RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

ELECTRICAL AND ELECTRONICS ENGINEERING

III & IV 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 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 60% 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. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

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 secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by 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 65th rank among 1143 top Engineering institutions of India for the year 2021 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 college. In 2003, the Department was recognized as a Research Centre by Visvesvaraya Technological University, Belagavi and offers Ph.D and MSc.(Engg.) by research programs. The Department also started a PG program in Computer Applications in Industrial Drives, in 2004. Our UG programme is accredited by NBA since 2001**.** The department has 15 well-qualified faculty members. The entire faculty holds postgraduate degree in either Power Systems / Power Electronics. Eight of the faculty members are doctorates. Dr. Pradipkumar Dixit is specialized in High Voltage Engineering (Ph.D from Visvesvaraya Technological University, Belagavi, 2009), Dr. Chandrashekhar Badachi is specialized in High Voltage Engineering (Ph.D from Jain University, Bengaluru, 2016), Dr. Kodeeswara Kumaran G is specialized in Power Electronics for Renewable Energy Applications (Ph.D from NITK, Surathkal, 2018). Dr. Sridhar S holds doctoral degree with specialization in Power Systems (from Visvesvaraya Technological University, Belagavi, 2018), Dr. S Dawnee holds doctoral degree with specialization in nanotechnology and MEMS. Dr Janamejaya B C holds doctoral degree with specialization in fast charging (from, University of Ontario Institute of Technology (UOIT), Ontario, Canada, 2018), Dr. Nagaraj C holds doctoral degree with specialization in Power Electronics Applications to Power Systems (Ph.D from NITK, Surathkal, 2020), Dr. Rakesh Kumar holds doctoral degree with specialization in power electronics and drives and Dr. G. R. Nagabhushana, formerly chairman, Dept. of High Voltage Engineering, Indian Institute of Science, Bangalore is with the department as Professor Emeritus. In addition, Sri. K V Jayaram, Retired JM-DGM, Bokaro Steel Plant /SAIL has joined the department as Coordinator for Schneider Electric Centre of Excellence.

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.

Semester wise Credit Breakdown for B E Degree Curriculum

Batch 2020-24

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	8	9	4	4					**25**
Engineering Sciences (ESC)	10	11							**21**
Humanities, Social Sciences and Management (HSMC)	2	2			3		3		**10**
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	12	**17**
Total Credits	**20**	**22**	**25**	**25**	**24**	**24**	**20**	**15**	**175**

SCHEME OF TEACHING
III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EE31	Engineering Mathematics-III	BS	3	1	0	4	5
2.	EE32	Digital Electronics	PC	4	0	0	4	4
3.	EE33	Microcontrollers: Programming & Interfacing	PC	4	0	0	4	4
4.	EE34	Electric Networks	PC	3	1	0	4	5
5.	EE35	Electrical Machines – I	PC	4	0	0	4	4
6.	EE36	Electrical & Electronic Measurements	PC	3	0	0	3	3
7.	EEL37	Microcontrollers and Applications lab	Lab	0	0	1	1	2
8.	EEL38	Digital Electronics Lab.	Lab	0	0	1	1	2
9.	AM31*	Additional Mathematics - I	BSC	0	0	0	0	3
Total				**21**	**2**	**2**	**25**	**32**

* Non Credit Mandatory Course L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. The Non Credit Mandatory Course, Additional Mathematics – I is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.
2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
   In case student fail to earn the prescribed activity points, Eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

SCHEME OF TEACHING
IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	EE41	Engineering Mathematics-IV	BS	3	1	0	4	5
2.	EE42	Field Theory	PC	3	1	0	4	5
3.	EE43	Power Electronics	PC	4	0	0	4	4
4.	EE44	Electronic Devices & Circuits	PC	4	0	0	4	4
5.	EE45	Electrical Machines - II	PC	4	0	0	4	4
6.	EE46	Fundamentals of Modern VLSI Devices and Fabrication	PC	3	0	0	3	3
7.	EEL47	Electrical Machines-I Lab.	Lab	0	0	1	1	2
8.	EEL48	Introduction to Product Design	Lab	0	0	1	1	4
9.	AM41*	Additional Mathematics - II	BSC	0	0	0	0	3
Total				**21**	**2**	**2**	**25**	**32**

* Non Credit Mandatory Course L – Lecture (one hour) T - Tutorial (Two hours) P - Practical (Two hours)

Note:

1. The Non Credit Mandatory Course, Additional Mathematics – II is prescribed for IV Semester Lateral Entry Diploma students admitted to BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE to appear for SEE. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.
2. **AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**
   Every regular student, who is admitted to the 4 year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years Degree Program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th Semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.
   In case student fail to earn the prescribed activity points, Eight semester Grade Card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the Eight Semester grade card.

III Semester

ENGINEERING MATHEMATICS - III

Subject Code: EE31 **Credit: 3:1:0**
Prerequisite: Nil **Contact Hours: 70**

Course Content

Unit I

Numerical solution of Algebraic and Transcendental equations: Method of false position, Newton - Raphson method.

Numerical solution of Ordinary differential equations: Taylor's series method, Euler's and modified Euler's method, fourth order Runge-Kutta method.

Statistics: Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves. Correlation and Regression. Applications to Engineering problems.

Unit II

Linear Algebra: Elementary transformations on a matrix, Echelon form of a matrix, rank of a matrix, Consistency of system of linear equations, Gauss elimination and Gauss – Seidel method to solve system of linear equations, Eigenvalues and Eigenvectors of a matrix, Rayleigh power method to determine the dominant Eigen value of a matrix, Diagonalization of square matrices, Solution of system of ODEs using matrix method. Applications to Engineering problems.

Unit III

Complex Variables-I: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions.

