING GRAPHICS**: Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS-SP-46, Representative Fraction, Types of Scales (Plainand Diagonal Scale), Dimensioning Terms and Notations, Types of Arrowheads, Lines, Lettering, Numbering and Dimensioning.	03	5%
2	**ENGINEERING CURVES**: Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutes and Cycloids with Tangents and Normal.	05	10%

3	**PROJECTIONS OF POINTS AND STRAIGHT LINES**:- Introduction to principal planes of projections, Notation System- Points in First, Second, Third and Fourth quadrants, Projections of line Parallel to Two and Perpendicular to one of the principal planes, Line parallel to one and inclined to two principal planes, Line inclined to all the three principal planes, True length of the line and its inclination with the reference planes	06	15%
4	**PROJECTIONS OF PLANES**: Projections of various planes -Polygonal, Circular and Elliptical shape inclined to one of the Reference Plane and inclined to two Reference Planes; Concept of Auxiliary Plane of Projections.	06	10%
5	**PROJECTIONS OF SOLIDS AND SECTIONS OF SOLIDS**: Classifications of Solids, Projections of right and regular solids with their axis Parallel to Two and Perpendicular to one of the principal planes, axis parallel to one and inclined to two principal planes, axis inclined to all the three principal planes. Section of solids and the true shape of the section	07	15%
6	**DEVELOPMENT OF SURFACES**: Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	06	15%
7	**ORTHOGRAPHIC PROJECTIONS**: Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection method; Full Sectional Orthographic Views -Side and Front, Offset Cutting views.	05	15%
8	**ISOMETRIC VIEW/DRAWING AND ISOMETRIC PROJECTIONS**: Isometric Scale, Conversion of orthographic views into isometric projection, isometric view or drawing	04	15%

Reference Book:

1. "Manufacturing processes for engineering materials" Kalpakjian and Schmid, (5th Edition)-Pearson India, 2014.
2. "Materials and Processes in Manufacturing" (8th Edition), E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi (ISBN 0-02-978760).
3. "Manufacturing Science" A. Ghosh, and A. K. Mallik, Affiliated East-West Press Pvt. Ltd. New Delhi.

List of Suggested Practical: -

1. Introduction to Engineering Graphics
2. Drawing Sheet on Engineering Curves.
3. Drawing Sheet on Projections of Points and Lines.
4. Drawing Sheet on Projections of Planes.
5. Drawing Sheet on Projections of Solids and Sections of Solids.
6. Drawing Sheet on Development of Surfaces.
7. Drawing Sheet on Orthographic Projections.
8. Drawing Sheet on Isometric Projection/View or Drawing.

Suggested Book:

1. "Nontraditional Manufacturing Processes", G.F. Benedict, Marcel Dekker, Inc. New York (ISBN 0- 8247-7352-7
2. "Production Technology" - H.M.T. By HMT
3. "Tool Design" by Donaldson, Tata McGraw Hill Pub.
4. "Metal cutting Principles" by Trent McGraw Hill Pub

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1	To know and understand the conventions and the method of engineering drawing.
CO2	Identify the Drawing Symbols, Conventions used in Engineering Drawing
CO3	Construct the Different types of Engineering Curves.
CO4	To improve their visualization skills so that they can apply these skill in developing new products.
CO5	Apply Descriptive Geometry Principles to Solve Engineering Problems Involving Points, Lines, Planes and Solids
CO6	To improve their technical communication skill in the form of communicative drawings

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*														
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
CO-1	1	-	2	-	1	-	-	-	1	-	-	-	-	-	-
CO-2	1	2	2	-	1	-	-	-	-	1	-	-	-	-	-
CO-3	1	2	2	1	1	-	-	-	-	1	-	-	-	-	-

CO-4	2	2	1	1	-	1	-	-	-	-	-	-	-	-	-
CO-5	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO-6	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-

FEB120105: ENVIRONMENTAL SCIENCE

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	1st Year	**Semester:**	II

Course title:	Environmental Science	**Course code**	FEB120105
Course type:	Engineering Science	**Course credit:**	00

Course Objective

- To enable learn about Building Planning and Construction
- To enable learn about Transportation Engineering
- To enable about basic of Surveying

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
02	02	0	04	0	70	30	00	00	100

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	Introduction to Environment: Definition and Components of Environment, Relationship between the different components of Environment, Man and Environment relationship, Impact of technology on Environment, Environmental Degradation, Multidisciplinary nature of the Environment studies, its scope and importance in the present day Education System	02	08%

2	Ecology and Ecosystems: Introduction: Ecology- Objectives and Classification , Concept of an ecosystem- structure and functions of ecosystem Components of ecosystem- Producers, Consumers, Decomposers Bio-Geo- Chemical Cycles- Hydrologic Cycle, Carbon cycle, Energy Flow in Ecosystem, Food Chains, Food webs ,Ecological Pyramids Natural Resources: Renewable and Nonrenewable resources, exploitation and Conservation, Role of individual in conservation of natural resources.	**04**	**14%**
3	ENVIRONMENTAL POLLUTION: a) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of Water pollutants, Effects of water pollutants b) Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO 2 ,NO X , Auto exhaust, Effects of common air pollutants c) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects d) Solid Waste: Generation and management e) Bio-medical Waste: Generation and management f) E-waste: Generation and management	**12**	**42%**
4	GLOBAL ENVIRONMENTAL ISSUES: Sustainable Development, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint, Cleaner Development Mechanism (CDM), International Steps for Mitigating Global Change	**04**	**14%**
5	BASIC CONCEPT OF GREEN BUILDING AND SMART CITIES & CONCEPT OF 4R's Green Building: Introduction, Objectives, Fundamental Principles, Benefits of Green Building, Examples of Green Building Smart Cities: Concept, Principles, Application of 4R's	**06**	**22%**

References Books:-

1. Textbook of Environmental Studies for Undergraduate Courses by ErachBharucha Second Edition, 2013 Publisher: Universities Press (India) Private Ltd, Hyderabad.

2. Basics of Environmental Studies by Prof Dr N S Varandani ,2013 Publisher: LAP - Lambert
Academic Publishing, Germany
3. Environmental Studies by AninditaBasak ,2009 Publisher: Drling Kindersley(India)Pvt. Ltd
Pearson
4. Textbook of Environmental Studies by Deeksha Dave & S S Kateva ,Cengage Publishers.
5. Environmental Sciences by Daniel B Botkin& Edward A Keller Publisher: John Wiley & Sons.
6. Environmental Studies by R. Rajagopalan, Oxford University Press
7. Environmental Studies by Benny Joseph, TMH publishers
8. Environmental Studies by Dr. Suresh K Dhameja, 2007 Published by : S K Kataria& Sons New Delhi
9. Basics of Environmental Studies by U K Khare, 2011 Published by Tata McGraw Hill

List of Practical / Activities:

1. Introduction to Environment
2. Water Pollution
3. Air Pollution
4. Noise Pollution
5. Solid Waste
6. Bio-medical Waste
7. E-waste
8. Global Environmental Issues
9. Concept of Green Building
10. Concept of Smart Cities
11. Concept of 4R's

Course Outcomes:-

After completion of the course, the students will be able to:

CO-1: Identify the types of pollution in society along with their sources and have idea how to deal with them.

CO-2: Realize the global environmental issues.

CO-3: Conceptualize the principles of Green Buildings and Smart cities.

CO-4: Implement the concept of recycle and reuse in all fields of engineering.

CO-5: Student will understand Ecology and Ecosystem of nature.

CO-6: Understand Renewable and Nonrenewable resources and how to use & save them.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)														
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	2	-	2	3	2	1	1	2	2	-	-	-
CO-2	3	3	1	-	-	1	3	2	2	-	1	1	-	-	-
CO-3	3	2	2	1	1	1	3	2	-	-	2	2	-	-	-
CO-4	3	2	2	-	2	2	2	2	-	1	2	2	-	-	-
CO-5	3	-	-	-	-	1	3	1	-	-	1	1	3	-	-
CO-6	3	2	-	-	-	1	3	2	-	-	1	1	3	2	-

FEB130001: EFFECTIVE TECHNICAL COMMUNICATION

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Effective Technical Communication	**Course code**	FEB130001
Course type:	Engineering Science	**Course credit:**	03

Course Objective

- Technical communication is necessary because it can provide a more efficient working environment
- Develop an understanding of the target audience in technical communication
- Learn techniques for expressing technical information with clarity and precision.
- Learn how to structure technical documents logically, including introductions, main content, and conclusions

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus-

Unit	Description in detail	Teaching Hours	Weightage
I	**Dynamics of Communication:** Definition and process, Kinesics, Proxemics, Paralinguistic features, Importance of Interpersonal and Intercultural Communication in today's organizations	06	20%
II	**Technical Writing:** Report writing, technical proposal, technical description, Business letters(sales, order, complaint, adjustment, inquiry, recommendation, appreciation, apology, acknowledgement, cover letter), Agenda of meeting, Minutes of meeting , Resume writing **Technical Communication:**	14	45%

	Public speaking, Group discussion , Presentation strategies, Interview skills, Negotiation skills, Critical and Creative thinking in communication		
III	**Ethics in Engineering:** Scope of engineering ethics, Accepting and sharing responsibility, Responsible professionals and ethical corporations, resolving ethical dilemmas, Making moral choices.	04	12%
IV	**Etiquettes:** Telephone etiquettes, Etiquettes for foreign business trips, Visits of foreign counterparts, Etiquettes for small talks, respecting privacy Learning to say NO, Time management	05	16%
V	**Self-development and Assessment:** Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Asses, Think, Communicate, Relate, Dream.	03	07%

Reference Books :

1.Raman and Sharma, Technical Communications, OUP, New Delhi, 2017

2. Lata and Kumar, Communication Skills, OUP, New Delhi, 2018

3. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 2014

4. Mohapatra and Sreejesh S., Case Studies in Business Ethics and Corporate Governance,

Pearson, UP, 2013

5. Ramesh and Ramesh, The Ace of Soft Skills, Pearson, UP, 2019

6. Sherfield, Montgomery and Moody, Cornerstone: Developing Soft Skills, UP, 2009

Suggested Readings :

1. Repedex
2. Conversations books
3. Oral communication skill - calameo
4. Effective communication development

Online Resources :

6. https://youtu.be/MUGmEKrZXI
7. https://youtu.be/srn5jgr9TZo
8. https://youtu.be/hE6I9apUvrk

9. https://www.scu.edu/ethics/focus-areas/more-focus-areas/engineering-ethics/engineering-ethics-cases/

List of Practical / Activities:

1. Role Play
2. Letter writing: Formal
3. Group Discussion.
4. Presentations
5. Book Review(Preferably related to self-development)
6. Mock Interview.
7. Report writing
8. Case studies related to unit 4, 5 and 6
9. Conducting meetings and minutes of meeting
10. Practical assessment

Course Outcome:

CO-1: Define and discuss dynamics of Verbal and Non-Verbal aspects of Communication.

CO-2: Write various formal documents of technical and professional communication.

CO-3: Communicate in diverse formal situations taking place in organizations.

CO-4: Illustrate and examine the knowledge of ethical aspects of engineering.

CO-5: Demonstrate and explain social and professional etiquettes.

CO-6: Plan self-development and practice self-assessment.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	-	2	-	-	2	-	2	-	-	-	-	-
CO-2	-	-	1	2	-	1	-	1	-	2	1	1	-	-
CO-3	2	1	-	-	1	1	-	1	1	1	1	-	-	-
CO-4	-	1	2	-	-	1	1	2	2	1	1	1	-	-
CO-5	1	-	-	1	-	-	1	1	1	-	1	2	-	-
CO-6	1	1	1	-	1	1	-	-	2	2	-	2		

FEB130002: INDIAN CONSTITUTION

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Indian Constitution	**Course code**	FEB130002
Course type:	Engineering Science	**Course credit:**	00

Course Objective

- The main objectives of the Indian constitution include sovereignty, socialism, secularism, democracy, and republic.
- Learn how to structure technical documents logically, including introductions, main content, and conclusions
- Develop an understanding of the target audience in technical communication.
- Learn how to structure technical documents logically, including introductions, main content, and conclusions

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	0	2	0	50	00	00	00	50

Details Syllabus-

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	Meaning of the constitution law and constitutionalism, History of Indian Constitution, Salient features and characteristics of the Constitution of India Meaning of the constitution law and constitutionalism, Background, Timeline of Formation of IC, Constituent Assembly, Membership, Drafting, Provision of Preamble, Implementation, Structures – Parts, Schedules & Articles, Appendix, Influence of other constitution, Special characteristics	05	17%

2	Fundamental Rights, Right to Equality under Article –14, Right to certain Freedom under Article 19 History, Right to Freedom, Right to Equality, Right against Exploitation, Right to Freedom of Religion, Right to Education & Culture, Right to Constitutional Remedies, Background, Provisions given under the article, Case – studies, Background, Provisions given under the article, Case – studies	06	21%
3	Scope of the Right to Life and Personal Liberty under Article 21, Fundamental Duties and its legal status, The Directive Principles of State Policy – Its importance and Implementation Background, Provisions given under the article, Case – studies, Background, Article 51-A, Implementations, Case – studies, Background, Part 4, , Article – 36, 41, 43 Implementations, Article – 44, 45,48, 48A, 51, Implementations	05	18%
4	Federal structure and distribution of legislative and financial powers between the Union and the States (PART - I), Parliamentary Form of Government in India –The constitution powers and status of the President of India, Powers and Procedure for Amendments in Indian Constitution Political, Economic and Constitutional relations between the Union and States, Union List over the State List and the Concurrent List, History of Parliament, Houses of Parliament, Powers Article 53, Powers and Duties , Legislative, Executive, Judicial, Appointment, Financial, Diplomatic, Military, Pardoning, Emergency, Selection & Election Process, Background, Types, Procedure, Responsible Article	07	25%
5	History of amendments in Indian Constitutional, Emergency Provisions: National Emergency, President Rule, Financial Emergency, Local Self Government –Constitutional Scheme in India Key amendments in Indian constitution, Background, Types, Procedure, Responsible Article, Background, Brief History, GVK Rao Committee, Laming Committee, Timeline of Formation, Present scenario, Functions.	05	18%

Reference Books:

1. Constitutional Law of India, Dr. J.N. Pandey, Central Law Agency

2. Introduction to the Consitution of India, Durga Das Basu, LexisNexis.
3. Indian Constitutional Law, M.P. Jain, LexisNexis
4. V.N.Shukla's Constitution of India, Mahndra Pal Singh, Eastern Book Company
5. Constitutional Law – I Structure, Udai Raj Rai, Eastern Book Company

Course Outcomes:

After completion of the course, the students will be able to:

CO-1: Enhance human values, create awareness about law enactment and importance of Constitution.

CO-2: To Understand the Fundamental Rights and Fundamental Duties of the Indian Citizen to instil morality, social values, honesty, dignity of life and their social Responsibilities.

CO-3: Create Awareness of their Surroundings, Society, Social problems and their suitable solutions while keeping rights and duties of the citizen keeping in mind.

CO-4: Understand distribution of powers and functions of Local Self Government.

CO-5: Understand the National Emergency, Financial Emergency and their impact on Economy of the country.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	2	2	3	2	2	-	-	2	2	2	-	-
CO-2	3	-	-	-	-	1	-	-	-	-	1	1	-	-
CO-3	3	2	2	2	2	-	2	-	-	2	-	-	-	-
CO-4	3	-	-	2	-	2	-	-	-	2	-	-	-	-
CO-5	3	2	-	1	1	-	3	-	-	-	2	-	-	-

FEB130101: ENGINEERING MATHEMATICS – III

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Engineering Mathematics – III	**Course code**	FEB130101
Course type:	Engineering Science	**Course credit:**	03

Course Objective

- To develop logical understanding of the subject
- To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Engineering fields
- To make aware students about the importance and symbiosis between Mathematics and Engineering

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus-

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**Probability** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality, Continuous random variables and their properties,	10	22%

	distribution functions and densities, normal, exponential and gamma densities, Expectation of Discrete Random Variables		
2	**Bivariate Distributions** Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule	**04**	**08%**
3	**Statistics** Measures of Central tendency: Moments, skewness and Kurtosis, Probability distributions: Binomial, Poisson and Normal, evaluation of statistical parameters for these three distributions, Correlation and regression, Rank correlation, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves, Test of significance, Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations, Test for single mean, difference of means and correlation coefficients, test for ratio of Variances – Chi-square test for goodness of fit, independence of attributes	**14**	**30%**
4	**Numerical Methods** Solution of polynomial , transcendental equations, Bisection method, Newton-Raphson method , Regula-Falsi method, Finite differences, Interpolation using Newton's forward and backward difference formulae, Central difference interpolation, Gauss's forward and backward formulae, Numerical integration, Trapezoidal rule , Simpson's 1/3rd and 3/8 rules, Ordinary differential equations: Taylor's series, Euler and modified Euler's methods, Runge- Kutta method of fourth order for solving first and second order equations, Milne's and Adam's predicator-corrector methods, Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation	**16**	**35%**
5	**Partial Differential Equations** First order partial differential equations, solutions of	**02**	**05%**

	first order linear and non-linear PDEs		

Reference Book:

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover
   i. Publications, 1993.
4. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
5. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
6. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
7. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
8. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi
   i. Publications, Reprint, 2010.
10. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill,
   i. New Delhi, 2010.

Course Outcomes: -

After completion of the course, the students will be able to:

CO-1: solve algebraic equation related to electric engineering problem by using numerical methods and understand convergent of it

CO-2: find unknown value of given data by using various interpolation methods and curve fitting

CO-3: calculate integration and solve differential equations by using numerical methods

CO-4: understand the terminologies of basic probability and their probability functions and apply it in electrical problems

CO-5: understand the central tendency methods and apply it in electrical problems

CO-6: observe and analyze the behaviour of various discrete and continuous probability distributions

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2

CO-1	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO-2	3	2	2	1	2	2	2	-	2	1	1	-	-	-
CO-3	3	2	2	1	1	-	2	-	2	-	-	3	-	-
CO-4	3	2	2	1	1	-	3	-	2	1	-	-	-	-
CO-5	3	2	2	1	1	-	2	-	2	-	-	-	-	-
CO-6	3	2	1	1	1	-	2	-	2	2	-	-	-	-

FEB130302: ELECTRICAL CIRCUIT ANALYSIS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Electrical Circuit Analysis	**Course code**	FEB130302
Course type:	Engineering Science	**Course credit:**	05

Course Objective

- To familiarize the basic laws, source transformations, theorems and the methods of analyzing electrical circuits.
- To explain the use of network theorems and the concept of resonance.
- To familiarize the analysis of three-phase circuits, two port networks and networks with non- sinusoidal inputs.
- To explain the importance of initial conditions, their evaluation and transient analysis of R-L and R-C circuits.
- To impart basic knowledge on network analysis using Laplace transforms.

