RAMAIAH
Institute of Technology

CURRICULUM

Academic year 2022 – 2023

ELECTRICAL AND ELECTRONICS ENGINEERING

VII & VIII SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 67th rank among 1249 top Engineering Institutions & 17th Rank for School of Architecture in India for the year 2022 and is 1st amongst the Engineering Colleges affiliated to VTU, Karnataka.

About the Department:

The department was started in the year 1962 along with the establishment of the Institute. In 2003, the Department has been recognized as a Research Centre by Visvesvaraya Technological University, Belagavi and offers Ph.D and MS(by Research) programs. PG program in Computer Applications in Industrial Drives has been started in the year 2004. UG programme has been accredited by NBA since 2001. The department has 18 well-qualified faculty members. The entire faculty holds postgraduate degree specialized in diversified areas of Electrical Engineering like Power Systems, Power Electronics, Control Systems, Electrical Machines, etc. 13 of the faculty members are doctorates from various esteemed institutions like University of Ontario Institute of Technology (UOIT), Ontario, Canada, IISc, Bangalore, IIT-Dhanbad, NITK, Surathkal, Vellore Institute of Technology, Vellore, Visvesvaraya Technological University, Belagavi, Pondicherry University, Pondicherry and Jain University, Bengaluru. In addition, the department is actively involved in research, testing and consultancy in the area of high voltage applications under the able guidance of Dr. G. R. Nagabhushana, Formerly Chairman, Dept. of High Voltage Engineering, Indian Institute of Science, Bangalore, and is presently with the department as Professor Emeritus. Also, Sri. K V Jayaram, Retired JM-DGM, Bokaro Steel Plant /SAIL is with the department for all the activities related to Home and Building Automation lab. The main focus of the department is to impart quality technical education to students in UG, PG and Ph.D levels based on OBE. Many technical activities are in place to enhance both technical and communication skills for students and staff.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs.

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization.
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations.
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs.

QUALITY POLICY

We at MS Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To excel in engineering education and research, inculcating professional ethics in students and emerge as leaders globally in the field of electrical & electronics engineering.

MISSION OF THE DEPARTMENT

The mission of the department is to produce graduates who will

1. Be able to apply their knowledge to identify and solve problems arising in any industry.
2. Be able to contribute to research and developmental activities in frontier areas.
3. Master innovative skills to be entrepreneurs and/or consultants.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Produce graduates who will have the ability to apply the knowledge of basic Sciences engineering sciences and electrical engineering to excel in professional career.

PEO 2: Produce graduates who will continue to enhance their knowledge.

PEO 3: Produce graduates who are confident to take up diverse career paths.

PEO 4: Produce graduates who will provide leadership and demonstrate the importance of professional integrity.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: 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.

PO3: 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.

PO4: 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.

PO5: 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.

PO6: 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.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: 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 (PSOs):

PSO1: Identify, formulate, analyze, design and implement—electrical and electronics circuits, control systems, drives, power systems and power electronic systems.

PSO2: Use modern tools to solve problems in diverse and multidisciplinary environment.

PSO3: Understand the impact of engineering solutions in societal and environmental context, commit to professional ethics, lifelong learning and communicate effectively.

PSO4: Apply project management techniques to electrical/electronic(s) systems, exhibiting team work.

Curriculum Course Credits Distribution

Batch 2019-2023

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	9	8	4	4					**25**
Engineering Sciences (ESC)	11	10							**21**
Humanities, Social Sciences and Management (HSMC)		2			3		3		**8**
Professional Courses – Core (PCC)			21	21	15	11	10		**78**
Professional Courses– Elective (PEC)					3	6	6	3	**18**
Other Open Elective Courses (OEC)					3	3			**6**
Project Work (PROJ), Internship (IN)						4	1	14	**19**
Total Credits	**20**	**20**	**25**	**25**	**24**	**24**	**20**	**17**	**175**

SCHEME OF TEACHING

VII SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EE71	Switchgear and Protection	PCC	4	0	0	4	4
2.	EE72	High Voltage Engineering	PCC	3	1	0	4	5
3.	EE73	Entrepreneurship & Management	HSS	3	0	0	3	3
4.	EEExxx	Department Elective – 4	Elective	3	0	0	3	3
5.	EEExxx	Department Elective – 5	Elective	3	0	0	3	3
6.	EEL76	Power Systems Lab.	Lab	0	0	1	1	2
7.	EEL77	Protection & High Voltage Lab.	Lab	0	0	1	1	2
8.	EESE01	Seminar	Seminar	0	0	1	1	
			Total	**16**	**1**	**3**	**20**	**22**

Elective Code	Elective Title	Elective Code	Elective Title
EEE741	Electric Drives	EEE751	Digital Image Processing
EEE742	Low Power Integrated Circuits	EEE752	Generation, Economics & Reliability Aspects of Power Systems
EEE743	Artificial Neural Network	EEE753	Electromagnetic Compatibility