Transformations: Conformal transformation, Discussion of the transformations - $w = z^2, w = e^z$ and $w = z + \frac{a^2}{z}\ (z \neq 0)$, Bilinear transformation.

Unit IV

Complex Variables-II: Complex integration, Cauchy theorem, Cauchy integral formula, Taylor and Laurent series (statements only), Singularities, Poles and residues, Cauchy residue theorem.

Transformations: Conformal transformation, Discussion of the transformations $w = e^z$, $w = z^2$ and $w = z + \frac{a^2}{z}$, $(z \neq 0)$, Bilinear transformations.

Unit V

Fourier Series: Convergence and divergence of infinite series of positive terms, Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period. Half range Fourier series. Applications to Engineering problems: Fourier series for Periodic square wave, Half wave rectifier, Full wave rectifier, Saw-tooth wave with graphical representation, Practical harmonic analysis.

Text Books

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 44th edition – 2017.

Reference Books

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4th edition – 2010.
2. Dennis G. Zill, Michael R. Cullen - Advanced Engineering Mathematics, Jones and Barlett Publishers Inc. – 3rdedition – 2009.
3. Dennis G. Zill and Patric D. Shanahan- A first course in complex analysis with applications- Jones and Bartlett publishers-second edition-2009.

Course Outcomes (COs):

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

1. Apply numerical techniques to solve Engineering problems and fit a least squares curve to the given data. (PO-1,2 & PSO-1,2)
2. Test the system of linear equations for consistency and solve system of ODE's using matrix method. (PO-1,2 & PSO-1,2)
3. Examine and construct the analytic functions. (PO-1,2 & PSO-1,2)
4. Classify singularities of complex functions and evaluate complex integrals. (PO-1,2 & PSO-1,2)
5. Construct the Fourier series expansion of a function/tabulated data. (PO-1,2 & PSO-1,2)

DIGITAL ELECTRONICS

Subject Code: EE32 **Credit: 4:0:0**
Prerequisite: Nil **Contact Hours: 56**
Course Coordinator/s: Dr. S. Dawnee

Course Content

Unit I

Principles of Combinational Logic: Review of Boolean algebra and basic gates, Definition of combinational logic, Canonical forms, Generation of switching equations from truth table, Karnaugh maps - 3, 4 variables, Map entered variables, Incompletely specified functions, Simplifying max term equations, Quine - McCluskey minimization technique.

Unit II

Analysis and Design of Combinational Logic I: General approach, Decoders-NAND gate implementation, types, using decoders as Boolean function generators, BCD decoders, encoders.

Analysis and Design of Combinational Logic II: Digital multiplexers-using multiplexers as Boolean function generators, adders & subtractors, Binary Comparators.

Unit III

Sequential Circuits I: Basic bistable elements, SR latch, applications, Gated SR latch, D, T, JK flip flops, Characteristics equations, Master/Slave JK flip-flop, Edge triggered flip flop, conversion of one flip flop to another.

Unit IV

Sequential Circuits II: Register, Counters, Asynchronous (ripple counters), Synchronous binary counters, Design of synchronous counters using different flip flops, Shift registers, Counters using shift registers.

Unit V

Sequential Design: Introduction, Mealy and Moore Models, State Machine Notation, State diagram, Synchronous Sequential Circuit Analysis.

Digital Integrated Circuits: Logic families and their characteristics-TTL, CMOS

Text Books

1. Thomas L Floyd**,** *Digital Fundamentals*, TMH, 8th edition
2. John M. Yarbrough, *Digital Logic Applications & Design*, Thomas Learning, 2001

Reference Books

1. Morris M.Mano, *Digital Logic& Computer Design,* Prentice Hall, 2006.
2. Donald P Leach, Albert Paul Malvino, *Digital Principles & Applications*, Tata McGraw Hill, 4th Edition.
3. Donald D Givone, *Digital Principles & Design*, TMH, 2002.

Course Outcomes (COs):

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

1. Analyze the given design specification and formulate the solution in the form of Boolean equations (PO-1) (PSO-1)
2. Develop combinational logic circuits using logic gates, multiplexers, decoders and other ICs (PO-1) (PSO-1)
3. Learn functioning, design aspects and develop sequential circuits using different flip flops (PO-1) (PSO-1)
4. Identify different logic families and their characteristics (PO-1) (PSO-1)
5. Design and develop finite state machines (PO-1) (PSO-1)

MICROCONTROLLERS: PROGRAMMING & INTERFACING

Subject Code: EE33 **Credits: 4: 0: 0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: **Sri. Vinayak V Rao/ Dr. Kodeeswara Kumaran.G**

Course Content

Unit I

Introduction to Microcontrollers: Comparison of microcontroller and microprocessors, microcontroller types, general resources available in microcontrollers, RISC and CISC architecture.
Review of numbering systems and binary arithmetic.
8051Basics: Architecture, pin configuration, oscillator and clock, internal and external memory, program counter, data pointer, CPU registers, Program Status Word (PSW), flags, stack, stack pointer, special function registers.

Unit II

8051-Assembly Language Programming: Addressing modes, Instruction Set - data movement instructions, arithmetic & logic instructions, and program control instruction. Programming tools and techniques, simple programs.

Unit III

8051 Programming in C: Data Types, Time Delay, I/O Programming, Timer Programming, Counter Programming, Serial Port Programming.

Unit IV

Interrupt Programming, Seven Segment Display Interfacing, Keypad Interfacing, External Memory Interfacing, ADC/DAC Interfacing.

Unit V

Introduction to Embedded Systems: Components of Embedded System, Classification, Device drivers and its functions, Operating systems goals and structure, RTOS Services & its necessity for an embedded systems.
Embedded Programming- Advantages and disadvantages.