Teaching & Evaluation Scheme: -

Teaching Scheme				**Credits**	**Examination Marks**				**Total Marks**
					Theory		**Practical**		
Th	**Tu**	**P**	**Total**		**SEE (E)**	**PA (M)**	**Viva (V)**	**PA (I)**	
3	**1**	**2**	**6**	**5**	**70**	**30**	**30**	**20**	**150**

Details Syllabus-

Unit	**Description in detail**	**Teaching Hours**	**Weightage**

I	**Concepts of Circuits and Circuit Elements** E.M.F, Potential and Potential Difference, Network classification, Energy sources, V-I relations for R, L and C. Graphical analysis of Voltage, Current and Charge for passive elements, Dot convention, Two-terminal Capacitance – Two-terminal Inductance-Independent and Dependent Electrical Sources –Power and Energy Relations for Two-terminal Elements. Types of sources. **Basic Network Analysis methods**: Kirchhoff's laws (KVL & KCL), Branch current and mesh currents, Mesh analysis for independent, dependent and sinusoidal sources, Super mesh, Nodal analysis for independent, dependent and sinusoidal sources, Super node, Source transformation techniques, duality concept	11	18 %
II	**Solution of First and Second order networks** Solution of first and second order differential equations for Series and parallel R-L, R-C, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response. **Network Theorems Their Application in Electric Networks:-** Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegan's theorem, Analysis with dependent current and voltage sources, Node and Mesh analysis, Concept of duality and dual networks, Maximum Power Transfer Theorem - Millman's	12	40 %
III	**Electrical Circuit Analysis Using Laplace Transforms:-** Review of Laplace Transform, Analysis of electrical circuits using Laplace transform for standard inputs, Convolution integral, Inverse Laplace transform, transformed network with initial conditions, Concept of complex frequency, Transfer function representation, Poles and zeros, Frequency response (magnitude and phase Poles, Zeros and the s-plane-Classification of Responses – Computation of sinusoidal steady state response for stable networks and systems. **Two –Port Networks :** One port networks – Two port admittance Parameters (y parameters)– Admittance parameters analysis of terminated two- Port networks - Two port impedance Parameters (z-parameters) –Impedance and Gain calculations of terminated two- Port networks modeled by z-parameters – Hybrid parameters (h para)– Inverse Hybrid Parameters (g-para)- Transmission parameters (ABCD parameters)-Scattering parameters(S parameters)-Scattering Transfer parameters(T parameters) – reciprocity-Various Combinations of Two-Port network-Various Combinations of Two port n/w. .	12	30 %
IV	**Fourier Series and Signal Spectra: -** Discrete spectra and	6	12 %

	symmetry of waveform, exponential form of Fourier series, Fourier transform and continuous spectra, and steady state response of a network to non-sinusoidal periodic inputs **Initial Conditions: -** Initial Conditions in elements, Derivative interpretation, Initial condition evaluation		

Text Book

1. M. E. Van Valkenburg, "Network Analysis", PHI Learning Private Limited.
2. Sudhakar & Shyam Mohan S. P., "Circuits & Networks: Analysis & Synthesis", Tata McGraw Hill Education Private Limited

Reference Book

1. Samarjit Ghosh, "Network Theory: Analysis & Synthesis", PHI Learning Private Limited,
2. Network Analysis & Synthesis By Franklin S. KUO, Wiley Publication.
3. Electric Circuits and Networks: - By K. S. Suresh Kumar – Pearson Education.
4. Linear Circuits Analysis 2nd edition: -By DeCarlo/ Lin – Oxford University Press (Indian edition)
5. Engineering Circuit Analysis: - By W H Hayt, J E Kemmerly, S M Durbin 6th Edition TMH Publication
6. K. S. Suresh Kumar, "Electric Circuits & Networks", Pearson India Education.
7. William H. Hayt, Jack Kemmerly & Steven M. Durbin," Engineering Circuit Analysis", Tata McGraw Hill Education Private Limited. indices of D/A and A/D converters

List of Suggested Experiments: -

Exp. No.	List of Experiments
1	To Verify Kirchhoff's Voltage Law (KVL) and Kirchhoff's current Law (KCL).
2	To Verify Superposition theorem for Resistive Network.
3	To Verify Thevenin's Theorem for Resistive Network.
4	To Verify Norton's Theorem for Resistive Network.
5	To Verify Maximum Power Transfer Theorem for Resistive Network.
6	To Analysis Transient Response of a RL Circuit.
7	To Analysis Transient Response of a RC Circuit.

8 To measure and calculate Z-parameters for a given two-port system

9 To measure and calculate Y-parameters for a given two-port system.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Apply the knowledge of basic circuital laws and simplify the dc and ac networks using reduction techniques.

CO-2: Analyse the dc and ac circuits using mesh and nodal analysis and network simplification theorems. Analyse the series and parallel resonant circuits

CO-3: Infer and evaluate transient response, steady state response of series, parallel and compound circuits.

CO-4: Develop Laplace transformed network for steady state and transient analysis.

CO-5: Analyse dc and ac circuits and time domain response using Advance Tools like MATLAB, PSIM, etc.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	-	-	-	-	-	-	1	-	-	-	2	1
CO-2	1	2	-	-	-	-	-	-	-	-	1	-	1	2
CO-3	-	-	2	-	-	-	-	-	1	-	-	-	-	1
CO-4	1	-	-	-	-	-	-	-	-	-	2	1	2	1
CO-5	2	1	2	-	-	-	-	-	-	-	-	1	-	-

FEB130303: ANALOG & DIGITAL ELECTRONICS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Analog & Digital Electronics	**Course code**	FEB130303
Course type:	Engineering Science	**Course credit:**	05

Course Objective

- Design and analyze various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the basic principles of analog and digital electronics
- Comprehend fundamental electrical concepts such as voltage, current, resistance, and power.
- Understand the concept of feedback and its role in analog systems.
- Understand sequential logic circuits, including flip-flops and registers.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage

I	**Differential, multi-stage and operational amplifiers** Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product) **Linear applications of op-amp** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	10	18 %
II	**Nonlinear applications of op-amp** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. **Combinational Digital Circuits** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization	14	25 %
III	**Sequential circuits and systems** A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K-T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design usingflip flops, special counter IC's, asynchronous sequential counters, applications of counters.	28	50 %
IV	**A/D and D/A Converters** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs	04	07 %

Text Books:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education.
2. Albert Malvino & David, "Electronic Principles", Tata McGraw-Hill, Seventh edition

Reference Books:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, Fifth edition.
2. Jaccob Millman, Chritos Halkias, Chetan D Parikh, “Integrated Electronics”, Tata McGraw Hill,Second Edition.
3. Albert Malvino& David, “Problems and Solutions in Basic Electronics”, McGraw Hill Education.
4. Ramakant A Gayakwad, Op- Amps and Linear Integrated Circuits, Prentice Hall of India.
5. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
6. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
7. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

List of Suggested Practical:

1. To Study the different parameter of op-amp.
2. To analyze Frequency response of inverting amplifier and non-inverting amplifier.
3. To Study of op-amp as inverting amplifier and non-inverting amplifier.
4. OPAMP circuits –integrator, differentiator, and comparator.
5. Phase shift and Wein’s Bridge oscillator with amplitude stabilization using OPAMPs.
6. Waveform generation – Square, triangular and saw tooth wave form generation using OPAMPs.
7. Application of op-amp as low pass filter, high pass filter and band-pass filter.
8. Verification of function of Half/Full adder circuits.
9. Verification of function of Binary to Grey code conversion.
10. Verification of function of Latch and flip-flop.
11. 11 Verification of counter circuit like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12. Verification of Specification and Performance indices of D/A and A/D converters

Online Resources:

1. Preparation of videos for showing real life applications, Preparation of animations for understanding the concepts,
2. Preparation of Pictures with annotations to explain the concepts.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Students will able to describe the functioning and selection of OP-AMP as per application.

CO-2: Students will able to design and testing of OP-AMP based circuits.

CO-3: Students will be able to design and implement Combinational and Sequential logic circuits.

CO-4: Students will be able describe the process of Analog to Digital conversion and Digital to Analog conversion.

CO-5: Understanding to characteristics of different Analog and digital electronic devices.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	-	-	1	-	-	-	1	-	-	1	2	1
CO-2	1	-	3	-	1	-	-	-	1	-	-	-	-	2
CO-3	1	-	1	-	-	-	-	-	-	-	2	-	1	1
CO-4	-	1	2	-	-	-	-	-	-	-	1	-	1	-
CO-5	2	-	-	-	-	1	-	-	-	-	-	-	1	1

FEB130304: CONTROL SYSTEM ENGINEERING

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Control System Engineering	**Course code**	FEB130304
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Understand transfer functions and block diagrams for representing system dynamics.
- Understand the basic concepts and principles of control systems
- Learn to model dynamic systems and processes using differential equations.
- Analyze the stability, transient response, and steady-state response of control systems.
- Learn about proportional-integral-derivative (PID) controllers and other control strategies.
- Analyze system behavior in the frequency domain using Bode plots and Nyquist plots.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage
I	**Introduction Of Control Systems:** Introduction to Control Systems: Introduction, Brief History of Automatic Control, Examples of Control Systems, Comparison Between Closed Loop And Open Loop Control Systems. **Block Diagram Representation &Signal Flow Graphs: -** Mathematical Models of Systems: Differential Equations of Physical Systems, Linear Approximations of Physical Systems Basic definitions, advantages and disadvantages of block diagram, Block diagram reduction rules, Examples based on block diagram reduction techniques, Important definitions related to SFG, comparison of block diagram and SFG methods, Mason's gain Formula for SFG, Formation of SFG from	13	30 %

	equations and electrical networks.		
II	**Time Response Analysis:** Transient and steady state response, stability and sensitivity, various test signals, steady state error, First and Second order system analysis, Damping Ratio, Time Domain Specifications The Time Response and the State Transition Matrix. **System Stability Analysis: -** The Stability of Linear Feedback Systems: The Concept of Stability The Routh-Hurwitz Stability Criterion, The Relative Stability of Feedback Control Systems, The Stability of State Variable Systems.	15	30 %
III	**Root Locus**: Introduction, General Rules for Constructing Root Loci. Root-locus Technique. The Root Locus Procedure, Parameter Design by the Root Locus Method, Sensitivity and the Root Locus, Three-Term (PID) Controllers. Frequency Domain Analysis: - Bode Plot, Nyquist plot Mapping Contours in the s-Plane, The Nyquist Criterion, Relative Stability and the Nyquist Criterion, Time-Domain Performance Criteria in the Frequency Domain, System Bandwidth, The Stability of Control Systems with Time Delays	16	30 %
IV	The Design of Feedback Control Systems: Approaches to System Design, Cascade Compensation Networks, Phase-Lead Design Using the Bode Diagram, Phase-Lead Design Using the Root Locus, System Design Using Integration Networks.	5	10 %

Suggested Readings:

1. Control Systems by Ashfaq Hussain, Haroon Ashfaq, Dhanpat Rai& Co.
2. Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Oxford
3. University Press
4. Linear Control Systems by B.S.Manke, Khanna Publishers
5. Modern Control Engineering By Katsuhiko Ogata, 4th Edition, Prentice Hall of India

Reference Books:

1. Modern Control System by Richarc C. Drof and Robert H. Bishop,11th Edition Person Int.
2. Modern Control Engineering by Katsuhiko Ogata, 4th Edition, Prentice Hall of India.
3. Automatic Control Systems by Benjamin C.Kuo, 8th Edition, FaridGolnaraghi, John Wiley & Sons.
4. Control Systems Engineering by Nagrath and Gopal New Age Publication
5. Feedback and Control Systems by Joseph J Distefano 2nd Edition TMH
6. Feedback Control Systems by Dr. S.D. Bhide, R.A. Barapate, S. Satyanarayan, Tech-Max Publication, Pune.
7. Modern Control System Theory – by Dr. M. Gopal, New Age International Publishers, 2nd edition, 1996.

Online Resources:

1. Open-source Math Tools:

2. http://maxima.sourceforge.net/
3. http://www.sagemath.org/
4. http://www.scilab.org/

List of Practical / Activities:

1. To Analysis Open Loop Control system.
2. To Analysis feedback control system.
3. To give different applications of control system.
4. To Analysis response of Type "0" Control system.
5. To Analysis response of Type "1" Control system.
6. To Analysis response of Type "2" Control system.
7. To Analysis Test Signal Generator.
8. Introduction to MATLAB/SCILAB Tool.
9. To Simulate Root Locus using MATLAB/SCILAB.
10. To Simulate Bode Plot using MATLAB/SCILAB.
11. To Simulate Nyquist Plot using MATLAB/SCILAB.
12. Draw chart of any close loop control system.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Apply systems theory to complex real-world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations.

CO-2: Predict system behaviour based on the mathematical model of that system where the model may be expressed in time or frequency domain.

CO-3: Analyse the behaviour of closed loop systems using tools such as root locus, Routh Hurwitz, Bode, Nyquist, and MATLAB

CO-4: Design controllers using classical PID methods, root locus methods, and frequency domain methods.

CO-5: Devise a safe and effective method of investigating a system identification problem in the lab.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	-	2	-	-	1	-	-	-	-	-	1	1	2
CO-2	3	1	-	-	-	-	-	-	2	-	-	-	-	1
CO-3	-	-	1	-	2	-	-	-	-	-	1	-	1	-
CO-4	2	1	-	-	-	-	-	-	1	-	-	1	-	-
CO-5	1	2	-	-	-	1	-	-	-	-	2	-	-	2

FEB140001: ESSENCE OF INDIAN KNOWLEDGE TRADITION

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	III

Course title:	Essence Of Indian Knowledge Tradition	**Course code**	FEB140001
Course type:	Indian Traditional Core Courses	**Course credit:**	00

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
- Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
- The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	0	70	30	0	0	100

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	Basic Structure of Indian Knowledge System	24	60%
2	Modern Science and Indian Knowledge System.	06	15%
3	Yoga & Holistic Health care	06	15%

4	Case Studies	04	10%

References Books: -

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014

2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

3. Fritz of Capra, Tao of Physics

4. Fritz of Capra, The wave of Life

5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am

6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta

7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, VidyanidhiPrakasham, Delhi, 2016

8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, VidyanidhiPrakasham, Delhi, 2016

9. P R Sharma (English translation), ShodashangHridayam

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO-1: Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective

CO-2: Identify the concept of Traditional knowledge and its importance.

CO 3: Explain the need and importance of protecting traditional knowledge.

CO 4: Illustrate the various enactments related to the protection of traditional knowledge.

CO 5: Interpret the concepts of Intellectual property to protect the traditional knowledge.

CO 6: Explain the importance of Traditional knowledge in Agriculture and Medicine.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	3	3	3	3	3	3	3	3	3	3	3	-	-
CO-2	2	2	2	1	2	-	-	1	-	2	-	-	-	-
CO-3	2	3	-	1	1	-	2	-	-	2	-	-	-	-
CO-4	3	3	3	1	1	2	2	-	-	-	-	-	-	-
CO-5	2	2	2	2	2	-	-	-	-	2	-	-	-	-
CO-6	-	3	2	2	2	3	-	1	-	2	3	-	-	-

FEB140301: ELECTRICAL MACHINE-1

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	IV

Course title:	Electrical Machine-I	**Course code**	FEB140301
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

- Understand the basic principles and types of electrical machines
- Understand the concepts of magnetic circuits.
- Understand the operation of dc machines.
- Analyse the difference in operation of different dc machine configurations.
- Analyse the single phase and three phase transformers circuits.
- Understand the construction, working principles, and applications of transformers.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**Electromechanical Energy Conversion:** Principle, Singly Excited Magnetic System and Doubly Excited Magnetic system. Physical concept of torque production; Electromagnetic torque and Reluctance torque. Concept of General terms pertaining to Rotating Machines: Electrical & Mechanical degree, Pole pitch, Coil, Generated EMF in full pitched coil, Generated EMF in a short pitched Coil, EMF polygon, Distribution factor, Pitch factor. MMF produced by Distributed Windings, MMF of a coil, MMF of	8	15

	single phase distributed Winding, MMF waveform of Commutator machines.		
2	**D.C. Machines:** Working principle, construction and methods of excitation. Armature Winding: Introduction of simplex lap and wave windings.DC generators: EMF equation – methods of excitation – separately and self-excited – shunt, series, compound - armature reaction – effects of armature reaction - demagnetizing & cross magnetizing ampere-turns – compensating windings – inter poles - commutation – methods to improve commutation - voltage build-up – no load characteristics – load characteristics – losses and efficiency - power flow diagram –parallel operation – applications of DC generators.	14	30
3	**D.C. Motors:** Principle of operation – back EMF – classification – torque equation – losses and efficiency – power flow diagram – performance characteristics of shunt, series and compound motors – starting of DC motors – necessity and types of starters – design of starters – speed control – methods of speed control – solid state speed control (block diagram) – testing – Swinburne's test – Hopkinson's test – separation of losses – retardation test – field test of dc motors – application of DC motor.	7	15
4	**Transformers:** Principle, construction and operation of single phase transformers, phasor diagram, equivalent circuit, voltage regulation, losses and efficiency,Testing- Open & short circuit tests, Polarity test, Sumpner's test, Separation of hysteresis and eddy current losses,Autotransformers - Construction, Principle, Applications and Comparison with two winding transformer,Three phase Transformer: Construction, various types of connection and their comparative features, 3-phase transformer connections - Δ-Δ, Y-Y, Δ-Y, Y-Δ, V-V – vector groupings Yy0, Dd0, Yd1, Yd11, Dy1, Dy11, Scott connection – three winding transformer – tertiary winding – per unit impedance, Parallel operation of single phase and three phase transformers.Excitation phenomenon in transformers, Harmonics in single phase and three phase transformers, Tap changing Transformers - No load and on load tap changing of transformers, Cooling methods of transformers. Special Transformers: Potential transformer, Current transformer, Pulse transformer, Audio frequency transformer, Grounding transformer.	21	40

References Books:-

1. Nagrath I J and Kothari D P, Electric Machines, Tata McGraw Hill
2. Ghosh, Electrical Machine, Pearson Education
3. P.S. Bhimbra, Electrical Machinery, Khanna Publishers
4. Clayton & Hancock, Performance & Design of DC machines, ELBS
5. MG Say, Theory, Performance & Design of A.C. Machines, CBS Publishers.
6. rving L. and Kosow, Electric Machinery and Transformers, Prentice-Hall of India
7. George Mcphersion ,"An Introduction to Electrical Machines and Transformers", John Wiley &Sons, NY

List of Suggested Practical: -

1. To obtain Magnetizing Characteristics, Internal & External Characteristic of Self Excited DC Shunt Generator. Also obtain the critical filed resistance of the machine from magnetizing Characteristics.
2. To conduct direct load test on a D.C. Compound generator with a) Shunt field alone b) Cumulative and differential compounding for short and long shunt connections.
3. To obtain Speed-Torque characteristics of DC Series Motor and DC Shunt Motor.
4. To determine the efficiency of two similar shunt machines by regenerative method. (Hopkinson's Test.)
5. To perform filed test on D.C. series motor.
6. To determine the various losses in a D.C. machine and separation of its core losses.
7. To perform direct load test on a D.C. shunt motor and plot variation of (a) Input current (b) Speed(c) Torque (d) Efficiency versus output power.
8. To separate hysteresis and eddy current losses of a single phase transformer at rated voltage, frequency by conducting no load tests at different frequencies keeping V/f constant.
9. To operate two single phase transformers of different KVA ratings in parallel and plot the variation of currents shared by each transformer versus load current.
10. To conduct Sumpner test on two identical single phase transformers and determine their efficiency at various loads.
11. To conduct open circuit and short circuit test on a three phase three winding transformer and determine the equivalent circuit parameters.
12. To conduct Sumpner test on two identical single phase transformers and determine their

efficiency at various loads.