SCHEME OF TEACHING
VIII SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EEIN2	Internship / NPTEL courses	Internship	**3**	**0**	**0**	**3**	**3**
2.	EEP3	Project Work	Project	**0**	**0**	**14**	**14**	**-**
			Total	**4**	**0**	**14**	**17**	**3**

VII SEMESTER

SWITCHGEAR AND PROTECTION

Subject Code: EE71 **Credit: 4: 0: 0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Sri. Ramakrishna Murthy

Course Content

Unit I

Switches and Fuses: Isolating switch, Fuse law, cut-off characteristics and time current characteristics, Fuse material, HRC fuse, Liquid fuse, Application of fuse, Selection of fuses.

Principles of Circuit Breakers: Principles of AC circuit breaking, Principles of DC circuit breaking, Arc initiation, maintenance and interruption, Arc interruption theories - slepian's theory and energy balance theory, Re-striking voltage, Recovery voltage, Rate of rise of re-striking voltage, Current chopping.

Unit II

Circuit Breakers: Classification of circuit breakers (CB), Air blast circuit breakers, Air break CB, Oil circuit breakers - single break, double break, minimum oil, SF_6 breaker -properties of SF_6 gas puffer and non-puffer type of SF_6 breakers, Vacuum CB, Operating mechanism of CB, Rating of CB.

Philosophy of protective relaying system: Need for protective system, Types and effects of faults, Zones of Protection, Primary and Back up Protection, Essential qualities of protective relaying, Classification of protective relays, Classification of protective schemes, CT & PT for Protection.

Unit III

Relays: Principle of relay operation, Static relays (block diagrams) – overcurrent, directional, distance relays, Advantages and limitations of static relays, Comparators-duality between amplitude and phase comparators, Rectifier bridge and phase splitting type amplitude comparators, coincidence type phase comparator.

Relay characteristics: Non-directional and Directional overcurrent relays, IDMT and directional characteristics. Differential relay –Types of differential relay, Distance Protection - impedance relay, reactance, Mho relay.

Unit IV

Protection Schemes: Generator protection scheme - stator & rotor protection. Transformer protection - external and internal faults protection, Buchholz Relay, Bus-zone protection - differential current protection, frame leakage protection of busbar, ring main protection, Motor protection - ground fault and phase fault protection, Pilot relaying schemes - circulating current scheme, balanced voltage scheme, Carrier aided distance protection.

Unit V

Numerical Protection: Numerical over current and distance protection (generalized interface).

Wide area measurement application: Introduction, PMU, WAMS architecture, Adaptive relaying - transformer protection, transmission line protection, reclosing, WAMS based protection concepts - supervision of backup zones, intelligent load shedding, load shedding and restoration.

Text Books

1. Badriram and ViswaKharma, '*Power System Protection and Switchgear',* 2nd edition, TMH, 2011.
2. Sunil S. Rao, '*Switchgear and Protection',* 10th edition, Khanna Publishers, 1992.
3. James S. Thorp; Arun G. Phadke, '*Computer Relaying for Power Systems'*, John Wiley & Sons, 2nd edition, 2009.

Reference Books

1. Soni, Gupta and Bhatnagar, '*A Course in Electrical Power'*, 4th edition, Dhanapat Rai Publications, 2010.
2. Y.G. Painthankar and S R Bhide, '*Fundamentals of Power system Protection'*, PHI, 2007.

Course Outcomes (COs):

A student completing this course should be able to:

1. Select a fuse and/or a circuit breaker for a given application. (PO-1) (PSO-1)
2. Distinguish between various types of circuit breakers. (PO-1) (PSO-1)
3. Compare the characteristic of different relays and identify a suitable relay for different zones of protection. (PO-1, 6) (PSO-1)
4. To identify different faults in generator, power transformers, transmission lines, busbars and motors and their protection. (PO-1, 6) (PSO-1)
5. To apply the basic concept of numerical relay and WAMS for protection. (PO-1) (PSO-1)

HIGH VOLTAGE ENGINEERING

Subject Code: EE72 **Credit: 3: 1: 0**
Prerequisites: Nil **Contact Hours: 70**
Course Coordinator/s: Dr.Pradipkumar Dixit/Dr. Chandrashekhar Badachi

Course Content

Unit I

Conduction and breakdown in Gases:
Gases as insulating media, Ionization Processes, ionization by collision, Photo-ionization, secondary ionization processes, Electron emission due to positive ion impact, electron emission due to photons, electron emission due to metastable and neutral atoms. Townsend's current growth equation, current growth in the presence of secondary processes. Townsend's criterion for breakdown. Breakdown in electronegative gases, electron attachment process. Time lags for breakdown. Streamer theory of breakdown in Gases, Paschen's law, breakdown in non-uniform fields and corona discharges.