Text Books

1. Muhammad Ali Mazidi, Janice Gillespie Mazidi, Rollin D. McKinlay, *The 8051 Microcontroller and Embedded Systems– using assembly and C*, Pearson Education, 2nd Edition.
2. Rajkamal, *Embedded Systems: Architecture, Programming and Design,* Tata McGraw-Hill, 7th Edition, 2006.
3. Andrew.N.Sloss, *ARM Systems Developers Guide*, Elsevier Publications, 2008.

Reference Books

1. Kenneth J. Ayala, *The 8051 Microcontroller Architecture Programming &Applications*, Penram International, 1996
2. Myke Predko, *Programming and Customizing the 8051 Microcontrollers*, TMH, 1999.
3. David Calcutt, Fred Hassan, '8051 Microcontroller: An Application Based Introduction', Newness, 2008.

Course Outcomes (COs):

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

1. Identify the different functional units of a microcontroller and explain their functionality. (PO-1) (PSO-1)
2. Develop algorithm and write assembly language/C programs for a given specification. (PO-2) (PSO-1)
3. Describe the function of 8051 peripherals and use it for their system design requirements. (PO-1,3)(PSO-1)
4. Design interfacing circuitry to interface basic input/output devices and design 8051 based systems using these interfacing circuitry. (PO-3,12) (PSO-1)
5. Explain the basics of embedded systems (PO-1) (PSO-1)

ELECTRIC NETWORKS

Subject Code: EE34 **Credits: 3: 1: 0**
Prerequisites: Nil **Contact Hours: 70**
Course Coordinator/s: **Dr. S Sridhar/Sri. Vinayaka V Rao**

Course Content

Unit I

Introduction: Practical sources, source transformation, network reduction using start-delta transformation, loop and node analysis with linearly dependent and independent sources for DC and AC network, concepts of super node and super mesh.

Unit II

Network theorems: Superposition, reciprocity, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Millman's theorem

Unit III

Two port network parameters: short circuit admittance parameters, open circuit impedance parameters, transmission parameters, hybrid parameters, relationship between parameter sets, calculation of these parameters for a given network

Unit IV

Transient behavior and initial conditions: Behavior of circuit element under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuit for AC and DC excitations, problem solving using Laplace transforms.

Unit V

Resonant circuits: Series and parallel resonance, frequency response of series and parallel circuits, Q factor and bandwidth.

Three phase circuits: Analysis of balanced and unbalanced three phase systems, measurement of active and reactive power (with balanced system), advantages of poly-phase system over single phase system.

Text Books

1. Ravish.R.Singh, "*Electrical Networks*", Mcgraw Hill company,2009
2. J.A.Edminister, "*Theory and Problems of Electric Circuits*", Schaum's Outline Series, 4th Edition.

Reference Books

1. G.K.Mittal, "*Netwrok Analysis,Khanna"*, Publishers,8th edition.
2. Van Valkenberg, "*Network Analysis"*, Prentice Hall, 1974.
3. C.L.Wadhwa, "*Electric Circuit Analysis*", New age International Publishers,2nd edition.
4. Roy Choudhary, "*Networks and Systems*", New age International Publishers,2nd edition.

Course Outcomes (COs):

A student completing this course should be able to:

1. Obtain solution to problems in electrical network using network reduction techniques and source transformations (PO-1, 2) (PSO 1)
2. Obtain solution to problems in electric circuits by applying network theorems. (PO-1, 2) (PSO 1)
3. Represent the two port network by Z, Y, ABCD and h Parameters. (PO-1, 2) (PSO 1)
4. Analyze the network under transient condition due to switching and able to apply the Laplace transforms. (PO-1, 2) (PSO 1)
5. Solve problems on frequency response and analyze poly phase balanced and unbalanced circuits. (PO-1, 2) (PSO 1)

ELECTRICAL MACHINES – I

Subject Code: EE35 **Credits: 4: 0: 0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Dr. Chandrashekhar Badachi/Dr. Nagaraj C

Course Content

Unit I

DC Generator – Review of basics, types of excitation, no-load & load characteristics, armature reaction, commutation – types, difficulties.

DC Motors - Torque equation, back emf, characteristics of shunt, series, compound motors, Speed control of shunt and series motors, applications of DC machines

Unit II

Testing of DC Machines - Necessity of starters, types of starters, losses in DC machines, efficiency, direct & indirect method of testing for shunt & series DC machines, permanent magnet DC motors and brushless DC motors.

Unit III

Synchronous Generator – Review of construction, EMF equation, effect of distribution of winding, use of chorded coils, harmonics – causes, effects, reduction, regulation by EMF, MMF, ZPF, ASA method, two reaction theory, slip test

Unit IV

Parallel Operation of Synchronous Generator - Synchronizing to infinite bus bars, parallel operation of synchronous generators, operating characteristics, power angle characteristics, (excluding armature resistance), operation at constant load with variable excitation and vice versa for generating mode & motoring mode, V curve of synchronous machine, compounding curves of synchronous generator, capability curves of synchronous generator.

Unit V

Synchronous Motor - Power flow equations of non-salient pole machines, hunting in synchronous machines, damper windings, starting methods of a synchronous machine to run as a motor, synchronous condenser, salient pole synchronous machines- power flow equations and power angle diagram, line start permanent magnet synchronous motor.

Text Books

1. I.J.Nagrath & D.P.Kothari , *Electric Machines*, TMH, 2nd Edition
2. Alexander Langsdorf , *Theory of Alternating Current Machines*, TMH, 2nd Edition
3. M.G.Say, *Performance & Design of AC Machines*, CBS Publishers, 3rd Edition

Reference Books

1. Bhimbra, *Electric Machinery*, Khanna Publishers, 2nd Edition.
2. Wildi, *Electrical Machines, Drives & Power Systems*, Pearson Education, 2006.