13. Speed control of DC Shunt Motor using a) Armature control and b) field control methods. Also perform Swinburne's test on DC Shunt Motor.

List of open-source software/ learning Website: -

Lab Work: The necessary no. of Kits, breadboard, equipment, accessories and instruments etc… to be provided to conduct the above practical in a group of max. 4 students

List of Open Source Software/learning website:

Open Source Software:

- LTSpice for circuit simulation,

Web-based tools for design:

- http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/
- http://www.ti.com/lsds/ti/analog/webench/overview.page

Circuit Lab:

- https://www.circuitlab.com/editor/

Open source Math Tools:

- http://maxima.sourceforge.net/
- http://www.sagemath.org/
- http://www.scilab.org/
- http://www.gnu.org/software/octave/

Learning website
- http://www.electrical-engineering-portal.com/
- http://nptel.iitm.ac.in/courses.php

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Understand working principle, performance, control and applications of DC Machines and Transformer.

CO-2: Carry out test and conduct performance experiments on DC machine and Transformer.

CO-3: To identify different part and function of DC machine and Transformer.

CO-4: To solve problems related to DC machine and Transformer.

CO-5: Understand various tests to be performed on transformers and induction machines to evaluate their performances.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	1	-	-	1	-	-	-	-	-	1	2	1
CO-2	1	2	-	1	-	-	-	-	1	-	1	-	1	-
CO-3	3	1	-	-	1	-	-	-	-	-	1	-	-	2
CO-4	2	-	1	-	-	-	-	-	-	-	-	1	-	1
CO-5	1	3	1	-	-	-	-	-	-	-	-	-	2	1

FEB140302: Electromagnetic Fields

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	IV

Course title:	Electromagnetic Fields	**Course code**	FEB140302
Course type:	Engineering Science	**Course credit:**	04

Course Objective:

- Understand the fundamental concepts of electromagnetism, including electric and magnetic fields, electric charges, and magnetic poles.
- Learn Maxwell's equations, which describe the behavior of electric and magnetic fields in space and time.
- Develop proficiency in vector analysis, as it is essential for understanding and solving electromagnetic field problems.
- Understand the behavior of magnetic fields in the absence of changing electric fields.
- Study the generation, propagation, and characteristics of electromagnetic waves.
- Develop skills in using numerical methods for solving complex electromagnetic field problems.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	1	0	4	4	70	30	30	20	150

Details Syllabus

Sr No.	Subject Content	Teaching Hours	Weightage (%)

1	**Vector Analysis** Scalars and Vectors, Vector Algebra, The rectangular co-ordinate system, Vector components and unit vectors, The vector field, The dot product, The cross product, Circular cylindrical co-ordinates, Spherical co-ordinate system **Coulomb's law and Electric Field Intensity** The experimental law of Coulomb, Electric field intensity, Field due to a continuous volume charge distribution, Field of a line charge, Field of a sheet charge. **Electric Flux Density, Gauss' law and Divergence Electric flux density,** Gauss' law, Application of Gauss' law: some symmetrical charge distributions, Application of Gauss' law to differential volume element, Divergence, Maxwell's first equation, The divergence theorem	11	28
2	**Energy and Potentia**l Energy expended in moving a point charge in electric field, The line integral, Definition of potential and potential difference, The potential field of a point charge, The potential field of a system of charges, Potential gradient, The dipole, Energy density in the electrostatic field **Current and Conductors** Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, Semiconductors. **Dielectrics and capacitance** The nature of dielectric materials, Boundary conditions for perfect dielectric materials, Capacitance, Several capacitance examples, Capacitance of a two wire line	10	25
3	**Poisson's and Laplace'sEquation** Derivation of Poisson's and Lapalce's equations, Uniqueness theorem, Example of the solution of Laplace's equation Example of solution of Poisson's equation **The Steady Magnetic Field** Biot Savart law, Ampere's circuital law, Curl, Stoke's theorem, Magnetic flux and magnetic flux density, The scalar and vector magnetic potentials, Derivation of steady magnetic field laws.	7	19

4	**Magnetic Forces,** Materials and Inductance Force on a moving charge, Force on a differential current element, Force between differential current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual inductance **Time Varying Fields and Maxwell's equation** Faraday's Law, Displacement current, Maxwell's equation in point form, Maxwell's equation in integral form **Effects of Electromagnetic Fields** Electromagnetic Interference and Compatibility (EMI/EMC), EMI Sources, Effects of EMI, Methods to eliminate EMI, EMC Standards, Advantages of EMC standards, Biological effects of EMI/EMR (Electromagnetic Interference, Electromagnetic radiation)	10	28

References Books: -

1. Engineering Electromagnetics by W.H. Hayt and J A Buck, Tata McGraw Hill Publications
2. Electromagnetic Field Theory and Transmission Lines by G.S.N. Raju, Pearson Education
3. Fundamentals of Electromagnetics by A.V. Mahatme, University Science Press
4. Elements of Electromagnetics by Matthew N.O. Sadiku, Oxford University Press
5. Electromagnetics with Applications by Kraus and Fleisch, Tata McGraw Hill Publications
6. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford University Press

List of open-source software/ learning Website: -

Numerical based on solving Engg. Electromagnetics problems using MATLAB for tutorials are available in CD accompanied with the book of "Fundamentals of Engineering Electromagnetic by Sunil Bhooshan" Matlab Experiments manual for Electromagnetic by Dr. M.H. Bakr

Active learning Assessment:-

Preparation of power-point slides: which may include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus can be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of faculty and the department.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: To differentiate different types of coordinate systems and use them for solving the problems of electromagnetic field theory.

CO-2: To describe static electric and magnetic fields, their behaviour in different media, associated laws, boundary conditions and electromagnetic potentials.

CO-3: To use integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory.

CO-4: To describe time varying fields, propagation of electromagnetic waves in different media, pointing theorem, their sources & effects and to apply the theory of electromagnetic waves in practical problems.

CO-5: To apply concepts of Wave reflection and refraction, Smith Chart in practical Field.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	-	2	3	-	-	-	1	-	-	1	-	3	1
CO-2	2	-	-	-	-	-	-	-	1	-	-	-	-	2
CO-3	1	1	-	-	1	-	-	-	-	-	-	-	2	1
CO-4	-	-	2	-	-	-	-	-	-	-	1	-	-	-
CO-5	2	-	-	-	-	1	-	-	-	-	-	-	1	1

FEB140304: POWER PLANT ENGINEERING

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	IV

Course title:	Power Plant Engineering	**Course code**	FEB140304
Course type:	Engineering Science	**Course credit:**	05

Course Objective:

- Understand the basic concepts and classifications of power plants
- Differentiate between various types of power generation systems
- Study the design and operation of steam generators, including boilers.
- Explore various prime movers used in power plants, including steam turbines, gas turbines, and internal combustion engines.
- Understand their roles in the overall power generation process.
- Develop skills in project planning and management for power plant construction and commissioning.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Details Syllabus

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Introduction:** Amount of generation of electric power from Conventional and non-conventional sources of energy in Gujarat and India and some developed countries of the world. **Steam power station:** Schematic arrangement, advantages and disadvantages, choice of site, efficiency of steam power station, Types of prime movers, Characteristic, speed control & auxiliaries. Environmental aspectsFor selecting the sites and locations of thermal power stations.**Hydro power station:**	**08**	20%

	Schematic arrangement, advantages and disadvantages, choice ofSite constituents of hydro power plant, Hydro turbine. Environmental aspects for selecting the sites and locations of hydro power stations		
2	**Nuclear power station:** Schematic arrangement, advantages and disadvantages, selection Of site, types of reactors, Hazards, Environmental aspects for selecting the sites and locations of nuclear power stations. **Gas turbine power plant:** Schematic arrangement, advantages and disadvantages of Gas Turbine power plant. Open cycle and Closed cycle gas turbine power plant, Combined cycle power plant, Comparison of various power plants **Diesel power station:** Introduction, Schematic arrangement, Advantages and disadvantages, Choice and characteristic of diesel engines, auxiliaries.	**09**	20%
3	**Power Generation by Non Conventional Energy Sources:** Introduction**:** Need of Renewable energy • Fossil fuel based systems • Impact of fossil fuel based systems • Non-conventional energy – seasonal variations and availability • Renewable energy – sources and features • Distributed energy systems and dispersed generation (DG) **Wind Power Conversion System:** • Introduction to wind energy • basic principles of wind energy conversion • forces on the blade • power in the wind – maximum power • wind energy conversion – wind data and (qualitative treatment only) energy estimation • Basic components of wind energy conversion systems • classifications of WECS-HAWT, VAWT, Geared wind • power plants (WPPs), direct-drive WPPs and Hybrid (semi geared) • WPPs • Schemes of electric generation • Squirrel Cage Induction Generators (SCIG), wound rotor • (WRIG), doubly-fed (DFIG), wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG) • Comparison/ advantages and disadvantages of WECS. • Site selection considerations. Numerical	**12**	30%
4	**Tariff and Economic aspects in power Generation:** Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak	**13**	30%

	load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, Tariffs, **Photovoltaic Power Conversion systems:** • Solar radiation spectrum. • Radiation measurement. • Applications of solar thermal systems **1.** Heating **2.** Cooling **3.** Drying **4.** Distillation **5.** Power generation • Solar Photovoltaic(SPV) systems 1. Operating principle 2. Photovoltaic cell concepts 3. Types of solar cells, fabrication of SPV cells 4. Cell, module, array (Series and parallel connections) 5. SPV system components and their characteristics, applications 6. Block diagram of general SPV system 7. Battery sizing and Array sizing • Applications of Solar Photovoltaic systems 1. Battery charging 2. Pumping 3. Lighting • Green Building (Solar – thermal, Solar – PV) 1. Sizing residential systems 2. Batteries and Inverters • Present Status of PV in India Governmental incentives, Numerical		

Reference Book

1. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S.
2. Bhatnagar, Dhanpat Rai Publication
3. Renewable Energy Technologies, Solanki, Chetan S. , PHI Learning, New Delhi, 2011
4. Wind Power Technology, Earnest, Joshua, PHI Learning, New Delhi, 2013
5. Renewable Energy Sources for Sustainable Development, N.S. Rathore and N. L. Panwar, New India Publishing Agency, New Delhi
6. Wind Power in Power System, Thomas Ackermann, John Willey &Sons, 2005
7. Renewable Energy Resources, J. Twidell and T. Weir, E & F N Spon Ltd, London, 1999
8. Electric Power Generation: Transmission and Distribution, S. N. Singh, PHI Learning, New
9. Electrical Power, Dr. S.L. Uppal

List of Suggested Experiments:

1. Interpret the line diagram of Thermal Power Station (T.P.S.) and main cycles & explain
2. Working of T. P. S.
3. Prepare technical report of visit to a nearby T.P.S./Prepare a report on thermal power Stations in Gujarat by collecting data from Internet
4. Study on load curve preparation and its interpretation.
5. Prepare technical report of visit to a nearby H.P.S./Prepare a report on Hydro power stations in Gujarat by collecting data from Internet.
6. Visit the website of MNRE/GEDA and prepare a report.
7. Draw and Interpret schematic diagram of gas based power plant
8. Study and working of various Equipments used in Diesel power plant/Diesel power plant
9. Study and working of various Equipments used in Nuclear power plant/Nuclear power plant
10. Study of Substation layout and equipments used in substations
11. Solar insolation measurement using Optical **pyranometer**
12. Solar cell/module/Array modelling, I-V char and performance analysis
13. PV module design and output analysis
14. Energy Conversion in Wind. (Prototype Wind Mill of 500W)
15. Case studies of Commercial/ Industrial/ Residential PV energy conservation systems and their economic analysis
16. Visit of Wind farm. Analysis of various aspects of wind farm
17. Study of Lead Acid Battery as a energy storage.
18. Wind power and annual energy estimation from wind data.
19. Pay back analysis, financial work sheet of a renewable energy project

List of Open Source Software/learning website:
MATLAB/Scilab

1. Solar cell/module/Array modelling and I-V curve
2. 2. Simulation of Battery charging/discharging

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Describe the working of thermal power station (TPS) using single line diagram and state the functions of the major equipment and auxiliaries of a TPS.

CO-2: Explain hydro energy conversion process with block diagrams and identify the appropriate site for it.

CO-3: Explain the working of nuclear power station.

CO-4: Describe the working of Diesel power station and Gas turbine power plant.

CO-5: Discuss the working principle and basic components of the hydroelectric plants and the economic principles and safety precautions involved with it.

Course Outcomes	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	1	-	-	-	-	-	-	-	1	-	1	2
CO-2	1	3	-	1	-	-	1	-	-	-	1	-	2	-
CO-3	2	1	2	-	1	-	-	-	-	1	-	-	-	1
CO-4	3	-	2	-	1	-	-	-	-	-	1	-	2	1
CO-5	2	1	1	-	1	1	-	-	1	-	1	-	1	1

FEB140305: POWER ELECTRONICS-I

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	2nd Year	**Semester:**	IV

Course title:	Power Electronics-I	**Course code**	FEB140305
Course type:	Engineering Science	**Course credit:**	05

Course Objective

- Understand the difference between signal level and power level devices.
- Understand the role and significance of power electronics in modern electrical systems.
- Analyze the characteristics and applications of these devices in power electronic circuits
- Explore different types of DC-DC converters, including buck, boost, and buck-boost converters.
- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

Content: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)

1	**Thyristor Fundamentals** Construction of SCR, Operating modes, Two transistor analogy, Static & dynamic characteristics, Gate characteristics, Turn on & turn off methods (Commutation methods), Series and Parallel operations of SCRs : Need, String efficiency, Issues, Static and Dynamic Equalizing circuit and Means to minimize the effect of mis-match Isolation of gate and base drive using pulse transformer and Opto-couplers Gate Drive/Triggering circuits: R trigger, RC trigger, Cosine Triggering, UJT and Programmable UJT as an oscillator and triggering circuit based on them Ratings, Cooling and Heat sinks, Thermal Modeling, di/dt and dv/dt protection, Design of Snubber Circuit, Over Voltage and Over Current protections, Gate protections, Electro Magnetic Interference(EMI) and Shielding. Introduction to Power Semiconductor Devices and Thyristor family Construction and Characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs) SCR, DIACs, TRIACs, Light Activated SCRs (LASCRs), Reverse Conducting Thyristor ,(RCT), Asymmetrical SCR (ASCR), Gate turn-off Thyristors (GTOs), Integrated Gate-Commutated Thyristors (IGCTs), MOS controlled Thyristors (MCTs), Power Integrated circuits (PICs), Intelligent Modules.	14	40
2	**Phase Controlled (AC to DC) Converters** Review of half-wave and full-wave diode rectifier (with RL load); Principle of phase controlled converter operation; Operation of 1-phase half wave converter with R, RL and RLE load; Significance of free-wheeling diode ;1-phase full wave converter : Center-tapped and Bridge Configuration; Operation and analysis with R,RL, RLE load; Analysis; Gating Requirements; Conversion (Rectification) and Inversion mode of operation; Operation and analysis of 1-phase Semi-converter/ Half-controlled converter: Asymmetric and Symmetric Configurations; 3-phase converters : Operation of half wave converter; Full wave fully controlled converters: Analysis and operation with different type of loads; Rectification and Inversion Mode; Semi-controlled converter; Dual Converter: Principle and operation; 1-phase and 3-phase configurations; Simultaneous and Non-simultaneous operation Effect of source and load inductances, Power factor improvement techniques, Applications of AC-DC converters	7	22

3	**DC to DC Converters** The chopper, Basic principle of DC chopper, Classification of DC choppers, Control strategies Basic DC-DC converter (switch regulator) topologies : Principle, operation and analysis for Step-down (Buck), Step-up (Boost), Step up/down (Buck-Boost), Continuous conduction and Discontinuous conduction operation Chopper configurations: Voltage Commutated, Current Commutated, Load Commutated Chopper Multi-phase chopper, Application of DC to DC Converter. **DC Drives with phase-controlled converters** Basic characteristics of DC motors, Two zone operation, Four quadrant operation (Operating modes), Principles of DC motor speed control Single phase separately excited drives: Half Wave converter, Semi-converter and Fully Controlled converter based drives; Braking operation of separately excited drive Single phase Series DC motor drive: Semi-converter and Fully Controlled converter based drives3-phase separately excited drives: Half Wave converter, Semi-converter and Fully Controlled converter based drives;	10	29
4	**DC drives with dc-dc converters** Principle of power control (motoring control) of separately excited and series motor with DC-DC Converter; Steady-state analysis Principle of Regenerative Braking; Chopper configuration for Regenerative braking; Analysis for minimum and maximum speed for Regenerative Braking; Combined regenerative and rheostatic brake control; Two and four quadrant DC-DC converter drives	4	9

References Books: -

1. M D Singh and K B Khanchandani, “Power electronics”, TMH, New Delhi, 2nded., 2007.
2. Muhammad H. Rashid, “Power Electronics -Circuits, Devices and Applications”, Prentice Hall of India, 3rd ed., 2003.
3. Vedam Subramanyam, “Power Electronics –Devices, Converters and Applications”, New Age International Publishers Pvt. Ltd., Bangalore, 2nded. 2006.
4. P.S. Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, 2012..
5. Ned Mohan, Undeland and Robbins, “Power Electronics –Converters, Applications and Design”, John Willey & sons, Inc., 3rd ed., 2003.
6. V.R.Moorthi, “Power Electronics”, Oxford University press, 2005.
7. G..K. Dubey, S.R. Doradla, A. Joshi, and R.M.K. Sinha, “Thyristorised Power Controllers”, New Age International Ltd. Publishers, 1986 (Reprint 2008).