Unit II

Conduction and breakdown in liquid dielectrics:
Liquid as insulation, conduction and breakdown in commercial liquids, suspended particle theory, Bubble theory, stressed oil volume theory.
Breakdown in Solid dielectrics:
Introduction, Intrinsic breakdown, Electromechanical breakdown, Thermal breakdown, breakdown due to treeing and tracking, breakdown due to internal discharges.
Generation of HVDC Voltages:
Half and full wave rectifier circuits, voltage doubler circuit, Cockcroft-Walton voltage multiplier circuit, expression for ripple and voltage drop, Electrostatic generators, Van-de-Graaff generator.

Unit III

Generation of HVAC voltages:
Cascade transformers, Resonant transformers, Generation of high frequency AC high voltages.
Generation of Impulse Voltages:
Standard impulse wave shapes, single stage impulse generator circuits and their analysis, Marx circuit, components of a multistage impulse generator. Generation of switching surges.
Generation of Impulse currents:
Definition of impulse current waveforms, circuit for producing impulse current waves, generation of high impulse currents, generation of rectangular current pulses, Trigatron gap.

Unit IV

Measurement of High Voltages:

High ohmic series resistance with microammeter, Generating voltmeters, Electrostatic voltmeter, Chubb-Fortescue method, Sphere gaps, Potential dividers for impulse voltage measurements, Resistance potential divider for very low impulse voltages and fast rising pulses, Resistance and Capacitance potential dividers with oscilloscope(impedance matching).

Unit V

Non-destructive Testing of Electrical Apparatus:

Measurement of Dielectric constant and loss factor: Low frequency measurement method-More's bridge, power frequency measurement methods – high voltage Schering bridge, Schering bridge arrangement for grounded capacitors

Partial discharge measurements: Introduction, terminology used, Straight discharge detection method, balanced detection method

High Voltage Testing of Electrical Apparatus:

Testing of Insulators, Bushings and Transformers

Text Book

1. M. S. Naidu and V. Kamaraju, '*High Voltage Engineering'*, 3ed, Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2005.

Reference Books

1. E. Kuffel, W. S. Zaengl and J. Kuffel, *"High Voltage Engineering – Fundamentals'*, Second edition 2000, published by Butterworth-Heinemann.
2. C. L. Wadhwa, 'High *Voltage Engineering'*, New Age International (P) Limited, Publishers, 2003.
3. R. S. Jha, '*High Voltage Engineering'*, Dhanpat Rai& Sons, New Delhi, 1984.

Course Outcomes (COs):

At the end of the course, the student is able to:

1. Classify the insulation and analyze the Electrical breakdown phenomena in any insulating medium. (PO-1) (PSO 1)
2. Identify the methods for generating High AC & DC Voltages. (PO-1) (PSO 1)
3. Justify the need and design of circuits for generation of impulse voltages and currents. (PO-1,3) (PSO 1)
4. Recognize the different techniques for measurement of High Voltages (PO-1) (PSO 1)
5. Identify different types of high voltage testing. (PO-1) (PSO 1)

Entrepreneurship & Management

Subject Code: EE73 **Credit: 3: 0: 0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator/s: Smt. Mamatha G M

Course Content

Unit I

Introduction: Meaning, nature & characteristics of managements Scope & functional areas of management, Management as a science, art of profession, management & administration, Role of management, levels of management.

Planning: Nature & Importance of planning process, Types of planning & decisions, Importance of planning, Steps in planning, Hierarchy of plans, Case Studies

Unit II

Organizing& Staffing: Nature & purpose of organization, Types of organization, Departments & committees. Centralization & decentralization of authority & responsibility, Nature & importance of staffing, Process of selection & recruitment.

Directing & Controlling: Meaning & nature of directing, Leadership styles, Motivation theories, Coordination, Meaning & importance, Steps involved in control essentials of sound control system, Methods of establishing control, Case Studies

Unit III

Introduction to Economics: Managerial Economics, Nature &Scope, Role of Managerial Economics in decision making, Objectives of Business firma, Alternative Objectives of the firm, Demand Analysis, Law of demand, Exceptions to Law of demand, Market Structures, Perfect competitions, Monopolic Competitions, Oligopoly competitions.

Entrepreneur: Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur – an emerging Class. Concept of **Entrepreneurship:** Evolution of Entrepreneurship, development of Entrepreneurship steps in entrepreneurial process, Role of entrepreneurs in Economic Development: Entrepreneurship in India; Entrepreneurship – is Barriers.

Unit IV

Small scale industry: Definition; Characteristics; Need and rationale: Objectives: Scope; role of SSI in Economic Development. Advantages of SSI. Steps to start in SSI – Government policy towards SSI; Different Policies of S.S.I.; Government Support

for S.S.I. during 5 year plans. Impact of Liberalization, Privatisation, Globalization on S.S.I., Effect of WTO/GATT Supporting Agencies of Government for S.S.I., Meaning; Nature of Support; Objectives; Functions; Types of Help, Brief concepts about SEZ & SME.