Course Outcomes (COs):

On successful completion of this course, the students will be able to:

1. Describe and analyze the characteristics of DC generator and DC motor and solve problems based on the method of speed control of DC motor (PO-1, 2) (PSO-1)
2. Analyze the performance of DC machines (PO-1, 2) (PSO-1).
3. Describe and analyze the construction and emf equation of alternator (PO-1, 2) (PSO-1).
4. Describe and analyze the regulation and parallel operation of alternator (PO-1, 2) (PSO-1).
5. Describe the starting of synchronous motor, use of damper windings, hunting in synchronous motor (PO-1, 2) (PSO-1).

ELECTRICAL & ELECTRONICS MEASUREMENTS

Subject Code: EE36 **Credits: 3: 0: 0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator/s: Sri. Narsimpur Tushar Suresh/ Smt. Mamatha G M

Course Content

Unit I

Review of fundamental and derived units, SI units, Dimensional equation, Standards. Requirements of instruments, Definition of Accuracy & Precision and resolution.
DC Bridges: Wheatstone bridge, Limitations, Kelvin double bridge.
AC Bridges: Maxwell's Bridge, Anderson Bridge & Schering Bridge.

Unit II

Introduction to Ammeter and Voltmeter, Extension of Instrument Ranges - shunt & multipliers. Instrument Transformers: Construction & theory of Instrument transformer, Ratio and phase angle error of CT and PT, Silsbee's method of testing CT, Difference between CT and PT, means to reduce error in CT & PT.

Unit III

Construction and operation of electrodynamometer single phase PF meter, Weston frequency meter and phase sequence indicator.
Introduction to electronic Instrumentation & ADC, True RMS responding voltmeter, Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, and Successive - approximation DVM, Q-meter, Electronic Multi-meter.

Unit IV

Wattmeter: Construction and theory of electrodynamometer wattmeter, Errors, LPF wattmeter.
Induction type energy meter, Construction, Theory, Errors, adjustments and calibration, Principle of electronic energy meter.

Unit V

Classification and Selection of Transducers, Strain Gauge, LVDT, RTD, Thermistors, Thermocouples. Introduction to Data Acquisition Systems, Components of Digital and Analog Data Acquisition Systems.

Text Books:

1. A.K.Sawhney, Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai& Sons, 9th Edition.
2. David A Bell, Electronic Instrumentation and Measurements, PHI, 2nd Edition.

Reference Books

1. Golding and Widdies, Electrical Measurements and Measuring Instruments, Wheeler Publications, 5th Edition.
2. Harris, Electrical Measurements, John Wiley, 2nd Edition.

Course Outcomes (COs):

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

1. Derive units of any physical parameters based on the equations governing that physical parameter. (PO –1) (PSO-1)
2. Find the values of Unknown Resistance, Inductance and Capacitance by using different methods. (PO – 1) (PSO-1)
3. Measure Current and Voltage using Instrument transformers. (PO –1) (PSO-1)
4. Determine the accuracy of measuring instruments. (PO – 1,4,12) (PSO-1)
5. Decide the type of transducer and measuring devices to be selected for any particular process. (PO -1,7,12) (PSO-3)

MICROCONTROLLER: PROGRAMMING & APPLICATIONS LAB

Subject Code: EEL37 **Credits: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Sri. Vinayak V Rao/ Dr. Kodeeswara Kumaran. G

List of Experiments

1. 8051 assembly language programs for data movement (using conditional statements and loop structures) and manipulation of port data.
2. 8051 assembly language programs for sorting numbers, finding largest/smallest numbers in a series and for converting numbers.
3. 8051 C language programs for reading and manipulating port data.
4. 8051 C language programs for sorting numbers, finding largest/smallest numbers in a series and for converting numbers.
5. 8051 C language programs for generating waveforms
6. Hardware implementation of seven segment display control using 8051 microcontroller
7. Hardware implementation of 9V DC motor control using 8051 microcontroller
8. Measurement of resistance with dc bridges using a microcontroller
9. Measurement of temperature using microcontroller
10. Measurement of DC voltage using microcontroller
11. Measurement of DC current using microcontroller
12. Design and Implementation of DC load power measurement with temperature control (Capstone Project)

Course Outcomes (COs):

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

1. Develop an algorithm that will enable the student to write 8051 programs. (PO-1,2,4) (PSO 1, 2)
2. Write, simulate and debug 8051 assembly/C programs for a given problem statement. (PO-1,2,4) (PSO 1, 2)
3. Create a hex file, program the microcontroller and conduct a hardware experiment. (PO-1,4) (PSO 1, 2)
4. Design and implement a simple 8051 microcontroller based system, in a group, to solve an engineering design problems. (PO-3,4) (PSO 4)

DIGITAL ELECTRONICS LAB

Subject Code: EEL38 **Credits: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Dr. S. Dawnee

List of Experiments

1. Simplification, realization of Boolean expressions using logic gates
2. Realization of half/full adder and half/full subtractor using logic gates
3. Realization of parallel adder/subtractor using 7483 chip and BCD to Excess 3 code conversion and vice versa
4. Realization of binary to gray code converter and vice versa
5. Use of MUX/DEMUX for arithmetic circuit and code converter
6. Realization of one/two bit comparator and study of 7485 magnitude comparator
7. Truth table verification of flip-flops (JK, T and D type)
8. Realization of 3-bit counters as a sequential circuit and mod-n counter design
9. Shift left and shift right, SIPO, SISO, PISO, PIPO operations using 7495
10. Design and testing of Ring Counter/ Johnson counter
11. Design of sequence generator

Course Outcomes (COs):

The course enabled the students to:

1. Learn functioning, design and implement digital circuits using logic gates, decoders, multiplexers, flip-flops etc. (PO-4) (PSO-1)
2. Enhance their technical and communication skills and demonstrate team spirit with mini project. (PO-9,10) (PSO-4)

ADDITIONAL MATHEMATICS – I

Subject Code: AM31 **Credits: 0: 0: 0**
Prerequisites: Nil **Contact Hours: 40L**
Course Coordinator/s: Dr. N L Ramesh

Course Objectives:

1. Learn successive differentiation, polar coordinate system and Taylor's series expansion of functions of single variable.
2. Learn the concept of reduction formula and multiple integrals.
3. Study vector algebra and vector differentiation.
4. Learn the procedure of solving first order and first degree ODE's.