List of Suggested Practical: -

1. To test different type of semiconductor devices with the help of data sheet, physical appearance and series.
1. Static and dynamic characteristics of an SCR.
2. Output characteristics and transfer characteristics of Power MOSFET.
3. R and RC triggering scheme and to determine the firing angle control range.
4. Principle of voltage commutation and current commutation to turn off an SCR.
5. Line synchronized UJT triggering and its use for firingthe SCRs of ac-dc converter
6. Use of Triac as a Fan regulator
7. Performance 1-Φ semi-converter & 1-Φ fully controlled (bridge) converter with R and RL load.
8. Time ratio control for regulating the output voltage of a step-down chopper
9. Time ratio control for regulating the output voltage of a step-up chopper
11. Performance of three phase fully controlled and half-controlled converter with R and R-L load
12. Speed control of DC separately excited motor with phase-controlled converter or DC-DC converter.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Understand basic concept of power electronics.

CO-2: Study the operation and characteristics of power electronics devices.

CO-3: Understand basic principle and working of AC to DC converter, DC to DC converters, DC to AC converters and AC to AC converters.

CO-4: Apply the knowledge of power electronic converter for speed control of DC motors.

CO-5: Explore various applications of power electronics converters

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	-	1	-	-	-	-	1	-	-	1	-	3	1
CO-2	3	1	-	-	2	-	-	-	-	-	2	-	1	2
CO-3	2	2	-	-	-	1	-	-	1	-	-	1	2	1
CO-4	2	1	-	1	-	-	-	-	-	-	1	-	1	-
CO-5	-	2	-	-	1	-	-	-	-	-	-	-	1	1

FEB150001: ENGINEERING ECONOMICS AND MANAGEMENT

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Engineering Economics & Management	**Course code**	FEB110304
Course type:	Engineering Science	**Course credit:**	03

Course Objective:

- Understand the fundamental principles of engineering economics
- Learn methods for analyzing and estimating costs associated with engineering projects.
- Analyze investment options, evaluate projects, and calculate financial metrics such as net present value (NPV) and internal rate of return (IRR).
- Understand the concept of time value of money and its impact on project economics
- Understand how to incorporate risk analysis into economic evaluations.

Teaching & Evaluation Scheme: -

Teaching Scheme				**Credits**	**Examination Marks**				**Total Marks**
					Theory		**Practical**		
Th	**Tu**	**P**	**Total**		**SEE (E)**	**PA (M)**	**Viva (V)**	**PA (I)**	
3	**0**	**0**	**3**	**3**	**70**	**30**	**0**	**0**	**100**

Details Syllabus

Sr. No.	**Topic**	**Teaching Hrs.**	**Weightage**
1	**Introduction to Economics;** Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics Theory of Demand & Supply; meaning, determinants, law of demand, law of supply, equilibrium between demand & supply Elasticity; elasticity of demand, price elasticity, income elasticity, cross elasticity **Theory of production;** production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital &	**08**	20%

	entrepreneur), Law of variable proportions & law of returns to scale Cost; meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. Break even analysis; meaning, explanation, numerical		
2	**Markets;** Meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income; meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal **Basic economic problems;** Poverty-meaning, absolute & relative poverty, causes, measures to reduce Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control **Money;** Meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools Banking; meaning, types, functions, Central Bank- RBI; its functions, concepts; CRR, bank rate, repo rate, reverse repo rate, SLR.	**13**	30 %
3	**Introduction to Management;** Definitions, Nature, scope Management & administration, skill, types and roles of managers Management Principles; Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory **Functions of Management;** Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance) Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization. **Introduction to Marketing management**; Marketing Mix, concepts of marketing, demand fore casting and methods, market segmentation Introduction to Finance Management; meaning, scope, sources, functions	**14**	33 %
4	**Introduction to Production Management;** Definitions, objectives, functions, plant layout-types & factors affecting it, plant location- factors affecting it. Introduction to Human Resource Management; definitions, objectives of manpower planning, **Corporate Social Responsibility;** meaning, importance Business Ethics; meaning, importance	**07**	17 %

Reference Books:

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
3. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
4. Principles and Practices of Management by L.M.Prasad
5. Principles of Management by Tripathy and Reddy.
6. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

List of Practical / Activities:

1. Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory.
2. The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered
3. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GGU.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: The course is intended to provide basic understanding of Economics and Management to engineering students with following aspects: To impart knowledge, with respect to concepts, principles and practical applications of Economics. Which govern the functioning of a firm/organization under different market conditions.

CO-2: To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.

CO-3: Identify the characteristics of various methods used for the generation of financial management decisions

CO-4: Develop and analyze information on investment planning and cost controls, and conduct cost/benefit analysis.

CO-5: Quantify and include elements of uncertainty and risk into an economic analysis.

Course Outcome	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*		

s	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	2	2	1	2	3	2	-	-	2	2	-	-
CO-2	1	2	2	2	1	1	2	2	-	-	3	2	-	-
CO-3	1	1	1	2	2	1	1	1	-	-	3	2	-	-
CO-4	1	1	-	2	2	-	1	1	-	1	2	1	-	-
CO-5	1	-	-	1	3	-	-	1	1	1	1	1	-	-

FEB150301: Electrical Machines- II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Electrical Machines- II	**Course code**	FEB150301
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Understand the basic concepts and classifications of electrical machines
- Differentiate between various types of electrical machines used for generation, conversion, and utilization of electrical energy.
- Explore the principles of operation and characteristics of AC machines.
- Study synchronous machines (generators and motors) and asynchronous machines (induction motors).
- Understand the role of automatic voltage regulators and current controllers

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus

Unit	Description in detail	Teaching Hours	Weightage
I	**Poly-phase Induction Motor:** Construction, Types of motor, working principle, Rotating magnetic field. Operating parameters at different load, No-load & blocked rotor test, Equivalent circuit, Phasor diagram, Circle diagram, Efficiency and slip scale with the help of circle diagram, Effect of rotor resistance on performance of motor, Double cage motor and its equivalent circuit, Introduction to machine dynamics. Starters of poly-phase induction motor including soft starter, Methods of speed control of 3- phase motor, Schematic diagram and advantages of Variable Voltage Variable Frequency drive. Electrical transients in induction	22	40 %

	machine, Magnetic levitation: Principle, advantages and application of linear induction motor. Effect of harmonics, Harmonic torques, Cogging & Crawling, Effect of unbalanced voltages on performance of motor. Performance of motor with variable voltage and frequency. Testing of induction motor as per IS, Energy efficient motors.		
II	**Single phase A. C. motors:** Double field revolving theory, Starting & running performance of 1-phase induction Motor, Equivalent circuit of 1phase induction motor, Types of single-phase motors, Principle and operation of split phase, Resistance start, Capacitor start and capacitor start & run induction motor, Shaded pole induction motor, Fractional horse power motors. **Induction Generator** Principle of operation and application, Its load and p. f. control	6	15 %
III	**Synchronous Machines:** Construction, Types, Applications, Working principle. Equation of induced emf with and without harmonics in MMF, pitch factor and distribution factor, MMF of distributed windings, Torque equation, Machine efficiency, Armature reaction and its compensation, Short circuit ratio, Effect of change in excitation, Effect of change in torque and speed, Voltage regulation, Determination of voltage regulation by Synchronous impedance method, MMF method, ZPF method and AIEE method, Synchronization: Importance and Methods of synchronization. Operating characteristic, Load angle and Power flow equations, Capability curves, Two reaction model of Salient pole machines, Parallel operation, Load sharing between parallel connected generators, Effect of unequal voltages & unequal percentage impedance, Governor characteristics, Introduction to single phase generators, Slip test for measurement of direct axis and quadrature axis reactance for salient pole machine, Sudden short circuit of Synchronous machine, Hunting of synchronous machines and its prevention. Methods of starting of synchronous motors, Different torques in Synchronous motor, Stability, Synchronous condenser, Synchronous phase modifiers, V-curves and O-curves of Synchronous motors, Auto Synchronous Motor: Construction, principle of operation, equivalent excitation current for various rotor connections, circle diagram.	20	40 %
IV	**Commutator motors:** Construction and working principle of Schrage motor, Universal motor and Repulsion motor.	3	5 %

Reference Books:

1. A K Theraja& B L Thereja, “A Text book of Electrical Technology (Vol II)”, S Chand & Co.

2. Bimbhra P. S., "Electrical Machinery", Khanna Pub., Delhi

Reference Books:

1. J B Gupta, Electrical Machines, S K Kataria Publications
2. I J Nagrath and D P Kothari, Electric Machines, Tata McGraw Hill
3. Ghosh, Electrical Machine, Pearson Education
4. Fitzgerald, Kingsley and Umans, "Electric Machinery", TMH, New Delhi
5. Ashfaq Husain, "Electric Machines", Dhanpat Rai and Co.
6. Nagrath and Kothari, "Electric Machines", TMH, New Delhi
7. Miller, T.J.E., "Brushless permanent magnet and reluctance motor drives", Oxford.
8. Say M. G,"The performance and design of alternating current machines", CBS Publishers
9. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons.

List of Practical / Activities:

1. To perform no load and blocked rotor test on a three-phase induction motor to find out its performance parameters with the help of (a) Equivalent circuit (b) Circle diagram
2. To perform direct load test on a three-phase induction motor to find out its performance parameters at different load conditions.
3. To study the construction of a three-phase induction motor with the help of a cut section model.
4. To study about the starters of three phase induction motors.
5. To study about the speed control methods for three phase induction motors.
6. To perform no load and blocked rotor test on single phase induction motor to obtain its equivalent circuit.
7. To study about the induction generator.
8. To perform the speed control and power factor control of a Schrage motor.
9. To perform open circuit, short circuit and resistance measurement tests on a synchronous generator (alternator) and to find out its voltage regulation by different methods. (a) Synchronous impedance method (b) MMF method (c) ZPF method (d) AIEE method
10. To obtain the direct axis and quadrature axis synchronous reactance of a salient pole machine with the slip test.
11. To perform the synchronization of two three phase alternators (or one alternator with grid) using different methods. (a) Lamps dark method (b) Two bright one dark method (c) Synchro scope
12. To obtain the V-curves of a synchronous motor

Online Resources:

1. Open-Source Software:
2. LTSpice for circuit simulation,
3. KiCAD for CAD application
4. Web-based tools for design:
5. http://www.fairchildsemi.com/support/design-tools/power-supply-webdesigner/

6. http://www.ti.com/lsds/ti/analog/webench/overview.page
7. Circuit Lab:
8. https://www.circuitlab.com/editor/
9. Open-source Math Tools:
10. http://maxima.sourceforge.net/
11. http://www.sagemath.org/
12. http://www.scilab.org/

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the construction, working principle, performance and applications of Poly-phase induction motor, single phase motors, synchronous generator (Alternator), synchronous motor and commutator motors.

CO-2: Carry out test and conduct performance experiments on above machines.

CO-3: To solve the numerical problems related to above machines.

CO-4: Understand the Application of Poly-phase induction motor, single phase motors, synchronous generator (Alternator), synchronous motor and commutator motors.

CO-5: Analyze and apply the concept of steady state analysis and electrical transients in polyphase machine

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	1	1	1	-	-	-	-	-	-	1	-	3	1
CO-2	2	2	-	-	1	-	-	-	2	-	-	1	-	2
CO-3	3	2	-	-	1	-	-	-	-	-	-	-	2	1
CO-4	1	1	2	-	-	1	-	-	-	-	1	-	1	-
CO-5	3	1	1	-	-	-	-	-	1	-	-	-	1	2

FEB150302: POWER ELECTRONICS-II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Power Electronics-II	**Course code**	FEB150302
Course type:	Engineering Science	**Course credit:**	04

Course Objective: -

- Understand the role of power electronics in modern electrical systems.
- Study various power semiconductor devices, such as diodes, thyristors, power MOSFETs, and IGBTs.
- Understand the operation and design of rectifiers (both controlled and uncontrolled) and inverters.
- Understand the control methods for improving power factor and regulating output voltage.
- Study AC-DC converters, including single-phase and three-phase rectifiers.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Evaluation Scheme				
					Internal		External		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	Total Marks
3	0	2	5	4	70	30	30	20	150

Details Syllabus

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1	**DC TO AC CONVERTERS: INVERTERS** Performance parameters of Inverters; Classification of Inverters: Voltage source inverters and Current source inverters; Single phase inverters: series, parallel and bridge type (Half wave and Full wave) inverters; Forced Commutated, Line commutated and Self-Controlled Switches based Inverters; Three phase bridge inverters: 180 degree conduction, 120 degree conduction and their comparison PWM Inverters: Principle of PWM control, PWM techniques classifications, Unipolar and Bipolar PWM, Effect of Switching frequency on Harmonic Spectrum, Sinusoidal PWM, Third harmonic PWM,	15	38%

	Selective Harmonic Elimination, Hysteresis band current control PWM, Space vector pulse width modulation technique, Comparison of PWM techniques, Voltage and frequency control of single phase and three-phase inverters, Harmonic Cancellation techniques Gating circuits for switches of inverter, Gate driver ICs having high side and low side reference output for driving switches of legs of inverters (like IR25604) Current Source Inverters: single phase and three phase ASCI and self-controlled switch based inverters; Comparison of Voltage and Current source Inverters.		
2	**AC VOLTAGE CONTROLLERS** Concept of On-Off or integral cycle control and Phase control; Various single phase full wave ac-ac controllers with R, L and RL load; Analysis for phase control and integral cycle control; Gating requirements; Sequence Control of AC regulators; 3-phase full wave converter configurations with Y and Δ connected loads and their analysis with R load; AC Voltage controller with PWM control; Basic principle of matrix converter **CYCLOCONVERTERS** Introduction; Basic Principle; Single to single-phase cycloconverters; Three-phase half-wave cycloconverters; Cycloconverters for three phase output; Output voltage equation; Output harmonics in cycloconverter; Comparison between cycloconverter and DC link Converter; Load Commutated cycloconverter	8	20%
3	**INDUCTION MOTOR DRIVES** Comparison of ac & dc drive; their selection for particular application; Review of Induction Motor fundamentals: Equivalent circuit, Characteristics, Basic Equations and speed control methods; motoring and braking (3 Hrs) Soft starting: Stator voltage control with AC voltage controller; Six-step VSI inverter-based drives; PWM-VSI drives; Braking and multi-quadrant operation of VSI drives; Cycloconverter based induction motor drive; Variable frequency control from a current source; Slip power control using Rotor resistance along-with chopper; Closed loop control schemes; Effect of non-sinusoidal wave form on AC machine performance; (6 Hrs)	9	18
4	**SYNCHRONOUS Motor Drives** Three phase synchronous motors; variable speed drives; variable frequency control; self-controlled synchronous motor drive employing load commutated thyristor inverter, self-controlled synchronous motor drive employing a cycloconverter.	3	8%

Reference Books:

1. M D Singh and K B Khanchandani, "Power electronics", TMH, New Delhi, 2nd ed., 2007.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2003.
3. Vedam Subramanyam, "Power Electronics – Devices, Converters and Applications", New Age International Publishers Pvt. Ltd., Bangalore, 2nd ed. 2006.
4. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 2012.
5. Ned Mohan, Undeland and Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
6. V.R.Moorthi, "Power Electronics", Oxford University press, 2005.

Suggested Readings:

1. IEEE research paper on Electrical Power Convertor
2. LTSpice for circuit simulation,
3. KiCAD for CAD application

Online Resources:

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php

List of Practical / Activities:

1. SCR based 1-phase ac voltage controller
2. SCR based 3-phase ac voltage controllers for (i) star connected load with neutral (ii) SCR based 3-phase ac voltage controller (star connected load without neutral)
3. SCR based 1-phase cycloconverter working on the principle of integral half cycle control.
4. SCR based 3-phase to 1- phase cycloconverter
5. Performance of 1-phase bridge inverter with R and R-L load
6. Harmonic spectrum of output voltage for unipolar and bipolar PWM controlled half-bridge and full bridge converter.

7. Performance of 3-phase bridge inverter operating with 120° and 180° conduction mode.
8. Simulation of SVPWM and its effectiveness over SPWM
9. Performance of V/F controlled induction motor drive
10. Closed loop speed control of Induction Motor using stator voltage control
11. Simulation of 1-phase bridge type cycloconverter in MATLAB

Coding for selective harmonic elimination technique

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.

CO-2: Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits

CO-3: Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

CO-4: Formulate and analyze a power electronic design at the system level and assess the performance

CO-5: Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.

CO-6: Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	-	1	-	-	-	-	-	-	-	2	1
CO-2	2	1	-	1	-	-	-	-	1	-	-	-	2	-
CO-3	2	2	1	-	-	1	-	-	-	-	-	-	1	2
CO-4	3	-	2	-	1	-	-	-	-	-	2	-	-	2
CO-5	1	2	1	-	-	-	-	-	1	-	-	-	1	1

FEB150303: MICROPROCESSORS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Microprocessors	**Course code**	FEB150303
Course type:	Engineering Science	**Course credit:**	04

Course Objective: -

- Understand the basic concepts of microprocessors and microcontroller systems
- Study the architecture and internal organization of microprocessors.
- Understand the functions of registers, ALU (Arithmetic Logic Unit), control unit, and other components
- Understand the format of instructions, addressing modes, and assembly language programming
- Learn the principles of interfacing microprocessors with input and output devices.
- Understand I/O ports, parallel and serial communication, and interrupt handling.

Teaching & Evaluation Scheme: -

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus

Unit	Description in detail	Teaching Hours	Weightage
I	Introduction to Microprocessor, Components of a Microprocessor: Registers, ALU and control & timing, System bus (data, address and control bus), Microprocessor systems with bus organization, Microprocessor Architecture and Operations, Memory, I/O devices, Memory and I/O operations	10	25 %

II	8085 Microprocessor Architecture, Address, Data and Control Buses, 8085 Pin Functions, Demultiplexing of Buses, Generation Of Control Signals, Instruction Cycle, Machine Cycles, T-States, Memory Interfacing	8	20 %
III	Assembly Language Programming Basics, Classification of Instructions, Addressing Modes, 8085 Instruction Set, Instruction and Data Formats, Writing, Assembling & Executing A Program, Debugging The Programs	8	20 %
IV	Writing 8085 assembly language programs with decision, making and looping using data transfer, arithmetic, logical and branch instructions	8	20 %
V	Stack & Subroutines, Developing Counters and Time Delay Routines, Code Conversion, BCD Arithmetic and 16-Bit Data operations	6	15 %

Text Books:

1. 8086 Programming and Advance Processor Architecture, Savaliya M. T., WileyIndia
2. The 8088 and 8086 Microprocessors, Triebel & Singh, Pearson Education

Reference Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh S. Gaonkar Pub: Penram International.
2. Microprocessors and Interfacing, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, S. K. Shah, Oxford
3. Advanced Microprocessors, Daniel Tabak, McGrawHill
4. Microprocessor & Interfacing - Douglas Hall, TMH
5. 8086 Programming and Advance Processor Architecture, Savaliya M. T., WileyIndia
6. The 8088 and 8086 Microprocessors, Triebel & Singh, Pearson Education

Online Resources:

1. Open-source simulator for 8085 processor
2. www.nptel.ac.in
3. www.intel.com
4. www.cpu-world.com

List of Practical / Activities:

Practical list should be prepared based on the content of the subject and following guidelines should be useful.