Unit V

Preparation of Project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal.

Identification of Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study: Payback period, IRR, Pre-Feasibility Report, Feasibility Report, Detailed Project Report (D.P.R), Social Feasibility Study

Text Books:

1. P.C.Tripathi, P.N.Reddy, "*Principles of Management"*, Tata McGraw Hill 4Th Edition.
2. Vasant Desai, "Dynamics *of Entrepreneurial Development & Management*", Himalaya publishing House .2007 Edition.
3. Jhingam Stephan, "Managerial *Economics*", Vrinda Publication 1998 Edition.

Reference Books:

1. Dr. NVR Naidu and T.KrishnaRao, "*Management and Entrepreneurship*"- I K International Publishing House Pvt. Ltd., New Delhi, 2008.
2. Poornima M Charantimath, "*Entrepreneurship Development – Small Business Enterprises*", Pearson Education, 2006.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Explicate Management and know its different perspectives. (PO – 11) (PSO-3)
2. Interpret the various functions of Management. (PO – 8,9) (PSO-3)
3. Know the importance of Managerial Economics in today's business market. (PO – 8,10) (PSO-2)
4. Cognize the Entrepreneurship and steps involved in the process and the government policies towards SSI. (PO – 7,9) (PSO-3)
5. Identify the project / business opportunities and its demand. (PO –7,10,11) (PSO-4)

POWER SYSTEMS LAB

Subject Code: EEL76 **Credit: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Dr. Sridhar. S / Dr. Neelamsetti Kiran Kumar

LIST OF EXPERIMENTS

1. Determination of ABCD Parameters, Regulation and transmission efficiency of transmission line.
2. Determination of power angle characteristics for salient and non-salient pole synchronous machines.
3. Fault analysis of an isolated 3-Φ synchronous machine.
4. Y-bus formation for a given power systems (without mutual coupling)
5. Formation of Z-Bus (without mutual coupling) using building algorithm.
6. Optimal generator scheduling for thermal power plant
7. Load flow analysis using Gauss Seidal Method/ Newton–Raphson method.
8. To plot Swing curve, find the system stability and Critical clearing time for a single machine connected to infinite bus.
9. Voltage control by load compensation.
10. Fault Analysis in power system.

Note: The above experiments can be done using any standard simulation software package.

Course Outcomes (COs):

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

1. Determine the power angle characteristics of synchronous machines. Solve the swing equation and determine the transient stability. (PO-1,5) (PSO-1,2)
2. Determine the transmission line performance. (PO-1,5) (PSO-1,2)
3. Obtain economic load dispatch of a thermal power plant. (PO-1,5) (PSO-1,2)
4. Conduct a study on power system faults. (PO-1,5) (PSO-1,2)
5. Analyze the Power flow of a given system. (PO-1,5) (PSO-1,2)

PROTECTION & HIGH VOLTAGE LAB

Subject Code: EEL77 **Credit: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Sri. Ramakrishna Murthy

LIST OF EXPERIMENTS

1. Over current relay: IDMT non-directional characteristics
2. IDMT characteristics of over voltage or under voltage relay (solid state or electromechanical type)
3. Current-time characteristics of fuse
4. Operating characteristics of microprocessor based (numeric) over-current relay
5. Operating characteristics of microprocessor based (numeric) over/under voltage relay.
6. Motor protection scheme fault studies
7. Field mapping using electrolytic tank for any one-model cable/capacitor/transmission line/sphere gap models.
8. Flashover characteristics of sphere gaps under AC and DC corrected to STP
9. Determine the breakdown strength of transformer oil
10. Flashover characteristics of non-uniform field gaps under HVAC
11. Measurement of HVAC using sphere gaps
12. Determine the breakdown voltage of solid insulations

Course Outcomes (COs):

A student completing this course should be able to:

1. Demonstrate the characteristics of fuse. (PO-1,4,9) (PSO-1)
2. Demonstrate the characteristics of voltage and current relays (PO-1,4,9) (PSO-1)
3. Realize the field distribution of a coaxial cable / parallel plate capacitor. (PO-1,4,9) (PSO-1)
4. Determine the breakdown voltage of air in uniform and non-uniform fields. (PO-1,4,9) (PSO-1)
5. Determine the breakdown voltage/strength of solid and liquid insulations. (PO-1,4,9) (PSO-1)

PROJECT WORK

Subject Code: EEP3 **Credit: 0: 0:14**
Prerequisites: Nil **Contact Hours: 78**
Course Coordinator/s: Dr. S. Dawnee

Course Content

Students will analyze, design and implement ideas pertaining to different aspects of electrical and electronics engineering. They will work in a group of 3/4 to solve a problem of current concern requiring an engineering solution. They are required to follow a systematic approach towards developing the solution by considering technical and non-technical factors. The working model of the solution along with the design documentation will be considered for final evaluation. Emphasis will also be on the skills to communicate effectively and present ideas clearly and coherently in both the written and oral forms.