Unit-I

Differential Calculus-I -08 Hrs

Successive differentiation, n^{th} derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

Unit-II

Integral Calculus -08 Hrs

Introduction, Reduction formula, Reduction formula for $\int sin^n x\, dx$, Reduction formula for $\int cos^n x\, dx$, Reduction formula for $\int sin^n x cos^m x\ dx$, Evaluation of double and triple integrals.

Unit-III

Vector Algebra-08 Hrs

Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

Unit –IV

Vector Differentiation-08Hrs

Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector, irrotational vector,Laplace's operator. Vector identities connected with gradient, divergence and curl.

Unit- V

First Order Differential Equations-08 Hrs

Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44thedition, 2017.
2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

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

1. Find the length of the perpendicular from pole to tangent and determine the series expansion of differentiable functions (PO-1, 2)
2. Evaluate multiple integrals (PO-1, 2)
3. Analyze and solve problems related to Vector Algebra. (PO-1, 2)
4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1, 2)
5. Solve the first order and first degree ordinary differential equations. (PO-1, 2)

IV Semester

ENGINEERING MATHEMATICS-IV

Subject Code: EE41 **Credits: 3: 1: 0**
Prerequisites: Nil **Contact Hours: 70**

Course Content

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton-Gregory forward and backward interpolation formulae, Lagrange's interpolation formula and Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cotes quadrature formula, Trapezoidal rule, Simpson's1/3rd rule and Simpson's 3/8th rule. Applications to Engineering problems.

Unit II

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, Properties, Inverse transform, Convolution theorem, Parseval's identity (statements only). Applications to Engineering problems. Fourier transform of rectangular pulse with graphical representation and its output discussion, Continuous Fourier spectra-example and physical interpretation. Limitation of Fourier transforms and the need of Wavelet transforms.

Z-Transforms: Definition, Standard Z-transforms, Single sided and double sided, Linearity property, Damping rule, Shifting property, Initial and final value theorem, Convergence of Z-transforms, Inverse Z-transform, Convolution theorem and problems, Application of Z-transforms to solve difference equations. Applications to Engineering problems.

Unit III

Random Variables: Random variables (discrete and continuous), Probability density function, Cumulative distribution function, Mean, Variance and Moment generating function.

Probability Distributions: Binomial and Poisson distributions, Uniform distribution, Exponential distribution, Gamma distribution and Normal distribution. Applications to Engineering problems.

Unit IV

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional probability and Conditional expectation.

Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

Markov Chain: Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states. Markov and Poisson processes. Applications to Engineering problems.

Unit V

Series Solution of ODEs and Special Functions: Series solution, Frobenius method, Series solution of Bessel differential equation leading to Bessel function of first kind, Orthogonality of Bessel functions, Series solution of Legendre differential equation leading to Legendre polynomials, Orthogonality of Legendre Polynomials, Rodrigue's formula**.**

Text Books:

1. R. E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
2. B. S. Grewal-Higher Engineering Mathematics-Khanna Publishers-44th edition-2017.
3. Wavelets: A Primer- AK Peters/CRC Press, 1st Edition-2002.

Reference Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10th edition-2015
2. Glyn James- Advanced Modern Engineering Mathematics-PearsonEducation-4th edition-2010
3. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.

Course Outcomes (COs):

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

1. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1,2 & PSO-1,2)
2. Evaluate Fourier transforms and use Z-transforms to solve difference equations. (PO-1,2 & PSO-1,2)
3. Analyze the given random data and its probability distributions. (PO-1,2 & PSO-1,2)
4. Determine the parameters of stationary random processes and use Markov chain in prediction of future events. (PO-1,2 & PSO-1,2)
5. Obtain the series solution of ordinary differential equations. (PO-1,2 & PSO-1,2)

FIELD THEORY

Subject Code: EE42 **Credits: 3:1:0**
Prerequisites: Nil **Contact Hours: 70**
Course Coordinator/s: Dr. Pradipkumar Dixit & Sri. Victor George

Course Content

Unit I

Coulomb's Law, electric field intensity, field of a line charge, sheet of charge, electric flux density, Gauss's law, divergence, Maxwell's first equation (Electrostatics), applications

Unit II

Vector operator ∇ and divergence theorem, definition of potential difference and potential, potential field of a point charge and system of charges, potential gradient, current and current density, continuity of current, applications

Unit III

Boundary conditions for perfect dielectrics, derivations of Poisson's and Laplace's equations, examples of the solutions of Laplace's and Poisson's equations. Capacitance, examples, Biot-Savart law, Ampere's circuital law, Curl, Applications

Unit IV

Magnetic flux and flux density, scalar and vector magnetic potentials, force on a moving charge and differential current element, force between differential current elements, force and torque on a closed circuit, applications.

Unit V

Magnetic boundary conditions, Potential energy, Inductance, Examples, Faraday's law, Displacement current, Maxwell's equation in point and integral form, retarded potentials, applications.

Text Book

1. William H Hayt Jr. and John A Buck, *Engineering Electromagnetic*, Tata McGraw-Hill, 7th Edition 2009.

Reference Books

1. John Krauss and Daniel A Fleisch, *Electromagnetics with Applications*, McGraw-Hill, 5th Edition 1999.
2. Matthew N.O. Sadiku, *Elements of Electromagnetics,* Oxford University Press, 3rd Edition, 2004.