1. 8085 assembly language programmers covering all the instructions.
2. Interfacing practical's using I/O instructions
3. Following list gives some programming examples. Teacher can prepare their own list in same manner keeping above guidelines and syllabus in mind.
4. Write an 8085-assembly language program for exchanging two 8-bit numbers stored in memory locations 2050h and 2051h.
5. Write an 8085-assembly language program to add two 8-bit numbers stored in memory locations 2050h and 2051h. Store result in location 2052h.
6. Write an 8085-assembly language program to add two 16-bit numbers stored in memory.
7. Write an 8085-assembly language program to add two decimal numbers using DAA instruction.
8. Write an 8085-assembly language program to find the minimum from two 8-bit numbers.
9. Write an 8085-assembly language program to get the minimum from block of N 8-bit numbers.
10. Write an 8085-assembly language program to add block of 8-bit numbers.
11. Write an 8085-assembly language program to find the number of 1's binary representation of given 8-bit number.
12. Write an 8085-assembly language program to count the length of string ended with 0dh starting from location 2050h.
13. Write an 8085-assembly language program to covert given hex digit to its equivalent ASCII number.
14. Write an 8085-assembly language program to compute even parity and insert it as MSB in 8-bit number.
15. Write a subroutine to exchange two 8-bit numbers. Use it to reverse an array of 8-bit numbers.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: List and specify the various features of microprocessor, memory and I/O devices including concepts of system bus.

CO-2: Identify the various elements of 8085 microprocessor architecture, its bus organization including control signals.

CO-3: Describe the 8085 processor addressing modes, instruction classification and function of each instruction and write the assembly language programs using 8085 instructions.

CO-4: Explain the concepts of memory and I/O interfacing with 8085 processor with Programmable devices.

CO-5: List and describe the features of advance microprocessors.

CO-6: Understand the real time application of microprocessors

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	-	-	-	-	-	2	-	-	-	2	1
CO-2	2	2	-	-	1	-	-	-	-	-	-	-	2	2
CO-3	3	2	1	-	1	-	-	-	1	-	-	1	2	1
CO-4	2	3	2	1	-	-	-	-	-	-	-	-	2	1
CO-5	3	-	1	-	-	-	-	-	1	-	-	-	-	1

FEB150304: ELEMENTS OF ELECTRICAL DESIGN

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Elements Of Electrical Design	**Course code**	FEB150304
Course type:	Engineering Science	**Course credit:**	03

Course Objective

- Understand the fundamental concepts and principles of electrical design
- Introduce the importance of electrical design in various engineering applications.
- Familiarize students with electrical codes and standards applicable to their region.
- Learn methods for estimating electrical loads in different types of installations.
- Understand the conventions used in electrical documentation.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus

Sr. No.	Topic	Teaching Hrs.	Weightage
1	**GENERAL DESIGN ASPECTS:** Basic principles of magnetic circuits – use of B-H curves in magnetic circuit; Calculations of MMF for air gap and teeth; Real and apparent flux density; Field Form; Air gap flux distribution factor (field form factor); Magnetising current calculation; Leakage Reactance calculation for various types of slots, Iron loss calculation concepts; Insulating Materials & Classifications.	**06**	20%

2.	**DESIGN OF STARTERS AND FIELD REGULATORS:** Introduction and review of A.C. and D.C. starters; Schematic diagrams of control circuit and power circuit for starters with contactors and timers. Design of starters and Field regulators. **DESIGN OF SMALL TRANSFORMERS AND CHOKE COILS:** Design of Small single-phase transformers; Design of variable air gap single phase and three phase choke coil; Design of ballast	**06**	20%
3	**ARMATURE WINDINGS:** **DC WINDINGS:** Simplex & Duplex windings; Lap & Wave windings; Applications; Basic terms related to armature windings; Dummy Coils; Equalizer connections; Split coils. **AC WINDINGS:** Introduction; No. of phases; Phase spread; Concentric winding, Hemitropic winding; Whole coil winding; Mush winding; Double layer windings; Integral slot lap and wave winding; Fractional slot lap and wave windings; Performance analysis of various windings	**08**	20%
4	**ESTIMATION AND COSTING FOR RESIDENTIAL AND COMMERCIAL WIRING:** Preparation of schematic diagrams and estimation of cost of wiring for Tenements, Row houses, Bungalows, Flats, Multi – Storied Buildings, Commercial Complexes like Offices, Hospitals, Hotels and Theatres. **DESIGN CONSIDERATION OF ELECTRICAL INSTALLATION:** Types of load, Electrical Supply Systems, Wiring systems, Load Assessment, Permissible voltage drops & Conductor size calculations, Design of Control panel. Estimation and costing for service connections.	**11**	40 %

Text Books:

1. K. Sawhney, “Electrical Machine Design”, Dhanpatrai & sons. Pub.
2. K. B. Raina & S. K. Bhattacharya, “Electrical Design, Estimating & Costing”, New Age International Publication

Reference Books:

1. N. Alagappan & S. Ekambaram, “Electrical estimating &costing “, Tata McGraw hill Ltd

2. Surjit Singh, "Electrical Estimating & Costing", Dhanpat Rai & sons
3. S. K. Sen, "Electrical Machine Design", Oxford Publications
4. Miller, T.J.E., "Brushless permanent magnet and reluctance motor drives", Oxford
5. Say M. G,"The performance and design of alternating current machines", CBS Publishers

List Of Practical / Activities:

1. During the laboratory hours, the design problems based on the syllabus should be assigned to the students..
2. After carrying out the detailed design, drawing sketches and winding diagrams should be prepared by the students.
3. Minimum five drawing sheets must be prepared and evaluated at the end of the term.

Online Resources:

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Explain the basic concepts related to design of electrical equipment.

CO-2: Understand the analysis of starters, field regulators, small transformers and choke coils.

CO-3: Design the starters, field regulators, small transformers and choke coils.

CO-4: Understand design expect of electrical installation

CO-5: Draw and explain the winding diagrams for AC and DC machines.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	3	1	-	1	-	-	-	-	-	-	-	2	2
CO-2	3	1	1	-	1	-	-	-	-	-	-	-	2	1
CO-3	2	1	3	-	-	1	-	-	-	-	-	-	1	2
CO-4	3	1	2	1	-	-	1	-	-	-	-	-	2	1
CO-5	3	1	3	-	-	-	-	-	-	-	-	-	1	2

FEB150305: Electrical Power System-I

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	V

Course title:	Electrical Power System-I	**Course code**	FEB150305
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Understand the concepts of power systems
- Understand the various power system components.
- Understand the basic concepts and components of electrical power systems.
- Introduce the importance of power systems in the generation, transmission, and distribution of electrical energy.
- Explore different types of power plants, including thermal, hydroelectric, nuclear, and renewable energy sources.
- Understand the functions and characteristics of each component.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus

Unit	Description in detail	Credit	Weightage
I	**Supply Systems:** Electric supply system, Typical AC power supply scheme, Comparison of DC and AC transmission, Advantages of high transmission voltage, Various systems of power transmission, Comparison of conductor material in the	12	30%

	overhead system, Comparison of conductor material in the underground system, Comparison of various systems of transmission, Elements of a transmission line, Economics of power transmission, Economical choice of conductor size, Economical choice of transmission voltage, Requirement of satisfactory electric supply. **Mechanical Design of Transmission Lines:** Main components of overhead lines, Conductor materials, Line supports, Insulators, Types of insulators, Potential distribution over suspension insulators, String efficiency, Methods of improving string efficiency, Sag in overhead lines, and sag calculations.		
II	**Inductance and Resistance of Transmission Line:** Introduction, Definition of inductance, Flux linkages of an isolated current carrying conductor, Inductance of a single phase two wire line, Conductor types, Flux linkages of one conductor in the group, Inductance of composite conductor lines, Inductance of three phase lines, Double circuit three phase lines, Bundled conductors, Resistance, Skin effect and proximity effect, Magnetic field induction. **Capacitance of Transmission Lines:** Introduction, Electric field of a long straight conductor, Potential difference between two conductors of a group of parallel conductors, Capacitance of a two-wire line, Capacitance of 3-phase line with equilateral spacing, Capacitance of a 3-phase line with unsymmetrical spacing, Effect of earth on transmission line capacitance, Method of GMD, Bundled conductors, Electrostatic induction.	14	35%
III	**DC and AC Distribution:** Distribution system, Classification of the distribution system, AC distribution, DC distribution, Connection scheme of the distribution system, Types of DC distributors, DC distribution calculations, DC distributor fed at one end, Uniformly loaded distributor fed at one end, Distributor fed at both ends, Distributor with both concentrated and uniform loading, Ring distributor, Ring main distributors with interconnector, AC distribution calculations, Methods of solving AC distribution problems, 3-phase unbalanced loads, 4-wire star-connected unbalanced load, Ground detectors.	6	15%
IV	**Representation of Power System Components:** Introduction, Single phase representation of balanced 3-phase networks, The one-line diagram, and impedance or reactance diagram, Per unit system, Advantages of per unit system, Per unit representation of a transformer, Per unit impedance diagram of a power system, Complex power, The steady-state model of synchronous machine, Power factor and power control, Salient pole synchronous generator, Loading capability diagram, Power transformer, Transmission of electric power, System protection, Representation	9	10%

	of load. **Underground Cables:** Underground cables, Construction of cables, Classifications of cables, Cables for 3-phase service, Insulation resistance of a single core cable, Capacitance of a single core cable, Dielectric stresses in a single core cable, Most economical conductor size in a cable, Grading of cables, Capacitance grading and inter sheath grading, Capacitance of 3-core cable and measurement of capacitance.		

Reference Books:

1. Modern Power System Analysis by **D. P. Kothari** and **I. J. Nagrath**: Fourth Edition: McGraw Hill [3,4,6]
2. Principles of Power System by **V.K. Mehta** and **Rohit Mehta**: Reprint 2014: S. Chand [1,2,5,7]
3. Power System Analysis: **John J. Grainger** and **W. D. Stevenson** Jr. Tata McGraw-Hill International
4. Power System Analysis: **C. L. Wadhwa**, 5th Edition, New Age International Publishers
5. Soni, Gupta, Bhatnagar & Chkraborty, "A Course In Electrical Power", Dhanpat Rai Publication
6. J. B. Gupta, "Electrical Power", S. K. Kataria Publication

Online Resources:

1. https://en.wikipedia.org/wiki/Electric_power_system
2. https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems

List of Practical / Activities:

1. Understand the basics of the power system.
2. Model & representation of system components used in power system.
3. Understand the use of cables in the distribution network.
4. Understand the concept of mechanical designing transmission line parameters.
5. To study the electrical supply system of India.
6. To make a case study about the distribution system of India.

Extra Activities:

1. Survey of generation scenario and power plants of Gujarat.
2. Survey different types of power plants in India to observe the power and energy supplied by them daily, their rates of energy, daily schedule, etc.

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Ability to design and analyse the real time electrical transmission system with respect to various electrical parameters considering environmental and economic obligations

CO-2: Develop the ability to implement the appropriate safety equipment's for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.

CO-3: Ability to implement the knowledge of basic mathematical, physical and electrical principles to formulate significant electrical hazards.

CO-4: Perform power flow analysis to determine the steady-state operating conditions of a power system.

CO-5: Understand the fundamental concepts and principles of electrical power systems, including generation, transmission, and distribution.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	1	-	-	-	-	-	-	1	-	-	-	2
CO-2	3	2	1	-	-	-	-	-	1	1	-	-	2	1
CO-3	2	3	1	-	1	-	-	-	-	-	-	1	1	2
CO-4	3	1	1	1	-	-	-	-	-	-	1	-	2	1
CO-5	2	1	2	-	1	-	-	-	-	-	-	-	1	2

FEB160301: ELECTRICAL POWER SYSTEM – II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	Electrical Power System-II	**Course code**	FEB160301
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Explore the concepts of per-unit system and its application in power system
- Acquire the basic knowledge of distribution systems.
- Understand the stability of power systems and factors affecting system stability.
- Study load flow analysis to determine the steady-state operating conditions of a power system.
- Understand methods for assessing and improving system reliability.
- Describe the principles of automatic generation control (AGC) and voltage control in power systems.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus

Unit	Description in detail	Teaching Hours	Weightage

I	**Current and Voltage Relations on a Transmission Line:** Representation of line, The short transmission line, The medium-length line, The long transmission line: Solution of the differential equations, The long transmission line: Interpretation of the equations, The long transmission line: Hyperbolic form of the differential equations, The equivalent circuit of a long line, Power flow through a transmission line (Circle diagrams), and Reactive compensation of transmission lines.	**08**	15 %
II	**Symmetrical Three-Phase Faults:** Transients in RL Series circuits, Short-Circuit currents and the reactance's of Synchronous machines, Internal voltages of loaded machines under transient conditions, The bus Impedance matrix in fault calculations, A bus impedance matrix Equivalent network, The selection of circuit breakers. **Symmetrical Components:** Synthesis of Unsymmetrical phasors from their symmetrical components, The symmetrical components of unsymmetrical phasors, Phase shift of symmetrical components in Star Delta Transformer Banks [2], Power in terms of symmetrical components, Sequence circuits of Y and Δ impedances, Sequence circuits of a symmetrical transmission line, Sequence circuits of the synchronous machine, Sequence circuits of a Y- Δ transformer, Unsymmetrical series impedances, Sequence networks	16	35 %
III	**Unsymmetrical Faults:** Single line to ground fault on an unloaded generator, Line to Line fault on an unloaded generator, Double Line to Ground fault on an unloaded generator, Unsymmetrical faults on power systems, Single line to Ground fault on a power system, Line to Line fault on a power system, Double Line to Ground fault on a power system, Interpretation of the interconnected sequence networks, Analysis of unsymmetrical faults using the bus impedance matrix, Faults through impedance, Computer calculations of fault currents	8	20 %
IV	**Transients in Power Systems:** Transients in Simple Circuits, 3-phase Sudden Short Circuit of an Alternator, The Restriking Voltage after Removal of Short Circuit, Travelling Waves on Transmission Lines, Attenuation of Travelling Waves, Capacitance Switching, Overvoltage due to Arcing Ground. **Corona:** Critical Disruptive Voltage, Corona Loss, Line Design based on Corona, Disadvantages of Corona, Radio Interference, Inductive interference between Power and Communication lines.	12	30 %

Text Books: -

1. V. K. Mehta, "Electrical Power System", S. Chand Publication.
2. Nagrath & Kothari, "Power System Engineering", TMH publishing Company Ltd.

Reference Books:

1. Power System Analysis: John J. Grainger, William D. Stevenson Jr., Tata McGraw Hill [1, 2, 3]
2. Elements of Power Systems Analysis: W. D. Stevenson Jr., 4th Edition, McGraw Hill International. [4]
3. Electrical Power systems: C. L .Wadhwa, 5th Edition, New Age International Publishers. [5, 6]
4. Modern Power system Analysis by I J Nagrath, D P Kothari, 4th Edition Tata McGraw Hill.
5. Power System Analysis by Hadi Saadat, Tata McGraw Hill.
6. D. Das, "Electrical Power System", New Age International Publishers
7. B.R. Gupta, "Power System Analysis and Design", S. Chand Publication
8. J. B. Gupta, "Electrical Power", S. K. Kataria Publications

Suggested Readings:

1. IEEE research paper on power system
2. Power Failure case studies
3. MATLAB, C/C++, Sci Lab software application

Online Resources:

1. www.nptel.com/powersystem
2. http://nptel.iitm.ac.in/coursecontents_elec.php

List of Practical / Activities:

1. To obtain voltage regulation and efficiency of a short transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
2. To write computer program for voltage regulation and efficiency of short transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).

3. To obtain voltage regulation and efficiency of a medium transmission line for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
4. To write computer program to calculate voltage regulation and efficiency of a Medium transmission line (using p model& T model) for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
5. To write computer program to calculate voltage regulation and efficiency of a Long transmission line using equivalent p model for different specified set of receiving end quantities (different load at leading, unity and lagging power factor).
6. To plot sending end power circle diagram and receiving end power circle diagram of a transmission line on a graph paper with some suitable scale.
7. Dynamic simulation of three phase fault on terminal of unloaded synchronous generator. The simulation should show the waveforms of all three line current for fault at different instant on voltage wave of phase A.
8. To analyze L-G fault of a small system (containing generator, transformer and lines) using interconnection of sequence networks.
9. To analyze L- L-G and L- L fault of a small system (containing generators, transformers and lines) using interconnection of sequence network
10. Calculation of symmetrical components for three to four different set of unbalanced three phase phasors.
11. Calculation of fault current for a three-phase fault in a small power system.

Course Outcome

After completion of the course, the students will be able to:

CO-1: Understand the basic principles of distribution systems.

CO-2: Describe the symmetrical components and its applications

CO-3: Analyse Symmetrical and Unsymmetrical faults in power systems

CO-4: Analyze different types of faults.