Course Outcomes (COs):

At the end of the course Students will be able to:

1. Define the problem to be solved in a clear and unambiguous terms. (POs – 1, 2, 3, 4, PSO – 1)
2. Identify and establish the need to solve the problem by gathering relevant literature. (POs – 1, 2, 3, 4, PSO – 1)
3. Describe the proposed design method in terms of technical block diagram or flowchart. (POs – 2, 3, 10, PSOs – 2, 3).
4. Implement and demonstrate the proposed design method using software/hardware tools. (POs – 2, 3, 4, 5, PSOs – 2, 3).
5. Document and present the solution to the peer group.(POs – 9, 10, PSOs – 2, 3)

ELECTRIC DRIVES

Subject Code: EEE741 **Credit: 3: 0: 0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator/s: Dr. Kodeeswara Kumaran G/Dr. R Subha

Course content

Unit I

Introduction to Electrical drives

Introduction, advantages of electrical drives, parts of electrical drives, choice of electrical drives, status of dc and ac drives, dynamics of electrical drives, fundamental torque equation, components of load torque, nature and classification of load torques, speed-torque conventions and multi-quadrant operation, equivalent values of drive parameters.

Unit II

DC Drives

Basic Concepts: Speed torque characteristics, starting, braking and speed control techniques of shunt/separately excited dc motor (theory only).

Rectifier controlled dc drives: Types of rectifiers- review, fully controlled rectifier fed dc drives, half controlled rectifier fed dc drives, multi-quadrant operation of rectifier controlled dc drives.

Chopper controlled dc drives: Types of choppers – review, chopper controlled dc drives – motoring and braking operation, multi-quadrant operation of chopper controlled dc drives.

Unit III

AC Drives

Basic Concepts: Speed-Torque characteristics of induction motors. Concept of induction motor starting. Types of starter - star delta, auto transformer, reactor, part winding, rotor resistance. Concept of induction motor braking. Methods of braking - regenerative, plugging, dynamic braking (theory only)

Speed control techniques: Rotor resistance control, Stator voltage control, stator frequency control, V/f control.

Unit IV

Special Machine Drives

Synchronous motors: Construction, operation from fixed frequency supply – starting, pulling in, braking. Synchronous motor variable speed drives. Self-controlled

synchronous motor drive employing load commutated thyristor inverter.

DC brushless motors: Construction, speed-torque characteristics, brushless dc motor controllers – rotor position measurement, commutation logic, speed controller.

Unit V

Stepper Motor Drives: Principle of operation of stepper motor, single stack variable reluctance motors, speed torque characteristics, control of stepper motors, unipolar and bipolar drive circuits

Text Book

1. G.K Dubey, *Fundamentals of Electrical Drives*, Narosa publishing house Chennai, 2 Edition, 5th reprint.
2. Mohamed A. El-Sharkawi, *Fundamentals of Electric Drives*, Thomson Learning, 2002

Reference Books

1. Dave Polka, *Motors and Drives: A Practical Technology Guide*, The Instrumentation, Systems and Automation Society, 200.
2. N.K De and P.K. Sen, *Electrical Drives*, PHI, 2007.
3. M.H.Rashid, '*Power Electronics: Circuits, Devices and Applications*', Pearson Education, 3rd Edition.

Course Outcomes (COs):

The course will enable the student to:

1. Describe the structure of a drive system and analyze the mutliquadrant operation of a drive system. (PO-1,2) (PSO-1)
2. Elucidate the operating principles of dc drives and solve problems related to it. (PO-1,2) (PSO-1)
3. elucidate the operating principles of ac drives and solve problems related to it. (PO-1,2) (PSO-1)
4. explain the functions of drive components and operating principles of special machine drives (including BLDC motor drive, synchronous motor drive and stepper motor drive. (PO-1) (PSO-1)
5. suggest required drive components and determine the design parameters for a given drive system specification. (PO-3) (PSO-1)

LOW POWER INTEGRATED CIRCUITS

Subject code: EEE742 **Credits: 3:0:0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator: Dr. S Dawnee/Sri. Victor George

Course content

Unit I

Introduction to low power design techniques, overview of CMOS technology, Statistical Dispersion of Transistor Electrical Parameters, Physical and Electrical Gate Oxide Thickness, Innovative Transistor Architectures, concept of the different leakage components of MOS transistors — gate tunnelling, subthreshold conduction, GIDL, junction leakage, and punch through leakage, basic concepts of circuit level leakage current in basic CMOS gates.