Course Outcomes (COs):

A student completing this course should be able to:

1. Determine force, electric filed, potential and potential gradient due to different charges. (PO-1, PSO-1).
2. Understand the application of divergence and estimation of current and current density. (PO-1, PSO-1)
3. Comprehend boundary relations and application of Laplace's & Poisson's equations (PO-1, PSO-1).
4. Realize application of Biot-Savart, Ampere's law and curl (PO- 1, PSO-1).
5. Gain concept of displacement current and time varying magnetic field (PO-1, PSO-1).

POWER ELECTRONICS

Subject code: **EE43** **Credits: 4:0:0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Sri. Omsekhar Indela

Course Content

Unit I

INTRODUCTION

Applications of power electronics, power semiconductor devices, control characteristics of power devices, Types of power electronic circuits.

POWER TRANSISTORS

Power MOSFET: Structure, operation, concept of pinch-off, steady state characteristics, switching characteristics.

IGBT: Structure, operation, steady state characteristics, switching characteristics.

Unit II

THYRISTORS

Introduction, static characteristics, two- transistor model, dynamic characteristics – turn-on and turn-off, di/dt and dv/dt protection, series and parallel operation of thyristors, Triac: structure, characteristics.

Thyristor firing circuits – R, R-C and UJT triggering circuit.

Unit III

THYRISTOR COMMUTATION TECHNIQUES

Introduction, natural commutation, Forced commutation – self commutation, resonant pulse commutation, complementary commutation, impulse commutation, external pulse commutation.

AC VOLTAGE CONTROLLERS

Introduction, principle of on-off and phase control, single phase unidirectional controller with R load, Single-phase bi-directional controller with resistive and inductive loads.

Unit IV

PHASE CONTROLLED RECTIFIERS

Introduction, single phase single pulse and two pulse converters with R& RL load, three phase three pulse and six pulse converter with R & RL load, single phase and three-phase semi-converters.

Unit V

DC CHOPPERS

Introduction, principle of step-up and step-down chopper, classification of choppers.

INVERTERS

Introduction, principle of operation, performance parameters, single phase half and full- bridge inverter with R and RL load, voltage control of single phase inverter – single pulse width, multiple pulse width, sinusoidal pulse width, modified sinusoidal pulse-width modulation and phase displacement control techniques.

Text Books

1. M. H. Rashid, "*Power Electronics: Circuits, Devices and Applications*", Third Edition, PHI, 2005.
2. M. D. Singh, Khanchandhani K. B, "*Power Electronics"*, TMH, 2001.

Reference Books

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "*Power Electronics-converters, applications and design*", Third edition, Wiley 2009.
2. Vedam Subramanyam, "*Power Electronics*", Revised Second Edition, New Age International Publishers, 2006.

Course Outcomes (COs):

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

1. Familiar with the structure, characteristics and operation of power semiconductor devices like MOSFET and IGBT. (PO 1) (PSO 1)
2. Analyze and synthesize the detailed operation of thyristors. (PO1, 2, 3) (PSO1)
3. Design suitable firing circuits and commutation circuits for thyristors. (PO 1, 2, 3) (PSO 1).
4. Analyze the working of various types phase controlled rectifiers and ac voltage controllers. (PO 1, 2) (PSO 1)
5. Analyze the working of DC choppers and inverters. (PO 1, 2) (PSO 1)

ELECTRONIC DEVICES AND CIRCUITS

Subject Code: EE44 **Credits: 4:0:0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Sri. Ramakrishna Murthy K / Sri. Victor George

Course Content

Unit I

Diode Circuits: Diode equivalent circuits, Transistor and diffusion capacitance, load line analysis, diode approximations, gate circuits, clippers, clampers.

BJT Analysis: Need for biasing, BJT configurations, CB, CE, CC (detailed analysis for CE only), transistor switching networks.

Emitter follower: Comparison of transistor configuration, Darlington emitter follower, bootstrapped Darlington circuit.

Unit II

FET: JFET construction and characteristics, introduction to depletion & enhancement type MOSFETS, CMOS, FET voltage divider biasing, small signal h parameter analysis for JFET voltage divider configuration.

Multistage Amplifier: Classification of amplifiers, distortion in amplifiers, frequency response of an amplifier, RC coupled amplifier.

Unit III

Introduction to Operational Amplifier: Op-Amp description – Circuit symbol and terminals, current, impedance and voltage level, equivalent circuit and block diagram of an Op-Amp. Basic op-amp parameters: Input and output voltage range, offset voltage and current, offset nulling, CMRR, PSRR, input and output impedance, slew rate and frequency limitation.

Op-Amp with Negative feedback: Introduction, block diagram representation of feedback configuration, voltage series feedback amplifier, voltage shunt feedback amplifier.

Op-Amp as D.C. Amplifier: Biasing operational amplifier, D.C. coupled voltage follower, D.C. coupled non inverting amplifier, D.C. coupled inverting amplifier, summing amplifiers and differential amplifier.

Unit IV

Signal Processing Circuits: Introduction, precision half wave rectifier: saturating precision rectifier, non-saturating precision rectifier, two output precision rectifier, precision full wave rectifiers: half wave rectifier and summing circuit, high input

impedance full wave precision rectifier, peak clipper, dead zone circuit, precision clipper, precision clamping circuit, precision rectifier peak detector, voltage follower peak detector, sample and hold circuit.

Active Filters: Introduction, First order low and high pass Butterworth filter, second order low and high pass Butterworth filter, band pass filter and band reject filter.

Unit V

Comparators: Positive feedback, upper threshold voltage, lower threshold voltage, zero crossing detector with hysteresis, inverting voltage level detectors with hysteresis, non-inverting voltage level detectors with hysteresis, voltage level detector with independent adjustment of hysteresis and center voltage.