CO-5: Understand the basic principles of distribution systems.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	1	1	-	1	-	-	1	-	-	-	-	2	1
CO-2	2	3	1	-	1	-	-	-	-	-	1	1	1	2
CO-3	3	2	2	1	-	-	1	-	-	1	-	-	1	2

CO-4	2	3	1	-	1	-	-	-	-	-	1	-	2	2
CO-5	3	2	1	-	1	-	-	-	-	1	-	-	2	2

FEB160302: ELECTRICAL MEASUREMENTS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	Electrical Measurements	**Course code**	FEB160302
Course type:	Engineering Science	**Course credit:**	04

Course Objective

- Introduce students to the basic principles and concepts of electrical measurements, including voltage, current, resistance, and power
- Understand the importance of electrical measurements in engineering applications
- Learn about different types of measurement systems and instruments used in electrical measurements
- Understand the characteristics and applications of various measuring devices.
- Understand the role of measurement standards in ensuring accuracy and traceability.
- Explore techniques for measuring inductance and capacitance

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	**0**	**2**	**5**	**4**	**70**	**30**	**30**	**20**	**150**

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)

1	**Philosophy Of Measurement-** Methods of Measurement, Measurement System, Classification of instrument system, Characteristics of instruments & measurement system, Errors in measurement & its analysis, Standards.	2	10
2	**Analog Measurement of Electrical Quantities** Electro dynamic, Thermocouple, Electrostatic & Rectifier type Ammeters & Voltmeters, Electro dynamic Wattmeter, Three Phase Wattmeter, Power in three phase system, errors & remedies in wattmeter and energy meter. Instrument Transformer and their applications in the extension of instrument range, Introduction to measurement of speed, frequency and power factor.	10	20
3	**Measurement of Parameters** Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter. **Digital Measurement of Electrical Quantities** Concept of digital measurement, block diagram Study of digital voltmeter, frequency meter Power Analyzer and Harmonics Analyzer; Electronic Multimeter.	16	30
4	**Transducers:** Definition different types of transducers – criteria for selection – general characteristics–dynamic characteristics – transducers for measurement of displacement (RVDT &LVDT), speed, angular rotation, altitude, force, torque, humidity and moisture, pressure, strain and temperature (Thermocouple and RTD method), Hall Effect transducer and applications Instrumentation amplifiers – differential amplifiers –Data transmission and telemetry – methods of data transmission, General telemetry systems – Digital methods of frequency, phase, time and period measurements. **Display methods, recorders:** Display methods and devices – different types of recorders – galvanometric recorders – pen driving system– magnetic recorders – digital recorders, digital storage oscilloscope (Block Diagram, theory and applications only)	17	40

Text Books: -

1. A.K. Sawhney, “A course in Electrical & Electronic Measurements & Instrumentation”, Publication Dhanpat Rai & Sons, Edition 1995.
2. R. K. Rajput, “Electrical and Electronic Measurements and Instrumentation”, S. Chand & Company Ltd., 1st Edition.2008

Reference Books:

1. Golding &Widis, Electrical Measurement and Measurement instrument, Wheelar Books
2. M.U. Reissland, "Electrical Measurements", Publication - Wiely Eastern Ltd, New Delhi, Edition 1992
3. H.S. Kalsi, Electronic Instruments, Tata Mc-Graw hill.
4. Helfrick and Cooper, "Modern Electronic Instrumentation & Measurement Techniques", Publisher- Pearson, Edition 2007.
5. E.W Golding, "Electric Measurement & Measuring Instruments", 3rd Edition, Sir Issac pitman and sons,1960
6. A.J. Bouwens, Digital Instrumentation, Tata Mc-Graw hill.
7. A.D. Heltric& W.C. Copper, Modern Electronic instrumentation & Measuring instruments, Wheeler Publication.

Online Resources:

1. Open source Math Tools:
2. http://maxima.sourceforge.net/
3. http://www.sagemath.org/
4. http://www.scilab.org/
5. http://www.gnu.org/software/octave/

Learning website

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php

List of Practical / Activities:

1. Measurement of resistance using Wheastone's Bridge and Kelvin Double bridge.
2. Extension of range of wattmeter using CT & PT
3. Measurement of displacement using LVDT
4. Measurement of current/ voltage using Hall effect transducer.
5. Thermocouple based ON – OFF controller
6. Measurement of physical quantities – strain, torque and angle
7. Measurement of temperature by RTD method

8. Measurement of low resistance by Kelvins double bridge
9. Measurement of voltage, current and resistance using dc potentiometer
10. Measurement of inductance by Maxwells bridge, Hays bridge, Andersons bridge
11. Measurement of capacitance by Owens bridge, De Sauty bridge, Schering bridge
12. Measurement of flow rate by anemometer

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the working principal and construction of the measuring instruments and recorders.
CO-2: Measure various electrical and physical quantities and parameters using meters and transducers
CO-3: Calibrate the measuring devices such as meters and transducers
CO-4: Develop the knowledge of theoretical and mathematical principles of electrical measuring instruments.
CO-5: Assess fault conditions in electrical installations and identify necessary remedial measures.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	2	1	1	-	1	-	-	-	-	1	-	1	2
CO-2	2	3	1	-	-	-	-	-	-	-	-	-	2	2
CO-3	2	3	1	1	-	-	-	-	2	-	-	1	2	1
CO-4	3	1	2	-	1	1	1	-	-	-	-	-	2	2
CO-5	2	3	-	-	-	1	-	-	-	1	-	-	1	2

FEB160303: ELECTRICAL DRIVES

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	Electrical Drives	**Course code**	FEB160303
Course type:	Engineering Science	**Course credit:**	03

Course Objective

- Understand the basic concepts and importance of electrical drives in various applications
- Introduce the role of electrical drives in controlling the speed and torque of electric motors.
- Explore different types of electrical drives, including DC drives, induction motor drives, and synchronous motor drives.
- Understand the operation of power electronic converters for variable speed control.
- Learn about dynamic braking and regenerative braking in electrical drives.
- Explore examples of drive systems in transportation, manufacturing, and robotics.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Sr No.	Subject Content	Teaching	Weightage

		Hours	(%)
1	**Introduction:** • History Of Dc Drive -Electronic Control -Solid State Control • State Of Art Of Dc Drive • Block Diagram Of Drive - Part Of Electrical Drive **Dynamics of Electrical Drives** Types of Load-Quadratal diagram of speed –torque characteristics – Types and Characteristics of load torque – Dynamics of motor- load combination – steady state & transient stability of an electrical drive – Determination of moment of inertia.	7	17
2	**Converters and control** a. Phase controlled converters b. Four quadrant operation c. Choppers d. AC to DC converters e. Inverters and PWM Techniques. **Adaptive control techniques for Electric Drives** a. Self-tuning control b. Model Referencing Adaptive Control (MRAC) c. Sliding Mode Control	14	30
3	**DC motor drives** a. Speed-torque characteristics DC shunt, PMDC and series motors b. Dynamic model c. Speed and position control methods **AC motor drives** a. d-q model of induction motor b. constant flux speed control structure c. vector control model d. vector control structure e. Synchronous motor and BLDC machine drive-Introduction	16	40
4	**Applications of Electric Drives** a. Introduction to Solar and battery powered Drives b. Introduction to traction Drives c. Servo motor drive requirement – control and implementation	4	13

Reference Books:

1. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education
2. Vedam Subrahmanyam, Electric Drives, TMH (I)

3. G..K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House
4. Ned Mohan, Undeland and Robbins, Power Electronics – Converters, Applications and Design, John Willey & sons
5. R.Krishnan, Electric Motor Drives–Modeling, Analysis and Control, PHI
6. Theodore Wildi, Electrical Machines, Drives and Power Systems, Pearson.

Suggested Readings:

1. IEEE research paper on Electrical Drives
2. MatLab for Electrical Machine simulation,

Online Resources:

1. http://electrical-engineering-portal.com/download-center/books-and-guides/siemens-basics-ofenergy/basics-of-dc-drives
2. https://www.joliettech.com/products/dc-variable-speed-drives/dc-drive-fundamentals/
3. http://www.eetimes.com/
4. http://www.ohioelectricmotors.com/a-guide-to-electric-drives-and-dc-motor-control-688
5. http://www.slideshare.net/psksiva13/63814075-electricaldrivesandcontrollecturenotes
6. http://metalab.uniten.edu.my

List of Practical / Activities:

1. To study the fundamental and block diagram of Electric drive.
2. To study different methods of speed control of D.C. Motor.
3. To study and simulate 1- F Semi Control of D.C. separately excited Motor.
4. To study and simulate 1- F Fully Controlled converter of separately excited Motor.
5. To study the control techniques used in D.C. chopper.
6. To study control of D.C. motor for (a) Current limit control (b) Closed loop torque control(c) Closed loop speed control.
7. To study chopper control of D.C. Motor for motoring and generating control.
8. To study D.C. Motor drive using PLL.
9. To study and simulate AC voltage controller-based speed control of AC motor.
10. To study and simulate Inverter based speed control of Induction/Synchronous motor.
11. To study and simulate Cycloconverter based speed control of synchronous motor.
12. To study and simulate AC voltage controller-based speed control of AC motor.
13. To study solar and battery powered drives.

    To study traction drives

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the basics of electric drives and fundamentals of drive dynamics.
CO-2: Learn and analyze DC drive.
CO-3: Learn and analyze different steady state speed control methods for Induction motors,
CO-4: Design and justify new control and power conversion schemes for implementing alternative solutions considering the critical and contemporary issues
CO-5: Identify the critical areas in application levels, and derive typical solutions.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	-	-	1	-	-	-	-	-	1	-	1	-
CO-2	3	1	1	-	-	-	-	-	-	-	-	-	1	2
CO-3	2	-	-	-	-	1	-	-	-	-	-	-	1	-
CO-4	1	1	-	-	1	-	-	-	-	-	-	-	2	-
CO-5	2	1	-	-	-	-	-	-	-	1	-	-	1	2

FEB160304: HIGH VOLTAGE ENGINEERING

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	High Voltage Engineering	**Course code**	FEB160304
Course type:	Engineering Science	**Course credit:**	03

Course Objective

- Understand the basic generation and measurement of High voltage and High current for testing purposes
- Comprehend Breakdown phenomenon in air, solid and liquid insulation
- Test high voltage electrical Equipment with various testing devices

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Breakdown of Gaseous, Liquid & Solid Dielectrics: -** Introduction to insulation materials, Breakdown in gas and gas mixtures, Breakdown in uniform and non-uniform fields, Paschen's law, Townsends criterion, Streamer mechanism, Corona discharge, Breakdown in electro negative gases, Breakdown in liquid dielectrics, Suspended particle	**09**	25%

	mechanism, Breakdown in solid dielectrics-intrinsic, Thermal breakdown, tracking breakdown of solid dielectrics in practice,		
2.	**DC High Voltages Generation:** Half wave and full wave circuits, Ripple voltages in HW and FW rectifiers, Voltage doubler circuits, Simple voltage doubler, Cascade voltage doubler, Voltage multiplier circuits, Crockroft Walton voltage multiplier circuits, Ripple and regulation, Electrostatic machines, Principles, Van de Graff generator. **AC High Voltages Generation:** Cascade transformers, Resonant transformers, Parallel and series resonant test systems, Generation of high frequency high voltages, Tesla coil.	**13**	30%
4.	**Impulse Voltages Generation:** Standard impulse wave shape, Basic circuits for producing impulse waves, Analysis of commercial impulse generator circuits, Wave shape control, multi-stage impulse generators, Marx circuit, Modified Marx impulse generator circuit, Components of multi stage impulse generator, Generation of switching surges, Generation of impulse current, Definition of impulse current waveform, Circuit for producing impulse current waves.	**09**	20%
5.	**Measurement of high voltages**: High direct voltage measurement, peak voltage measurements by spark gaps, sphere gaps, reference measuring systems, uniform field gaps, rod gaps, factors affecting sphere gap measurements, examples - electrostatic voltmeters - ammeter in series with high ohmic resistors and high ohmic resistor voltage dividers - generating voltmeters and field sensors - the measurement of peak voltages, the Chubb–Fortescue method, high- voltage capacitors for measuring circuits - voltage dividing systems and impulse voltage measurements, digital recorders, errors inherent in digital recorders. **High Voltage Testing:** Testing of insulators and bushings, testing of isolators and circuit breakers Testing of cables, testing of transformers - testing of surge diverters - radio interference measurements - design, planning and layout of high voltage laboratory	**14**	25%

Reference Books:

1. L. L. Alston, “High voltage Technology”, BS Publications, 2007.
2. M. S. Naidu, V. Kamaraju, “High voltage engineering”, TMH, 2nd edition, 2001.

3. Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering: Fundamentals" Butterworth- Heinmann (A division of Reed Educational & Profession Publishing Limited), 2nd Edition, 2000.
4. Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2009.
5. Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New Age International Publishers, New Delhi, 2010.
6. Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers, New Delhi, 2010.
7. Hugh M. Ryan, "High Voltage Engineering and Testing", 2nd edition, The Institution of Electrical Engineers, London, United Kingdom, 2001.

Suggested Readings:

1. IEEE research paper on High Voltage Engineering
2. Virtual Lab,

Online Resources:

1. Finite Element Method Magnetics FEMM
2. LTSpice for circuit simulation,
3. KiCAD for CAD application

Practical / Activities:

1. Study Of Impulse Voltage Generator
2. Parametric Analysis Of Impulse Voltage Waveform
3. Study Of Impulse Current Generator
4. Parametric Analysis Of Impulse Current Waveform
5. Critical Flashover of a Sphere Gap using IVG
6. Study of Rectangular Pulse Current Generator
7. Functioning of Voltage Doubler
8. 3-Stage Cockroft Walton Voltage Multiplier

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the basic generation and measurement of High voltage and High current for testing purposes

CO-2: Describe the principles behind generating high DC – AC and impulse voltages.
CO-3: Develop equivalent circuit models of the different high voltage generators
CO-4: Perform a dynamic response analysis of high voltage measurement systems.
CO-5: Transient voltages and their propagation characteristics.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	1	2	-	-	-	-	-	-	1	-	-	-	1	1
CO-2	3	1	2	-	-	-	-	-	1	-	-	-	-	2
CO-3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO-4	1	-	1	-	-	-	-	-	-	-	-	-	-	1
CO-5	2	1	1	-	-	-	-	-	-	1	-	-	-	1

FEB160305: ELECTRICAL MACHINE DESIGN-I

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	Electrical Machine Design-I	**Course code**	FEB160305
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Understand the basic principles and operating characteristics of electrical machines.
2. Explore the differences between various types of machines, such as induction motors, synchronous motors, and generators.
3. Understand the concept of magnetic flux, magnetic field distribution, and design considerations for achieving desired performance.
4. Explore aspects such as rotor and stator construction, materials selection, and mechanical stress analysis.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**DESIGN OF THREE PHASE TRANSFORMER:** Types of transformers; Position of HV and LV windings and its importance; Relation between core and yoke cross section area and its significance; Different types of transformer windings; Different positions of taping; Window space factor; Factors affecting window space factor; Relation between emf per turn and transformer rating; Stacking factor. MAIN DIMENSIONS: Design of window dimensions, yoke dimensions and overall core dimensions; Numerical examples. DESIGN OF WINDINGS: Design of HV and LV windings (No. of turns and area of cross section); Selection of type of winding. PERFORMANCE PARAMETERS ESTIMATION: Primary and secondary winding resistance and Leakage reactance calculation; Calculation of no load current, losses and temperature rise of transformer; Design of tank with tubes; Calculation of dimension of tank; Numerical examples. Variation of output and losses in transformer with linear dimensions; Basic design aspects of dry transformer and high frequency transformers. Basic design aspects of welding transformers and instrument transformers.	**21**	50%
2.	**DESIGN OF DC MACHINES:** Introduction; Output equation; MMF calculation; Selection of number of poles; Design of core length and armature diameter; Carter's fringing curves and its significance; Design of length of air gap; Numerical examples. ARMATURE DESIGN: Choice of armature winding; Armature conductor; Number of armature slots; Slot dimensions; Slot loading; Design of armature core; Numerical examples. DESIGN OF FIELD SYSTEMS: Pole design; Design of field winding of shunt, series and compound machines; Design of inter poles; Effects and minimization of armature reaction; Design of commutator and brushes; Numerical examples. Performance parameters evaluation.	**21**	50%

Reference Books:

1. A course in electrical machine Design – A. K. Sawhney.
2. Electrical Machine Design – R. K. Agrawal
3. Design of Electrical Machine- V. N. Mittle

Suggested Readings:

1. IEEE research paper on Latest Electrical Machine
2. MatLab for Electrical Machine simulation,

Online Resources:

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php
3. Virtual Lab Website www.vlab.co.in

List of Practical / Activities:

1. Draw sheet Parts of 3-Phase Transformer
2. Draw sheet parts of DC Machine.
3. Carry out the detailed design of a 63 kVA, 11 kV/440 V, 50 Hz, Three phase, Delta/Star, core type, oil immersed, and natural cooled distribution transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer
4. Carry out the detailed design of a 10 MVA, 66 kV/11 kV, 50 Hz, Three phase, Delta/Star, core type, oil immersed, Oil natural Air forced cooled power transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer.
5. Carry out the detailed design of a 100 MVA, 132 kV/66 kV, 50 Hz, Three phase, Star/Star, core type, oil immersed, Oil forced Air forced cooled power transformer. Maximum temperature rise should not exceed 45 degree centigrade. Prepare the drawings of designed transformer with appropriate scale. Prepare a list of accessories for this transformer.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Analyze and evaluate the cyber security needs of an organization.

CO-2: Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation.
CO-3: Measure the performance and troubleshoot cyber security systems
CO-4: Design and develop a security architecture for an organization.
CO-5: Design operational and strategic cyber security strategies and policies.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	-	-	-	-	-	-	1	-	-	-	-	2
CO-2	2	1	1	-	-	-	-	-	1	-	-	-	-	2
CO-3	3	-	1	1	-	-	-	-	-	-	-	-	-	1
CO-4	2	1	-	-	1	-	-	-	-	-	-	-	1	-
CO-5	1	-	2	-	-	-	-	-	1	-	-	-	-	-

FEB160001: CYBER SECURITY

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	3rd Year	**Semester:**	VI

Course title:	Cyber Security	**Course code**	FEB160001
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Understand the importance of cybersecurity in the modern digital landscape.
2. Understand the different types of cyber threats, including malware, phishing, ransomware, and more.
3. Learn fundamental security concepts, including confidentiality, integrity, and availability (CIA triad).
4. Explore techniques for securing computer networks.
5. Understand the principles of cryptography in securing information.
6. Learn about encryption algorithms, digital signatures, and cryptographic protocols.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	

0	**2**	**2**	**4**	**3**	**0**	**0**	**80**	**20**	**100**

Details Syllabus: -

Sr. No.	Topic	Teaching Hrs.	Weightage
1	**Systems Vulnerability Scanning**: Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, WinRelay, Network Reconnaissance – Nmap, THC-Amap and System tools. Network Sniffers and Injection tools – Tcpdump and Windump, Wireshark, Ettercap, Hping Kismet	**10**	15 %
2	**Network Defense tools Firewalls and Packet Filters & Web Application Tools Scanning for web vulnerabilities tools:** Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System,Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. DVWA, Webgoat, Password Cracking and Brute-Force Tools – John the Ripper, L0htcrack, Pwdump, HTC-Hydra	**30**	40 %
3	**Introduction to Cyber Crime and law Cyber Crimes:** Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world, A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	**15**	30 %
4	**Introduction to Cyber Crime Investigation**: Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks	**10**	15 %

Reference Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.

2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by NinaGodbole and SunitBelpure, Publication Wiley.
3. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley
4. Cyber Security and Cyber Laws Paperback – 2018 by Alfred Basta, Nadine Basta , Mary Brown , Ravinder Kumar, publication Cengage
5. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill.
6. Cyber security and laws – An Introduction, Madhumita Chaterjee, Sangita

List of Suggested Practical:

1. TCP scanning using NMAP
2. Port scanning using NMAP
3. TCP / UDP connectivity using Netcat
4. Network vulnerability using OpenVAS
5. Web application testing using DVWA
6. Manual SQL injection using DVWA
7. XSS using DVWA
8. Automated SQL injection with SqlMap

Course Outcome:

After completion of the course, the students will be able to:

CO-1: Understand the fundamentals and structure of a C programming language

CO-2: Apply the loops, arrays, functions and string concepts in C to solve the given problem

CO-3: Apply the pointers and text input output files concept to find the solution for the givenapplications.