Unit II

Basic concepts and physical phenomena in the nanoscale MOSFET, Passive Photonic Devices for Signal Routing- waveguides, resonators, photonic crystals, Link Performance (Comparison of Optical and Electrical Systems), Low power arithmetic operators, carry look ahead adder, modified booth multiplier, floating-point arithmetic, content addressable memory, phase locked loops, Low-Power and Standard Cell Libraries, gated clocks, Latch-Based Designs, Cell Drives, basics of low-power very fast dynamic logic circuits.

Unit III

Circuits Techniques for Dynamic Power Reduction, Dynamic Power Consumption Component, Power Reduction Approaches, Circuit Parallelization, Memory Parallelization, Parallelized Shift Register, voltage scaling-based circuit techniques, Multiple Voltages Techniques, Low Voltage Swing, Circuit Technology-Independent Power Reduction, Precomputation, Retiming, Circuit Technology-Dependent Power Reduction, Path Balancing, Technology Decomposition.

Unit IV

Low-Power and Low-Voltage Communication for SoCs, Basics of Wires, Power Consumption Related to Interconnect, Strategies for Power Savings in Interconnect, efficient on chip power management using fully integrated DC-DC converters, inductive and capacitive converter, Concept of single inductor dual output (SIDO) and single inductor multiple output (SIMO) DC-DC converters.

Unit V

Circuit techniques for improving the power density of switched capacitor converters, capacitor charge sharing loss and concept of soft charging, EMC applications, digital circuit power distribution, digital circuit radiation, conducted emissions, RF and transient immunity, Electrostatic discharge.

Text Books:

1. Christian Piguet, '*Low power CMOS circuits- technology, logic design and CAD tools*', Taylor and Francis, 2006.
2. Mona M Hella, Patrick Mercier, '*Power management Integrated circuits*', CRC Press, 2016.
3. Henry W Ott, '*Electromagnetic compatibility engineering*', Wiley, revised edition, 2009.

Course Outcomes (COs):

At the end of the course the students will be able to

1. Understand the causes of leakage currents at device and circuit levels
2. Understand the various low power techniques used for data transfer, arithmetic operations and logic circuitries in an IC
3. Identify various circuits techniques for dynamic power reduction
4. Understand the topologies and techniques used in DC/DC converters for efficient on chip power management
5. Identify the electromagnetic compatibility issues related to digital circuits

ARTIFICIAL NEURAL NETWORK

Subject Code: EEE743 **Credit: 2: 1: 0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator: Smt. Kusumika Krori Dutta

Course content

Unit I

Introduction:
Fundamental concepts and Models of Artificial Neural systems, Biological Neural Networks, Typical Architectures, Setting the Weights, Common Activation Functions, Mc-Culloch –Pitts model- AND gate, OR gate, AND-NOT gate, XOR gate.

Unit II

Fundamental Models of Artificial Neural Networks:
Simple neural nets for Pattern Classification, Hebb net, examples, Single Layer Perceptron Classifiers, Single Layer Feedback Networks, examples, Perceptron learning.

Unit III

Associative memory networks:
Pattern associations, applications, Training algorithm, Hebb rule & Delta rule, Classification of associative memory, Hetero associative neural net architecture, Examples with missing and mistake data, Auto associative net architecture, Examples with missing and mistake data, Storage capacity.

Unit IV

Feed Back Networks:
Recurrent linear auto associate, Examples, Discrete Hopfield net, Examples with missing and mistake data, Bidirectional associative net, architecture, Examples with missing and mistake data, Hamming distance, Fixed weight competitive nets, Architecture, applications.

Feed forward Network:
Architecture, applications, examples of back propagation neural network (BPN), and Radial Basis Function Network (RBFN)

Unit V

Special Networks:

Introduction to Boltzmann machines, Boltzmann machine with learning.

Self-organizing Feature Map:

Kohonen Self-organizing Feature Map, Learning Vector Quantization, Max net, Mexican Hat, Hamming Net

References:

1. LaureneFausett, '*Fundamentals of Neural Networks: Architecture, Algorithms and Applications*', Person Education, 2004.
2. Simon Hayking, '*Neural Networks: A Comprehensive Foundation*',2nd Ed., PHI.
3. S.N Sivanandam, S Sumathi, S.N Deepa '*Introduction to Neural Net using Matlab 6.0'*, TMH, 2008

Course Outcomes (COs):

The course enables the students to:

1. Describe the relation between real brains and simple artificial neural network models. (PO-1) (PSO-1)
2. Design basic model of logic gates and circuits using Perceptron, Hebbian algorithm and McCulloch -Pitt's models and verify the same using MATLAB. (PO-1,3) (PSO-1,2)
3. Identify the main implementation issues for common neural network systems (PO-1) (PSO-1)
4. Apply the models of ANN in different areas like optimization of efficiency (PO-1) (PSO-1)
5. Apply ANN models to data compression, pattern identification, etc. (PO-1) (PSO-1)

DIGITAL IMAGE PROCESSING

Subject Code: EEE751 **Credit: 2: 1: 0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator: Smt. Kusumika Krori Dutta

Course content

Unit I

Digital Image Fundamentals:
What is Image Processing? Fundamental steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic relationships between Pixels.