Integrator and differentiator

Signal Generators: Basic principle of oscillator, phase shift oscillator using Op-Amp and BJT, Wein bridge oscillator using Op-Amp and BJT, Square wave generator with Op-Amp, triangular wave generator with Op-Amp and saw tooth wave generator using Op-Amp. (Only circuit, explanation and design, analysis excluded)

Specialised IC Applications: 555 timer, 555 timer as a monostable multivibrator, monostable multivibrator applications, 555 timer as an astable multivibrator, astable multivibrator applications, voltage regulators: fixed voltage regulators, adjustable voltage regulators.

Text Books

1. Robert L Boylestad & Louis Nashelsky, *"Electronic Devices & Circuit Theory"*, 6th Edition, PHI, 2002. (For Unit1, Unit 2 and BJT Oscillators)
2. David A Bell, "*Operational amplifiers and Linear IC's*", Prentice Hall, 2nd Edition. (For the following topics: Introduction to Operational amplifier, OP-AMP as D.C. Amplifier, Signal Processing circuits).
3. Ramakant A Gayakwad, "*Op-Amps and Linear Integrated Circuits*", Prentice Hall, 4th Edition. (For the following topics: Active Filters, Signal Generators, Integrators and differentiators, Op-amp with negative feedback, Specialised IC Applications)
4. Robert F Couglin, Frederick F Driscoll, "*Operational Amplifiers and Linear Integrated Circuits*", Prentice Hall, 6th Edition. (For the topic: Comparators).

References

1. Jacob Millman & Christos C Halkias, "*Integrated Electronics*", Tata McGraw-Hill, 1991.
2. Roy Choudhary, "*Linear Integrated Circuits*", New Age International, 2003.

Course Outcomes (COs):

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

1. Analyze transistor circuits using hybrid model and amplifier's distortion, design clipper and clamper (PO 1, 2, 3) (PSO 1).
2. Analyze effects of feedback in transistor amplifier and design oscillator circuits(PO2,3) (PSO 1).
3. Analyze various electrical characteristics of different IC's through interpretation of their data sheets. (PO 2) (PSO 1).
4. Design and analyze linear circuits and non-linear circuits for different functionality using Op-Amp (PO 2, 3) (PSO 1).
5. Illustrate the function of 555 timer and voltage regulators (PO 1, 3) (PSO 1).

ELECTRICAL MACHINES – II

Subject Code: EE45 **Credits: 4:0:0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Dr. Chandrashekhar Badachi

Course Content

Unit I

Transformers: Principle of transformer action for voltage transformation, Constructional details of shell type and core type single phase and three transformers, Types of transformers-Power distribution, Constant voltage transformer, Constant current transformer, Variable frequency and auto transformers, Tap changing transformers, Ideal and practical transformers on no-load, EMF equation, Transformers on load, Vector diagrams.

Unit II

Single phase transformers: Analysis & performance, - Equivalent circuit, Losses, Power and all-day efficiency, Regulation, Parallel operation and load sharing
Testing of transformers: Polarity test SC, OC test, Sumpner's test.

Unit III

Three phase transformers: Types of 3 phase transformers, Connections including open delta choice of connection, Phase conversion-Scott connection, three phases to two phase conversion, Labeling of three phase transformers terminals and applications
Autotransformers: Advantages/ disadvantages of 3 winding transformers, saving of copper in autotransformers

Unit IV

Induction machines: Basic concepts: Concept of rotating magnetic field, Operating principle, Construction, Classification and types.
Analysis & Performance of 3 phase induction motor: Induction motor on no load & load, Efficiency and losses, Vector diagram, Equivalent circuit, Performance (hp, torque, efficiency, Current and power factor evaluation, Slip torque characteristics covering regions of motoring, Generating and braking induction generator.

Unit V

Computation and circle diagrams: No load and blocked rotor tests, Circle diagram and performance evaluation, Cogging and crawling equivalent circuit and performance of double cage and deep bar motor.

Starting & Control: Need for starter, DOL, star-delta, Auto transformer starting, Rotor resistance starting, Electronics starter (any one type), Speed control-voltage, Frequency and rotor resistance variations

Single Phase induction motor: Double revolving field theory and principle of operation, Types-split phase capacitor, Shaded pole motors.

Text Books

1. A Langsdorf, *Theory of Alternating Current Machines*, TMH, 2nd Edition.
2. M.G.Say, *Performance & Design of AC Machines*, CBS Publications, 2005

Reference Books

1. J. Nagarath& Kothari, *Electric Machines*, TMH, 2nd Edition.
2. Ashfaq Hussain*, Electric Machines*, Dhanpat Rai & Co., 1999.

Course Outcome (COs):

At the end of the course students are able to:

1. Explain the principle and construction of transformers (PO-1) (PSO-1)
2. Evaluate the performance of single phase transformers (PO-1) (PSO-1)
3. Differentiate three phase transformers and auto-transformers (PO-1) (PSO-1)
4. Analyze the performance of induction motors (PO-1) (PSO-1)
5. Illustrate starting and control of induction motors. (PO-1) (PSO-1)

FUNDAMENTALS OF MODERN VLSI DEVICES AND FABRICATION

Subject Code: EE46 **Credits: 3:0:0**
Prerequisites: Nil **Contact Hours: 42**
Course Coordinator/s: Dr. S Dawnee

Course Content

Unit I

Introduction: Evolution of VLSI Device Technology, Modern VLSI Devices, CMOS transistors, Bipolar Transistors

Basic Device Physics: Electrons and holes in Silicon, Energy bands, n-type and p type Silicon, Carrier transport, basic equations for device operation, p-n junctions, built-in potential and applied potential.

Unit II

Fabrication Technology: Introduction**,** Why silicon, Purity of Silicon, Czochralski growing Process, Fabrication processes, Planar PN Junction diode fabrication, Fabrication of resistors and capacitors in ICs.