CO-4: Use the Enumerated, Data types, Structures and Unions

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	-	-	-	-	-	-	-	-	-	-	-	2	-
CO-2	-	3	1	-	-	-	-	-	-	-	-	-	2	-
CO-3	-	3	1	-	-	-	-	-	-	-	-	3	2	-
CO-4	1	3	-	-	-	-	-	-	-	-	-	-	2	-

FEB170301: ELECTRICAL MACHINE DESIGN-II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VII

Course title:	Electrical Machine Design-II	**Course code**	FEB170301
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Understand the importance of electrical machine design in various applications.
2. Review fundamental electromagnetic principles underlying the operation of electrical machines
3. Understand the behavior of magnetic fields and their interaction with conductors.
4. Explore different types of electrical machines, including transformers, induction motors, synchronous motors, and DC machines.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Credit	Weightage
I	**DESIGN OF THREE PHASE INDUCTION MOTOR:** MAIN DIMENSIONS: Output equation, choice of specific loadings, separation of D and L. STATOR DESIGN: Stator winding design, Calculation of no. of turns per phase, Conductor's area, Shape of the stator slots, Area of stator slots, Stator teeth design, Depth of the stator core, Length of air gap, Numerical problems related to above topics. ROTOR DESIGN: A. Squirrel cage rotor – Selection of no. of rotor slots, Effect of harmonics and choice of rotor slots to minimize harmonics, vibration, noise and voltage ripples, Rules for selecting no. of rotor slots, Methods for reducing harmonic torque, Design of rotor bars and rotor slots. Design of end rings and rotor core. B. Wound rotor - Calculation of number of rotor slots, Number of turns, Cross sectional area of rotor conductors, Types of rotor windings, Check for rotor tooth density, Design of rotor slot and rotor core. PERFORMANCE PARAMETERS EVALUATION: No load current calculation, Stator and rotor resistance and reactance calculation, Circle diagram, Dispersion coefficient – effect on maximum output power factor Design aspects for large size machine, High voltage machine, High speed machine.	1	40 %
II	**DESIGN OF SINGLE-PHASE INDUCTION MOTOR:** Design of main dimensions, Design of stator, Design of rotor, Design of auxiliary winding. PERFORMANCE PARAMETERS EVALUATION: Rotor resistance, Stator resistance, Iron loss, Friction and Windage loss, Starting torque, Circle diagram, Calculation of capacitance for maximum torque.	1	20 %
III	**DESIGN OF SYNCHRONOUS MACHINE:** Output equation and design of main dimensions, Short Circuit Ratio (SCR) and its significance, Length of air gap and shape of pole face. ARMATURE DESIGN: Armature winding (Single layer and double layer), Number of armature slots, Slot dimensions, Length of mean turn, Calculation of armature resistance and reactance. DESIGN OF FIELD SYSTEM: Design of magnetic circuit, Open circuit characteristic, Determination of full load field MMF, Design of field winding, Determination of direct and quadrature axis synchronous reactance, Short circuit characteristics.	1	40 %

	DESIGN OF TURBO ALTERNATORS: Main dimensions, Length of air gap, Stator & Rotor design. Design considerations for low speed alternators and vertically operated alternator.		

Reference Books:

1. A Course in electrical machine design – A. K. Sawhney, Dhanpat Rai and Sons
2. Electrical machine design – R. K. Agrawal, S.K. Kataria& Sons
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan.
5. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Suggested Readings:

1. Design of Electrical machines – V. N. Mittle, Standard Publishers Distributors
2. Design and Testing of Electrical Machines – M V Deshpande, PHI

Online Resources:

1. http://www.electrical-engineering-portal.com/

2. http://nptel.iitm.ac.in/courses.php

3. Virtual Lab Website www.vlab.co.in

4. http://www.femm.info

List of Practical / Activities:

1. Design of three phase squirrel cage induction motor
2. Design of three phase slip ring induction motor
3. Design of single-phase induction motor
4. Design of turbo alternator
5. Design of salient pole low speed alternator

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Design the Induction and Synchronous machines of given specifications.

CO-2: Prepare the detailed sketches of the designed machine

CO-3: Understand the design of various parts of DC machines and solve the problems of design

CO-4: understand the design concepts of transformers and know about how to design the parts.

CO-5: understand the design concepts of synchronous machines and solve the problems related to design.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	-	-	-	1	-	-	1	-	-	-	-	1
CO-2	1	2	-	1	-	-	-	-	-	-	-	-	1	2
CO-3	1	2	-	-	-	1	-	-	-	-	-	-	1	-
CO-4	2	1	-	-	1	-	-	-	-	-	-	-	1	1
CO-5	2	1	1	-	-	-	-	-	-	-	-	-	1	-

FEB170302: POWER SYSTEM PROTECTION

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VII

Course title:	Power System Protection	**Course code**	FEB170302
Course type:	Engineering Science	**Course credit:**	04

Course Objective

1. Understand the importance of power system protection in ensuring the reliability and stability of electrical networks.
2. Study different types of faults that can occur in power systems, such as short circuits, open circuits, and ground faults
3. Learn about protective relays and their role in detecting and responding to abnormal conditions in power systems
4. Understand the applications and limitations of each protection scheme
5. Understand their characteristics and applications

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE	PA	Viva	PA	

					(E)	(M)	(V)	(I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Credit	Weightage
I	**Introduction to Protective Relaying and Electromagnetic Relays:** Faults, Causes and Effects, Protective Zones, Primary and Backup Protection, Desirable Qualities and Terms of Protective Relaying, Basic Connection of Trip Circuit, Types of Relay Units, Relay Pick up, Reset or Drop out, pick up/Drop off Ratio, Construction and Working of Different Electromagnetic Relays. **Over Current Protection of Transmission Line:** Introduction, Fuse, Thermal Relays, Over Current Relays, Application of Definite Time & IDMT O.C. Relays for Protection of Feeder, Directional Over Current Relay, Limitations of O.C. Relays. **Differential Protection:** Simple Differential Protection, Zone of Protection and Actual Behavior of Simple Differential Protection, Percentage Differential Protection, Earth Leakage Protection. **Transformer Protection:** Types of Faults, Over Current Protection, Percentage Differential Protection, Inrush Phenomenon, High Resistance Ground Faults in Transformers, Interturn Faults, Incipient Faults, Over-fluxing Phenomenon.	12	25%
II	**Generator Protection:** Various faults & abnormal operation conditions, stator & rotor faults, transverse differential protection, unbalanced loading, overspeeding, loss of excitation, loss of prime mover. **Induction Motor Protection:** Various faults & abnormal operation conditions, starting of induction motor, protection of small & large induction motor. **Distance Protection of Transmission Line:** Drawbacks of O.C. Protection, Introduction to Distance Protection, Types of Distance Relay, Impedance, Reactance, MHO Relay, Performance of Distance Relay During Normal Load and Power Swing, Effect of Arc Resistance on Reach of Distance Relays, Comparison of Distance Relays, Distance Protection of Transmission line, Reasons for Inaccuracy of Distance Relay Reach, Three Step Protection, Trip contact configuration, 3-step protection of double and fed lines.	14	30%
III	**Carrier Aided Protection of Transmission Lines:** Need for carrier-aided protection of transmission lines, various options for the carrier, Coupling and trapping the carrier into the desired line	13	20%

	section, single line to ground coupling, line to line coupling, unit type carrier aided directional comparison relaying, carrier aided distance scheme for the acceleration of zone II, transfer trip or inter trip, permissive inter trip, acceleration of zone II, pre-acceleration of zone II, phase comparison relaying (unit scheme). **Numerical Protection:** Introduction, a block diagram of numerical relay, numerical over current protection, numerical transformer protection, numerical distance protection of transmission line. **Theory of Circuit Interruption:** Introduction, Physics of arc phenomena, Maintenance of the arc, Losses from plasma, Essential properties of arc, Arc interruption theories. **Circuit Constant in Relation to Circuit Breaking:** Introduction, Circuit breaker rating, Circuit constants & circuit conditions Restriking voltage transient Characteristics of re-striking voltage, Interaction between the breaker & circuit, Current chopping, duties of switchgear.		
IV	**Theory & Practice of Conventional Circuit Breaker and Modern Circuit Breakers:** Automatic switch, Air-break circuit breakers, Oil circuit breakers, Single and multi-break Construction, Air-blast circuit breaker, Performance of circuit breakers and system requirements, Modification of circuit breaker duty by shunt resistors, Power factor correction by series resistance, Comparative merits of different types of conventional circuit breakers, Modern trends, Vacuum circuit breakers, Sulphur hexafluoride (SF6) circuit breakers, DC circuit breaker, auto-reclosing - definitions & features, 3-Phase versus 1-Phase auto-reclosing. **Protective Current Transformer and Potential Transformer:** Magnetization curve of CT, Difference between measurement & protective CT, CT errors, calculation of CT accuracy, selection of CT, CT requirements for differential protection, specifications of CT, specifications of PT, CVT.	11	25%

Reference Books:

1. Fundamentals Of Power System Protection – **Y. G. Parithankar**&**S. R. Bhide**, 2 editions, PHI
2. Power system protection and switchgear by **Oza**, **Nair**, **Mehta**
3. Switchgear and Protection – **S. S. Rao**, Khanna publication
4. Power System Protection and Switchgear – **B. Ravindranath** and **M. Chander**
5. Modern Power System Protection – **DivyeshOza**, TMH Publication
6. Power System Protection – **B. Ram**, TMH Publication

7. Art And Science of Protective Relaying – **Masson**
8. A Web Course on Digital protection of power system by **Prof. Dr. S.A.Soman**, IIT Bombay
9. Protection of power systems by **Blackburn**

Suggested Readings:

1. Electrical India *magazine:* https://www.electricalindia.in/
2. Video Lectures by Prof. Bhaveshkumar R. Bhalja (IIT Roorkee): https://www.youtube.com/watch?v=QsGn7H_14VY&list=PLLy_2iUCG87BIJ6ZliVIRCx2Crf9_fJMB

Online Resources:

1. https://en.wikipedia.org/wiki/Power_system_protection
2. https://www.scimagojr.com/journalsearch.php?q=21100900364&tip=sid&clean=0

Practical / Activities:

1. To study Micro controller based 3-Phase Differential Relay.
2. To study Micro controller based over current Relay.
3. To study the Numerical Protection of induction motor.
4. To obtain the operating characteristics of an IDMT relay.
5. To study the operating characteristics of directional over current relay.
6. To study the operating characteristics of the transformer percentage differential relay.
7. To study the magnetic inrush current in a transformer and its protection.
8. To study radial feeder protection using two over current and one Earth fault relay.
9. To obtain and study the magnetization characteristic of CT.
10. To study transformer differential protection.
11. To study the protection schemes for different abnormal conditions in an alternator.
12. To study Buchholz relay for transformer protection.
13. To study generalized block diagram of Numerical Relay.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Explain the purposes of protection, in relation to major types of apparatus.

CO-2: Identify the challenges and solutions to industrial power system protection problems

CO-3: Analyze and compare specified protection systems Compare merits of various principles

CO-4: Compare the different type of circuit breakers performance based on which selection of circuit breaker can be made for a given application.

CO-5: Analyze power system faults for balanced and unbalanced conditions.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	1	-	-	-	-	-	-	1	-	-	1	1	1
CO-2	2	1	-	-	1	-	-	-	-	-	-	-	1	-
CO-3	2	1	-	-	1	-	-	-	-	-	-	-	-	1
CO-4	1	2	-	-	-	1	-	-	1	-	-	-	1	1
CO-5	2	1	1	1	-	-	1	-	-	-	-	1	1	1

FEB170303: SIGNALS & SYSTEMS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VII

Course title:	Signals & Systems	**Course code**	FEB170303
Course type:	Engineering Science	**Course credit:**	04

Course Objective

1. Understand about various types of signals, classify them, analyze them, and perform various operations on them.
2. Understand about various types of systems, classify them, analyze them and understand their response behavior.
3. Appreciate use of transforms in analysis of signals and system.
4. Carry simulation on signals and systems for observing effects of applying various properties and operations.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Hours	Weightage
I	**Introduction Signal and System:** Introduction, Classification of Signals, Multichannel and Multidimensional signal, Continuous time and discrete time signals, continuous-valued and discrete-valued signals, Deterministic and random signals, symmetrical and anti-symmetrical (odd) signals, Energy signal andpower signal, characteristics of continuous time and discrete time signal, discrete time signal representation, standard test signals, operating upon signals, Classification of Systems, static and dynamic systems, Time invariant/ time-invariant systems, Linear and non-linear system, Casual and non-casual system, stable and unstable system, inevitability, symbols used in discrete time system for block schematic representation.	7	20%
II	**Linear time-invariant (LTI) System (Convolution):** Introduction, Convolution sum, tabulation method, Commutative Law, Associative Law, Distributive Law, Stability criteria for Linear time-invariant system, causality criteria for LTI system. **Fourier Series representation of Periodic signals:** Introduction, Representation of Fourier series, the existence of Fourier series, trigonometric form of Fourier series, cosine representation, , Fourier spectrum, power representation using the Fourier series, Gibbs phenomena, properties of continuous time Fourier series.	12	30%
III	**Fourier Transforms:** Introduction, Fourier transform representation of non-periodic functions, Magnitude, and phase representation of Fourier transforms, Existence of Fourier transforms, Fourier transforms of standard signals, Properties of continuous time Fourier transforms, Fourier transforms of periodic signals, system analysis of periodic signals, system analysis with Fourier transforms, introduction to Hilbert transforms, inverse Fourier transform.	6	15%
IV	**Discrete Fourier Transform and Fast Fourier Transform:** Discrete Fourier Transform (DFT), its properties; DFT errors and their minimization; Fast Fourier Transform (FFT), FFT algorithm (Radix-2), Decimation in Time and Decimation in Frequency, Related problems **Z-Transforms:** Introduction, the relation between DTFT and Z-transforms, Z-transforms of some common equation, Z-transforms and ROC of finite duration sequences, Properties of ROC, Properties of Z-transforms, Inverse Z-transforms, Transfer analysis of LTI systems, stability, and causality, solution of difference equation using Z-Transforms.	10	35%

Reference Books:

1. Signals and Systems by **A.Anand Kumar**, PHI Publication.
2. **N. G. Palan**, "Digital Signal Processing", Tech Max Publication
3. **J. Nagrath**, **S. N. Sharan**, "Signals and Systems", Tata McGraw Hill Publication
4. **Alan V Oppenheim**, **Alan S Willsky** and **A Hamid Nawab**, "Signal and Systems", Pearson Education Asia/ PHI
5. **Ganesh Rao** and **SatishTunga**, "Signals and Systems", Sanguine Technical Publishers
6. Electronics Devices and circuits by **David A.Ball** by Oxford publishing.
7. **G. Phadke**,"Power System Relaying"**B. P. Lathi**, "Linear Systems and Signals", Oxford University Press

Suggested Readings:

1. Electrical India *magazine:* https://www.electricalindia.in/
2. Video Lectures by Ankursharma: https://www.youtube.com/watch?v=8U9XFupRGQ0&list=PL6Hn_dJKTVOks2X-GgiEmBGg_nFgBota4

Online Resources:

1. https://en.wikiversity.org/wiki/Signals_and_systems
2. http://ajss.univ-boumerdes.dz/

Practical / Activities:

1. Generations and capturing various continuous time signals from sensors.
2. Generation and capturing of discrete time signals and plot them.
3. Discretization using different sampling rate and observing aliasing effect.
4. Observing the effects of lower sampling rate and higher sampling rate on CT signal.
5. Performing various operations on the signal using circuits and computational software.
6. Using digital circuit building block to perform operations on signals.
7. Simulation of continuous time LTI system.
8. Simulation of discrete time LTI systems.
9. Obtaining impulse response of the systems.
10. Computing FT and DTFT of the CT signals and DT sequences.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand about various types of signals, classify them, analyze them, and perform various operations on them.

CO-2: Understand about various types of systems, classify them, analyze them and understand their response behaviour

CO-3: Appreciate use of transforms in analysis of signals and system

CO-4: Carry simulation on signals and systems for observing effects of applying various properties and operations.

CO-5: Understand and resolve the signals in frequency domain using Fourier series and Fourier.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	-	-	-	-	-	-	1	-	-	1	1	1
CO-2	2	1	-	-	1	-	-	-	-	-	-	-	1	-
CO-3	2	1	-	-	1	-	-	-	-	-	-	-	-	1
CO-4	1	2	-	-	-	1	-	-	1	-	-	-	1	1
CO-5	2	1	1	1	-	-	1	-	-	-	-	1	1	1

FEB170304: INTERCONNECTED POWER SYSTEM

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VII

Course title:	Interconnected Power System	**Course code**	FEB170304
Course type:	Engineering Science	**Course credit:**	04

Course Objective

1. Understand the significance of interconnected power systems in providing reliable and efficient electrical power.
2. Learn about the key components of interconnected power systems, including generators, transformers, transmission lines, and substations
3. Study the operation of interconnected power systems under normal and abnormal conditions.
4. Understand the role of control centers and operators in maintaining system stability.
5. Understand economic dispatch and optimal power flow techniques.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE	PA	Viva	PA	

					(E)	**(M)**	**(V)**	**(I)**	
3	**0**	**2**	**5**	**4**	**70**	**30**	**30**	**20**	**150**

Details Syllabus: -

Unit	Description in detail	Credit	Weightage
I	**Introduction:** Concept of Interconnection, Hierarchical Grid arrangements, Cascade Tripping, Islanding, Load dispatch Centre, Power Generation Scenario in Gujarat and India **Power System Matrices:** Brief explanation of Graph theory, Primitive Network, Ybus formation methods, Singular transformation method, Direct method, Removal of elements, Algorithm for the formation of Zbus matrix addition of branch and link, Numericals [4]	1	20%
II	**Load Flow Studies:** Introduction, Static Load Flow Equations, Bus Classifications, Approximate method, Gauss-Seidel Method, Newton Raphson Method, Fast Decoupled Load Flow Method, Comparison of different methods, Numericals [1]	10	15%
III	**Economic Operation of Power Systems:** Generator operating cost, Economic operation of generators within the thermal plant, Optimal operation by co-ordination equation, Penalty factor, Derivation of transmission loss formula (Kron's method), Unit commitment problem solution by dynamic programming, Numericals [5] **Frequency and Voltage Control Methods:** Speed governing mechanism, Mathematical modeling, Adjustment of Governor characteristics, Single area control, Flat frequency control, Selective frequency control, Tie line load bias control, Methods of voltage control, Numericals [3]	12	25%
IV	**Power System Stability:** Introduction, Mechanics of angular motion, The swing Education, transfer reactance, power relations, Steady state stability, Synchronizing power coefficient, Analysis of steady state stability, steady state stability with automatic voltage regulators, the concept of shunt fault, transfer reactance during a fault, reduction of the power system to one machine connected to the infinite bus, Transient stability, simplified transient generator model, The equal area stability criterion, solution of swing equation, Numericals [2]	12	30%

Reference Books:

1. Modern Power System Analysis by **D. P. Kothari** and **I. J. Nagrath**: Fourth Edition: McGraw Hill

2. Power System Analysis and Stability, **S.S. Vadhera**, Khanna Publication
3. Power System Analysis, **HadiSaadat**, Tata McGraw-Hill Education
4. Computer Aided Power System Analysis, **G.L. Kusic**, © 1986
5. Elements of Power System Analysis by **William D. Stevenson** McGraw-Hill

Suggested Readings:

1. Electrical India *magazine:* https://www.electricalindia.in/
2. Video Lectures by Himanshu Joshi (SLTIET): https://www.youtube.com/watch?v=n8lJMqDCDE8&list=PLOl9U_957yLy9Z0rf0JISBBNebqe_AFJ7

Online Resources:

1. https://en.wikipedia.org/wiki/Electrical_grid
2. https://www.sciencedirect.com/topics/engineering/electric-power-system-interconnection

List of Practical / Activities:

1. Formation of Primitive, incidence Ybus and Zbus matrix for a given network.
2. Solution of static load flow equation using the approximate method of Load Flow.
3. Solution of static load flow equation using Gauss-Seidel Method of Load Flow.
4. Solution of static load flow equation using Newton Raphson Method of Load Flow.
5. Find the most economical generation on the generator of a given power system.
6. Find the penalty factor for the given system.
7. Find (Beta) coefficient for the given system.
8. Find the steady state/transient stability of the system for various disturbances in the power system.
9. Find critical clearing time using equal area criterion.
10. Solution of swing equation using a step-by-step method.
11. To study LDC.
12. To study Ice landing.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Model modern power system network.