Unit II

Image Enhancement in Spatial Domain:
Image Enhancement in Spatial Domain, some basic Gray level transformations, Histogram processing, Enhancement using arithmetic/logic operations.

Unit III

Spatial Domain Filtering:
Basics of Spatial filtering, smoothing spatial filters, Sharpening spatial filters.
Frequency domain Filtering:
Image Enhancement in frequency domain, smoothing frequency domain filters, Sharpening frequency domain filters. Constrained least squares filtering, Geometric mean filter.

Unit IV

Image Segmentation:
Detection of discontinuities, edge linking and boundary detection, Thresholding region based segmentation. Segmentation using morphological watersheds, Some basic morphological algorithms.

Unit V

Image Transforms:
Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform, Discrete cosine transform, Sine transform, Hadamard transform, Haar transform, KL transform.

Lab Experiments:

1. Basic concepts of Images: Read and display, information about the image.
2. Image display: Basics, bit planes, quantization and dithering.
3. Point processing: Arithmetic operation, image negative.
4. Filtering, create filters, high and low pass filters.
5. Image geometry: Scaling smaller, rotation.
6. The Fourier transform: two dimensional DFT.
7. Image segmentation: thresholding, edge detection.
8. Canny edge detection, second derivatives.

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", Pearson Education, I Ed, 2001, ISBN-13:9780131687288

Reference Book:

1. Anil K. Jain, "*Fundamentals of Digital Image Processing*", Pearson Education, PHI, 2001, ISBN-13:9780133361650

Course outcomes (COs):

At the end of the course the student will be able to

1. Describe the processes of Image acquisition and Image Processing. (PO-1) (PSO-2)
2. Extract the information from the image through spatial domain enhancement methods. (PO-1, 2) (PSO-2)
3. Enhance the image quality through different filtering and restoration techniques. (PO-2 ,5) (PSO-2)
4. Extract the information from the image through segmentation methods. (PO-2,5) (PSO-2)
5. Apply and analyse different types of Image transforms on conversion of spatial domain to frequency domain and vice versa. (PO-2) (PSO-2)

GENERATION, ECONOMICS & RELIABILITY ASPECTS OF POWER SYSTEMS

Subject Code: EEE752 **Credit: 3: 0: 0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator: Sri. Vinayak V Rao

Course content

Unit I

Generating station: Steam station: Advantages, disadvantages, block diagram, choice of site, efficiency, equipment.

Hydroelectric station: Advantages, disadvantages, block diagram, choice of site, equipment.

Diesel station: Advantages, disadvantages, block diagram.

Nuclear station: Advantages, disadvantages, block diagram, selection of site.

Unit II

Economic aspects: Important terms and factors, load curves, types of loads, Numerical. Points in selection of units, advantages of interconnected systems, Numerical.

Economics of power generation: cost of electrical energy, expressions for the cost of electrical energy, methods of determining depreciation, Numerical.

Tariff: Desirable characteristics of Tariff, types of tariff, Numerical

Unit III

Reliability aspects: Basic power system reliability aspects: probabilistic evaluation of power systems, adequacy and security, need for power system reliability evaluation, functional zones, hierarchical levels, reliability cost/reliability worth, reliability data, reliability test systems.

Generation system adequacy evaluation: Analysis of IEEE reliability test systems, LOLE analysis of the base case, effect of rounding, derated states, load forecast uncertainty, scheduled maintenance, peak load etc. Numerical.

Unit IV

Montecarlo simulation: modelling, convergence & computing time, advantages and disadvantages.

Composite System adequacy evaluation: Factors in contingency enumeration approach, appropriate network solution technique, appropriate load curtailment

philosophies, effect of load curtailment passes, appropriate contingency levels, station originated outages. Comparison between ENEL & U of S approach. Numerical.

Unit V

Distribution System adequacy evaluation: Definition of basic distribution indices, Numerical

Assessment of reliability worth: Interruption costs for commercial, industrial, residential customers.