Metal Oxide Silicon Systems: Introduction, Energy band diagrams, Band-bending and the effect of bias voltages, Threshold Voltage, Oxide charges in MOS Capacitor

Unit III

Metal Oxide Semiconductor FET: Introduction, Construction and basic operation, Structure, Regions of operation: Cut-off, Linear, and Saturation regions, types of MOSFETs, control of threshold voltage- external biasing, V I Characteristics.

Unit IV

CMOS Design and Fabrication: CMOS structure, Transistor Design Methodology, Hierarchy, Circuit Design example, Design styles and Packaging, CMOS Fabrication-Twin well CMOS process.

Unit V

Bipolar Junction Transistors: Introduction, structure and basic operation, Fabrication of bipolar IC transistor, Terminology, Symbols and regions of operation, comparison between MOSFET & BJT

Text Books

1. Kanaan Kano "*Semiconductor Devices*", Pearson Education, 2006.
2. B. Streetman, S. Banerjee, "Solid State Electronic Devices", Prentice Hall of India Pvt Ltd,2008

Reference Books

1. K. N. Bhat, "*Physics of Semiconductor Devices*", Narosa Publications, 2004.
2. S. M. Sze, "*Semiconductor Devices: Physics and Technology*", Second Edition, Wiley India, 2008.

Course Outcomes (COs):

At the end of the course students are able to:

1. Illustrate the basic device physics associated with p-n junctions. (PO-1) (PSO 1)
2. Analyze the metal oxide silicon systems with specific focus on MOSCAP. (PO-1) (PSO 1)
3. Elucidate the design and analysis of MOSFET vis a vis CMOS design. (PO-1) (PSO 1)
4. Develop a comparative analysis of different VLSI devices- MOSFET vs BJT. (PO-1) (PSO 1)
5. Interpret and compare the fabrication technologies of different VLSI devices. (PO-1) (PSO 1)

ELECTRICAL MACHINES-I LAB

Subject Code: EEL47 **Credits: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Dr. Chandrashekhar Badachi

List of Experiments

1. No load characteristics of DC Generator.
2. Load test on DC Shunt Generator.
3. Load test on DC Shunt Motor.
4. Speed control of DC Shunt Motor.
5. Swinburne's test on DC Motor.
6. Hopkinson's test on a pair of identical DC Machines.
7. Speed control of DC Motor by ward Leonard method.
8. Slip test on 3- Φ Alternator.
9. Predetermination of % regulation of 3-Φ Alternator by EMF method.
10. Predetermination of % regulation of 3-Φ Alternator by MMF method.
11. Predetermination of % regulation of 3-Φ Alternator by ZPF method.
12. V-curves and inverted-V curves of a 3-Φ Synchronous motor.

Course Outcomes (COs):

At the end of the course students are able to:

1. Predetermine and determine the performance of dc machines. (PO-1,4) (PSO-1)
2. Predetermine the regulation of an alternator by various methods. (PO-1,4) (PSO 1)

INTRODUCTION TO PRODUCT DESIGN

Subject Code: EEL48 **Credits: 0: 0: 1**
Prerequisites: Nil **Contact Hours: 28**
Course Coordinator/s: Dr.Kodeeswara Kumaran. G/ Dr. Sridhar. S

Course contents

This course is an extension of Engineering Design and introduces the students to a detailed process of Engineering Design. Students 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.

References

1. https://resources.saylor.org/wwwresources/archived/site/wp-content/uploads/2012/09/ME101-4.1-Engineering-Design-Process.pdf
2. *http://ocw.mit.edul*

Course Outcomes (COs):

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

1. Define the problem to be solved in a clear and unambiguous terms (PO-1)(PSO-1)
2. Identify and establish the need to solve the problem by gathering relevant literature (PO-1) (PSO-3)
3. Generate multiple solutions, analyze and select one solution (PO-3,4,5) (PSO-1)
4. Test and implement the solution as a team (PO-9, 10) (PSO-2,4)
5. Document and present the solution to the peer group (PO-10, 12) (PSO-3,4)

ADDITIONAL MATHEMATICS – II

Subject Code: AM41 **Credits: 0: 0: 0**
Prerequisites: Nil **Contact Hours: 40L**
Course Coordinator/s: Dr. N L Ramesh

Course Objectives:

The students will

1. Understand the concept of partial derivatives, composite functions and Jacobians.
2. Learn to evaluate line, surface and volume integrals.
3. Learn to use Laplace transform method to solve initial and boundary value problems.
4. Learn the procedure of solving Linear differential equations with constant and variable coefficients.
5. Study the concepts of basic probability.

Unit-I

Differential calculus - 08 Hrs

Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions, Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

Unit-II

Vector integration – 08 Hrs

Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

Unit-III

Laplace transforms - 08 Hrs

Definitions, Laplace transforms of elementary functions, derivatives and integrals, periodic function, unit step function, inverse transforms, applications of Laplace transform to solve differential equations.

Unit-IV

Higher Order Differential Equations - 08 Hrs

Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

Unit-V

Probability - 08Hrs

Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability-illustrative examples. Bayes theorem –examples.

Text Books:

1. B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44thedition, 2017.
2. Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.

References:

1. H.K. Dass – Higher Engineering Mathematics – S Chand Publications - 1998.
2. B.V. Ramana – Engineering Mathematics – Tata McGrawHill Publishing Co. Ltd. – New Delhi – 2008.

Course Outcomes (COs):

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

1. Find Jacobian, extreme values and power series expansion of a function. (PO-1, 2)
2. Exhibit the interdependence of line, surface and volume integrals using integral theorems. (PO-1, 2)
3. Use the concept of Laplace transforms to solve initial and boundary value problems (PO-1, 2)
4. Solve Linear differential equations with constant and variable coefficients (PO-1, 2)
5. Demonstrate the understanding of axioms and rules of probability to solve problems. (PO-1, 2)