CO-2: Solve the problem of power flow through any power system network

CO-3: Optimal Ordering & Sparse Matrix Techniques

CO-4: Power Flow Methods, Available Transfer Capability.

CO-5: Fault Analysis – Two Bus Construction.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	1	2	-	-	-	-	-	-	1	-	-	-	2	1
CO-2	1	2	1	-	1	-	-	-	-	-	1	-	2	1
CO-3	2	1	1	-	-	-	-	-	1	-	-	-	1	-
CO-4	1	1	1	-	-	-	-	-	-	-	-	-	-	1
CO-5	2	1	-	-	-	-	1	-	-	-	-	1	-	1

FEB170305: PROJECT- I

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VII

Course title:	Project- I	**Course code**	FEB170305
Course type:	Engineering Science	**Course credit:**	06

Course Objective

1. Develop skills in project planning, including defining project scope, objectives, and deliverables.
2. Understand the importance of setting timelines, milestones, and resource requirements.
3. Conduct a literature review to understand the existing knowledge and solutions related to the project
4. Consider factors such as system architecture, components, and technical specifications.
5. Identify relevant theories, methodologies, and technologies.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	

0	**0**	**12**	**12**	**6**	**0**	**0**	**80**	**20**	**100**

Details Syllabus: -

Content:

Content: Student will select a topic for project work in consultation with the guiding teacher and/or expert from industries. The student will have to do literature survey & experimental work on that topic. At the end of the semester, he/she will have to submit a report on his/her works. The student will present his/her topic in front of experts and staff. His/her performance will be assessed on the basis of his/her project report and presentation.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

List of Open-Source Software/learning website:

http://nptel.iitm.ac.in, World Wide Web, Google Search Engine etc.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: student manager will be able to choose an appropriate topic for study and will be able to clearly formulate& state a research problem.

CO-2: For a selected research topic, student manager will be able to compile the relevant literature and frame hypotheses for research as applicable.

CO-3: For a selected research topic, student manager will be able to plan a research design including the sampling, observational, statistical and operational designs if any.

CO-4: For a selected research topic, student manager will be able to compile relevant data, interpret analyze it and test the hypotheses wherever applicable.

CO-5: Based on the analysis and interpretation of the data collected, student manager will be able to arrive at logical conclusions and propose suitable recommendations on the research problem.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	-	-	1	-	-	2	1	-	-	2	1
CO-2	3	3	1	-	2	-	-	-	-	-	-	-	2	2
CO-3	3	2	2	-	-	-	-	1	-	-	-	-	1	1
CO-4	2	1	2	1	-	-	-	-	-	1	-	-	1	1
CO-5	2	3	2	-	-	-	1	-	-	-	-	1	-	1

FEB180301: POWER QUALITY AND FACTS

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VIII

Course title:	Power Quality and Facts	**Course code**	FEB180301
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Understand the concept of power quality and its significance in electrical systems.
2. Identify various power quality issues and their impact on electrical equipment and consumers.
3. Understand the analysis and mitigation of harmonics using filters and passive/active compensation
4. Understand international and regional standards related to power quality.
5. Introduce the concept of FACTS and their role in power system control.
6. Understand the need for FACTS devices in enhancing transmission system controllability

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Sr No.	Subject Content	Teaching Hours	Weightage (%)
1.	**Transmission Lines and Series/Shunt Reactive Power Compensation** Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation. Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.	10	22
2.	**Voltage Source Converter based (FACTS) controllers** Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.	8	12
3.	**Application of FACTS** Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.	10	22
4	**DSTATCOM** Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.Voltage Sag/Swell	14	18

	mitigation: Dynamic Voltage Restorer Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): WorkingPrinciple. Capabilities and Control Strategies		

References Books: -

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.

2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.

3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.

4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

5. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

List of Suggested study Practical: -

1. To study Transmission Lines and Series/Shunt Reactive Power Compensation.

2. To study Thyristor-based Flexible AC Transmission Controllers (FACTS).

3. To study Voltage Source Converter based (FACTS) controllers.

4. To Study Application of FACTS.

5. To Study Power Quality Problems in Distribution Systems.

6. To study DSTATCOM.

7. To study Dynamic Voltage Restorer and Unified Power Quality Conditioner.

List of open source software/ learning Website: -

1. http://nptel.ac.in

Major Equipment:

1. Current probe for measuring current harmonics

2. True RMS meter

3. Spectrum analyzer

4. Oscilloscope with high sampling rate

5. Data loggers and chart recorders

6. Low frequency electromagnetic field meter

7. MATLAB for simulation of harmonics generated by non-linear loads

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the basics and breath of Electrical Engineering as a field.

CO-2: Explain the characteristics of ac transmission and the effect of shunt reactive compensation.

CO-3: Explain the characteristics of ac transmission and the effect of series reactive compensation.

CO-4: Describe the working principles of FACTS devices and their operating characteristics.

CO-5: Know the basic concepts of power quality.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	2	2	1	-	1	-	-	-	-	1	-	-	-	1
CO-2	2	3	1	-	-	1	-	-	-	1	-	-	-	1
CO-3	2	2	1	-	-	-	-	1	-	-	-	-	-	1
CO-4	2	1	2	-	-	-	-	-	-	1	-	-	-	1
CO-5	1	-	2	-	-	-	1	-	-	-	-	1	-	-

FEB180302: INDUSTRIAL INSTRUMENTATION

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VIII

Course title:	Industrial Instrumentation	**Course code**	FEB180302
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Understand the role and significance of instrumentation in industrial processes.
2. Learn about measurement systems and the components of instrumentation systems.
3. Understand the principles of sensors, transducers, and signal conditioning.
4. Explore various types of instruments used in industrial settings, such as pressure, temperature, flow, and level instruments.
5. Understand the principles of operation and applications for each type.
6. Understand the importance of signal conditioning in preparing sensor signals for measurement.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	2	4	3	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage
I	**TRANSDUCERS:** Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers, **STRAIN GUAGE AND STRAIN MEASUREMENT:** -Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, gauging techniques and other factors, strain gauge circuits and temperature compensation, applications of strain gauges	10	22%
II	**DISPLACEMENT MEASUREMENT:** Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders. **FORCES AND TORQUE MEASUREMENT:** Load cells and their applications, various methods for torque	11	22%
III	**Pressure Measurement:** Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration, **Flow Measurement:** Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electromagnetic flow meter, hot wire anemometer, Ultrasonic flow meter	11	22%
IV	**Level Measurement:** Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method).**Temperature Measurement:** Resistance type temperature sensors –RTD & Thermistor, Thermocouples & Thermopiles, Laws of thermocouple – Fabrication of industrial thermocouples –Signal conditioning of thermocouples output -Radiation methods of temperature measurement –Radiation fundamentals –Total radiation & selective radiation pyrometers –Optical pyrometer –Two color radiation pyrometers, **Digital Data Acquisition systems & control:**	16	34%

	Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems. Types of Instrumentation systems. Components of an analog Instrumentation Data –Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.		

Reference Books:

1. Industrial Instrumentation & Control by S. K. Singh.TMH Publication
2. Electrical and Electronics Measurement and Instrumentation, By A. K. Shawney, Dhanpatrai& sons' publications.
3. Measurement Systems –Application and Design by E.O. Doebelin, TMH Publication
4. Principles of Industrial Instrumentation, D Patranabis, 3rd edition, Mc Graw hill

Suggested Readings:

1. Mechanical & Industrial Measurements by R. K. Jain, Khanna pub

Online Resources:

1. http://www.electrical-engineering-portal.com/

2. http://nptel.iitm.ac.in/courses.php

3. Virtual Lab Website www.vlab.co.in

List of Practical / Activities:

1. To study the measurement of weight using Strain gauge.
2. To study the measurement of linear displacement using Linear Variable Differential Transformer (LVDT).
3. To Study the measurement and control of temperature using Resistance Temperature Detector (RTD).
4. To Study the measurement and control of temperature using Thermocouple.
5. To Study the measurement and control of temperature using Thermistor.
6. To study the measurement of flow using Ultrasonic Flow meter.
7. To study the measurement of speed using Decoder.
8. To study the measurement of torque.
9. To study the measurement of force using Piezoelectric transducer.
10. To study Measurement of flow using Electromagnetic flow-meter.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the basics and breath of Electrical Engineering as a field.

CO-2: Select a transducer based on its operating characteristics for the required application.

CO-3: Check various available techniques available and select appropriate to obtain satisfactory task for the parameter to be measured.

CO-4: Know advantages and limitations of selected techniques.

CO-5: Interpret the measurement results and cause of any possible error.

CO-6: Understand the working principles of devices to industrial instrumentation.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	3	2	1	-	1	1	-	-	-	-	2	-	1	1
CO-2	3	2	1	-	-	-	1	-	-	-	-	-	-	-
CO-3	2	1	2	-	-	1	-	-	-	1	-	-	-	-
CO-4	2	-	1	-	-	-	-	-	1	-	-	-	-	-
CO-5	2	1	-	-	-	-	-	-	-	-	-	-	1	-

FEB180303: COMPUTER AIDED DESIGN & DESIGN FOR ELECTRICAL ENGINEERING

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VIII

Course title:	Computer Aided Design & Design for Electrical Engineering	**Course code**	FEB180303
Course type:	Engineering Science	**Course credit:**	04

Course Objective

1. Understand the role and significance of instrumentation in industrial processes.
2. Learn about measurement systems and the components of instrumentation systems.
3. Understand the principles of sensors, transducers, and signal conditioning
4. Explore various types of instruments used in industrial settings, such as pressure, temperature, flow, and level instruments
5. Understand the importance of signal conditioning in preparing sensor signals for measurement.

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

Details Syllabus: -

Unit	Description in detail	Teaching Hours	Weightage
I	**CONCEPT OF COMPUTER-AIDED DESIGN AND OPTIMIZATION:** Introduction; Computer Aided Design; Explanation of details of flow chart; Input data to be fed into the program; Applicable constraints Max or Minimum permissible limits; Output data to be printed after execution of program; Various objective parameters for optimization in an electrical machine; Selection of optimal design; Explanation of lowest cost and significance of "Kg/KVA"; Flowcharts	8	18%
II	**BASIC CONCEPTS OF DESIGN** Introduction; Specification; Output coefficient; Importance of specific loadings; Electrical Materials: Conducting Materials, Insulating Materials and Magnetic Materials; Magnetic circuit calculations; General procedure for calculation of Amp-Turns; Heating and Cooling; Modes of heat dissipation; Standard ratings of Electrical machines; Ventilation schemes in static machines (Transformers) and in rotating machines; Quantity of cooling medium; Types of enclosures; General design procedure; Steps to get optimal design	06	16%
III	**APPLICATION OF FINITE ELEMENT METHOD IN DESIGN:** Introduction; Basics of Finite element, Shape functions, Single element computation. Assembly of elemental coefficient matrix, Global coefficient matrix, Application of FEM technique for design problems. Use of open source FEM software for 2D design. Computation of Capacitance of capacitor, cable, multi dielectric cable through FEM, Computation of electrostatic field for various geometry, skin and proximity effect in conductors	08	22%
IV	**COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS:** **Introduction;** Flowcharts and programs for computer aided design of Starters, field regulators, small transformers, choke coils. 2D FEM open source software based electrical apparatus design. COMPUTER AIDED DESIGN OF DC MACHINES: Introduction; Flowcharts and programs for computer aided design of DC machines. 2D FEM open source software-based DC machine part design COMPUTER AIDED DESIGN OF TRANSFORMERS: Introduction; Flowcharts and programs for computer aided design of transformers. 2D FEM open source software-based transformer part design	20	44%

Reference Books:

1. Computer aided design of electrical machines - K M Vishnu Murthy, B S Publications
2. Computer aided design of electrical machines – Maurya, Jallan, Shukla, Kataria publication

Suggested Readings:

1. An Introduction to the Finite Element Method – J Reddy, TMH Publication

Online Resources:

1. http://www.electrical-engineering-portal.com/
2. http://nptel.iitm.ac.in/courses.php
3. Virtual Lab Website www.vlab.co.in

List of Practical / Activities:

1. Prepare a flow chart and computer program for optimum design of a small transformer with given specifications and constraints. Use of GUI (Graphical User Interface) may be a better choice.
2. Prepare a flow chart and computer program for optimum design of starter for a DC motor with given specifications and constraints. Use of GUI may be a better choice.
3. Prepare a flow chart and computer program for optimum design of field regulator for a DC motor with given specifications and constraints. Use of GUI may be a better choice. Various geometry, skin and proximity effect in conductors
4. prepare a flow chart and computer program for optimum design of a choke coil with given specifications and constraints. Use of GUI may be a better choice.
5. prepare a flow chart and computer program for optimum design of a distribution transformer with given specifications and constraints. Use of GUI may be a better choice.
6. Prepare a flow chart and computer program for optimum design of a power transformer with given specifications and constraints. Use of GUI may be a better choice.
7. Prepare a flow chart and computer program for optimum design of a DC motor to be used for industrial applications with given specifications and constraints. Use of GUI may be a better choice.
8. Prepare a flow chart and computer program for optimum design of a small DC motor to be used for a lab with given specifications and constraints. Use of GUI may be a better choice.
9. Prepare a small transformer model using finite element technique.
10. Do a survey and prepare a report on application software's being used for computer aided design of electrical equipment's. List their relative merits and demerits.
11. Do a literature survey about the optimization techniques for design problems.
12. Find leakage inductance of transformer using FEM software
13. Find force on plunger using FEM software.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: Understand the basics and breath of Electrical Engineering as a field.

CO-2: Explain the concepts related to computer aided design of electrical Induction motor.

CO-3: Explain the concepts related to computer aided design of electrical Transformer.

CO-4: Explain the concepts related to computer aided design of electrical synchronous motor.

CO-5: Explain the concepts related to computer aided design of electrical generator.

CO-6: Formulate and solve the optimum design problems with computers.

Course Outcomes	Expected Mapping with Programme Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*													
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO-1	2	1	2	-	1	-	-	-	1	-	-	-	2	1
CO-2	3	1	2	-	-	1	-	-	-	-	-	-	1	-
CO-3	2	-	2	-	-	-	1	-	-	-	-	1	1	-
CO-4	1	2	-	1	-	-	-	-	-	-	1	-	-	1
CO-5	2	-	2	-	-	-	-	-	1	-	-	-	-	1

FEB180304: PROJECT- II

Program:	Bachelor of Engineering	**Branch:**	Electrical Engineering
Year:	4th Year	**Semester:**	VIII

Course title:	Project- II	**Course code**	FEB180302
Course type:	Engineering Science	**Course credit:**	03

Course Objective

1. Develop a detailed design and implementation plan for the project.
2. Consider factors such as system architecture, components, and technical specifications
3. Enhance technical skills relevant to the project, including programming, circuit design, simulation, or any other specialized skills.
4. Understand the importance of setting timelines, milestones, and resource requirements
5. Understand the importance of effective communication and coordination within a team

Teaching & Evaluation Scheme

Teaching Scheme				Credits	Examination Marks				Total Marks
					Theory		Practical		
Th	Tu	P	Total		SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	12	12	6	00	00	80	20	100

Details Syllabus: -

Content:

Content: Student will select a topic for project work in consultation with the guiding teacher and/or expert from industries. The student will have to do literature survey & experimental work on that topic. At the end of the semester, he/she will have to submit a report on his/her works. The student will present his/her topic in front of experts and staff. His/her performance will be assessed on the basis of his/her project report and presentation.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

List of Open Source Software/learning website:

http://nptel.iitm.ac.in, World Wide Web, Google Search Engine etc.

Course Outcomes

After completion of the course, the students will be able to:

CO-1: student manager will be able to choose an appropriate topic for study and will be able to clearly formulate& state a research problem.

CO-2: For a selected research topic, student manager will be able to compile the relevant literature and frame hypotheses for research as applicable.

CO-3: For a selected research topic, student manager will be able to plan a research design including the sampling, observational, statistical and operational designs if any.

CO-4: For a selected research topic, student manager will be able to compile relevant data, interpret analyze it and test the hypotheses wherever applicable.

CO-5: Based on the analysis and interpretation of the data collected, student manager will be able to arrive at logical conclusions and propose suitable recommendations on the research problem.

Course Outcome	**Expected Mapping with Programme Outcomes** *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*

s	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2
CO-1	3	2	1	-	-	1	-	-	2	1	-	-	2	1
CO-2	3	3	1	-	2	-	-	-	-	-	-	-	2	2
CO-3	3	2	2	-	-	-	-	1	-	-	-	-	1	1
CO-4	2	1	2	1	-	-	-	-	-	1	-	-	1	1
CO-5	2	3	2	-	-	-	1	-	-	-	-	1	-	1