Smart Grid: Introduction, Functional units of smart grid

Reliability in Smart Grid: Preliminaries on reliability Quantification, System adequacy Quantification, Congestion Prevention: An Economic Dispatch Algorithm**.**

Text books:

1. V K Mehta, '*Principles of power systems',* S Chand Publishers, 2005
2. Roy Billington & Alan, '*Reliability Assessment of large power systems'*, Kluwer Academic Press 1989.
3. James Momoh, '*SMART GRID Fundamentals of Design and Analysis*', IEEE-press, Wiley Publishers, 2012.
4. K G Boroojeni 'Smart Grids: Security and Privacy Issues' Springer Publication, 2017

Reference books:

1. G R Nagapal, '*Power plant engineering',* 14th edition, Khanna Publishers, 2000.
2. Arora and Doomkundwar, '*A course in power plant engineering'*, Dhanpat Rai publishers, 2001.
3. B R Gupta, '*Generation of Electrical Energy',* Eurasia Publishing House, 3rdEdition.
4. Dr. S Uppal, '*Electrical power',* Khanna Publishers, 6thEdition.
5. Soni Gupta & Bhatnagar, '*A course in electrical power',* Dhnapat Rai & Sons, 2nd Edition.
6. R K Rajput, '*Utilization of Electrical Power*', Laxmi publications, First Edition,2006.
7. Moslehi "*Smart Grid – A Reliability Perspective*", IEEE-PES Conference on Innovative Smart Grid Technologies, 2010

Course Outcomes (COs):

At the end of the course, the student is able to:

1. Describe and compare different types of power generation. (PO-1,10) (PSO-1,3)
2. Apply the concepts of economic aspects of power generation to determine the cost of electrical energy, depreciation and tariffs. (PO-1,2) (PSO-1)
3. Apply the reliability concepts to different hierarchy levels of power systems (PO-1,2) (PSO-1)
4. Evaluate the adequacy of HL-I, HL-II and HL-III by determining their reliability indices (PO-1,2) (PSO-1)
5. Discuss and explain the reliability worth in terms of interruption cost for different types of customers and smart grid. (PO-1,2) (PSO-1)

ELECTROMAGNETIC COMPATIBILTY

Subject Code: EEE753 **Credit: 3: 0: 0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator: Smt. Mamatha G M/ Dr. Pradipkumar Dixit

Course content

Unit I

Electrostatic field, their control & Estimation: Electric field intensity, Electric strength, classification of electric fields, Degree of uniformity of electric fields, control of electric filed intensity, estimation of electric field intensity, Basic Equation for potential and field intensity in electrostatic fields, Analysis of electrostatic fields in homogeneous single dielectric medium.

Sources: EMC regulation, typical noise path and use of network theory, Method of noise coupling, miscellaneous noise sources and methods of eliminating interference.

Unit II

Cabling: Capacitive coupling, effect of shield on magnetic coupling, mutual inductance effect, agnatic filed between shield & inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, Shield transfer impedance, Coaxial cable vs shielded twisted pair cables.

Digital circuit radiation: Differential radiation, Common mode radiation, controlling techniques for Differential & common mode radiation, EMC testing procedures.

Unit III

Shielding: Near& Far fields, Characteristics& Wave impedance shielding effectiveness, Absorption loss, Reflection loss, composite absorption& reflection loss, Shielding with magnetic materials, effects of apertures, conductive windows, coatings, cavity resonance.

Intrinsic noise sources: Thermal noise, contact noise, shot noise & popcorn noise, Measuring random noise, Noise factor, Measurement of noise factor. Digital circuit Noise & layout, Power Distribution noise.

Unit IV

Electrostatic Discharge: Static generation, human body mode, Static discharge and ESD protection in equipment design, Software & ESD protection, ESD vs EMC.

Contact Protection: Glow discharge, Arc Discharge, Loads with high inrush currents, contact protection fundamentals Contact protection networks for inductive loads and resistive loads.

Unit V

Balancing & filters: Balancing, Power supply decoupling, Decoupling filters, High frequency decoupling, System bandwidth, Modulation and coding.

Grounding: safety grounds, Signal grounds, Single point ground systems, multipoint ground systems, Functional ground layout, Hardware grounds, ground loops, Grounding of cable shields, Guard shields, Guard meters.

EMC applications: RF& Transient Immunity, PCB layout & stack up

Text books:

1. Henry W. Ott., "*Electromagnetic Compatibility Engineering",* Revised Edition, John Wiley 2009.
2. Ravindra Arora, "*High Voltage insulation engineering"*, New age International Publication 1995.

Reference books:

1. Henry ott., "*Noise reduction techniques in electronic systems",*2nd Edition, John Wiley 1988.

Course Outcomes (COs):

At the end of the course, the student will be able to:

1. Interpret on Estimation and Control of Electric Field Intensity. (PO 1, 2, 8, 10) (PSO 1, 2, 3)
2. Analyze the factors affecting EMC. (PO 1, 5, 6, 7, 10) (PSO 1, 2, 3)
3. Design a Cabling and Filtering network for various circuits to mitigate EMC issues. (PO 1, 2, 3, 4, 5, 8, 10) (PSO 1, 2, 3)
4. Recognize Shielding and methods of Grounding for different EMC applications. (PO 1, 2, 3, 4, 5, 8, 10) (PSO 1, 2, 3)
5. Justify the need of protection of equipments against ESD. (PO 1, 5, 6, 7, 10) (PSO 1, 2, 3)