UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

IV SEMESTER

ELECTRICAL AND ELECTRONICS ENGINEERING
### SCHEME -2013

**IV SEMESTER**

**ELECTRICAL AND ELECTRONICS ENGINEERING (E)**

<table>
<thead>
<tr>
<th>Course No</th>
<th>Name of subject</th>
<th>Credits</th>
<th>Weekly load, hours</th>
<th>C A Marks</th>
<th>Exam Duration Hrs</th>
<th>U E Max Marks</th>
<th>Total Marks</th>
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<tbody>
<tr>
<td>13.401</td>
<td>Engineering Mathematics -III (E)</td>
<td>4</td>
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<tr>
<td>13.402</td>
<td>Digital Electronics and Logic Design (E)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>50</td>
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<tr>
<td>13.403</td>
<td>Engineering Electromagnetics (E)</td>
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<td>2</td>
<td>1</td>
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<tr>
<td>13.404</td>
<td>Electrical Measurements and Measuring Instruments (E)</td>
<td>4</td>
<td>3</td>
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<tr>
<td>13.405</td>
<td>Power Electronics (E)</td>
<td>4</td>
<td>2</td>
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<tr>
<td>13.406</td>
<td>Power Generation, Transmission and Distribution (E)</td>
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<td>13.407</td>
<td>Electrical Machines Lab I (E)</td>
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<td>13.408</td>
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<td><strong>14</strong></td>
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<td><strong>8</strong></td>
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Course Objective:

- To introduce the basic notion in complex analysis such as Analytic Functions, Harmonic functions and their applications in fluid mechanics and differentiations and integration of complex functions, transformations and their applications in engineering fields.
- Mathematics programming techniques are introduced as a part of this course. These techniques are concerned with allotment of available resources so as to minimize cost and maximize profit subject to prescribed restrictions.

Module – I

**Complex Differentiation:** Limits, continuity and differentiation of complex functions. Analytic functions – Cauchy Riemann equations in Cartesian form (proof of necessary part only). Properties of analytic functions – harmonic functions. Milne Thomson method.

**Conformal mapping:** Conformality and properties of the transformations \( w = \frac{1}{z} \), \( w = z^2 \), \( w = z + \frac{1}{z} \), \( w = \sin z \), \( w = e^z \) - Bilinear transformations.

Module – II

**Complex Integration:** Line integral – Cauchy’s integral theorem – Cauchy’s integral formula – Taylor’s and Laurent’s series – zeros and singularities – residues and residue theorem. Evaluation of real definite integrals – \( \int_0^{2\pi} f(\sin x, \cos x) \, dx \), \( \int_{-\infty}^{\infty} f(x) \, dx \) (with no poles on the real axis). (Proof of theorems not required).

Module – III


Module – IV

References:


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

**Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.**

**Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.**

**Course Outcome:**

*After successful completion of this course, the students will be familiar with the large scale applications of linear programming techniques. This course helps students to master the basic concepts of complex analysis which they can use later to solve problems related to engineering fields.*
13.402 DIGITAL ELECTRONICS AND LOGIC DESIGN (E)

Teaching Scheme: 2(L) - 1(T) - 0(P)  
Credits: 3

Course Objectives:

To familiarise the students with basic principles and design of digital circuits. The course should also give a foundation for a course in microprocessors and microcontrollers.

Pre-requisites:

Knowledge of number systems (decimal binary, octal and hexadecimal), binary arithmetic – 1’s complement and 2’s complement methods.

Module – I

Binary codes (BCD, Excess 3 and Gray codes), Logic functions and gates: Review of basic gates and truth tables - Elements of Boolean algebra – De Morgan’s theorem - Universality of NAND and NOR gates. Realisation of combinational circuits using sum of products (SOP) and product of sums (POS) expression – Don’t care conditions - Minimisation of Boolean functions by Boolean algebra, Karnaugh map (up to four variables), Quine McCluskey method (up to 5 variables).

Module – II

Combinational logic circuits: Half adder and full adder – parallel binary adder – BCD adder - ripple carry and look ahead carry adders, binary subtractor - parity checker/generator, 4 bit magnitude comparator – multiplexers and de-multiplexers - decoders and encoders – BCD to decimal and BCD to seven segment decoders. Realisation of logic functions using multiplexers and decoders. Logic families: Description of TTL, CMOS and ECL families - advantages and disadvantages of major logic families – Transfer characteristics of TTL and CMOS family IC’s – Current sourcing and current sinking operations of digital IC’s – fan-out and noise margin. Familiarisation of commercially available logic gates in 7400, 5400 and 4000 series of IC’s.

Module – III

Module – IV

Timer circuits: Monostable and astable multivibrators using logic gates and passive components, 555 Timer – astable multivibrator and monostable multivibrator circuits, 74121 Monostable multivibrator. Programmable Logic Devices: Description of PAL, PLA and FPGA. Memories – ROM- organisation, PROMs, RAMs – Basic structure, Static and dynamic RAMs. Basics of Hardware Description Languages – VHDL – example programs.

References


Internal Continuous Assessment (Maximum Marks-50)

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours       Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.
Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

After successful completion of this course, the students will be able to design digital circuits such as counters, registers, decoders, encoders, multiplexers etc. using the basic building blocks.
13.403 ENGINEERING ELECTROMAGNETICS (E)

Teaching Scheme: 2(L) - 1(T) - 0(P)  
Credits: 3

Course Objectives:

To provide the basic skills required to understand, develop and design various engineering applications involving electromagnetic fields.

Module – I

Overview of vector analysis: vector algebra-dot product and cross product- Cartesian co-ordinate system - cylindrical co-ordinate system – spherical co-ordinate system.

Coulomb's law & electric field intensity - field due to a continuous volume charge distribution - line charge -sheet of charge - flux density - Gauss law – applications. Divergence – divergence theorem.

Module – II

Concepts of electric potential: potential difference and energy - line integral -potential field of a point charge -system of charges - conservative property -potential gradient - electric field due to a dipole - energy density.

Conductors and dielectrics - current and current density - continuity of current -conductor properties and boundary conditions - method of images - boundary conditions for perfect dielectric materials.

Capacitance - capacitance of co-axial cable, two wire line.

Module – III

Poisson's and Laplace's equations - examples - uniqueness theorem.


Module – IV


Uniform plane wave-general solution-TEM waves-relation between electric and magnetic fields-phase and group velocity-plane waves in lossy medium-skin depth-propagation
constant and intrinsic impedance. Harmonically varying field. Poynting’s theorem-interpretation-application.

Transmission lines: uniform transmission line-VI solution-characteristic impedance-VSWR-impedance matching.

References:


Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours

Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to apply the basic concepts and principles of electromagnetic fields, for the design of electromagnetic circuits.
13.404 ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS (E)

Teaching Scheme: 3(L) - 1(T) - 0(P)  
Credits: 4

Course Objective:
- To provide knowledge in the specific area of electrical measurements
- To expose students to various measuring instruments

Module – I


Wattmeters : electrodynamometer type - construction - errors and compensation.

Energymeters: Induction type - construction - working principle - testing and adjustment - rotating substandard. Maximum demand indicator (Merz Price Type only) - trivector meter-TOD meter. Significance of IS standards of Instruments.

Module – II


Module – III

Bridges and Potentiometers: DC bridges: Wheatstones bridge - Kelvin's double bridge.

AC bridges: Maxwell's bridge- - Schering bridge

DC potentiometers: Vernier potentiometer - calibration of ammeter, voltmeter and wattmeter. AC potentiometers : polar and coordinate type
**Cathode Ray Oscilloscope**: Principle of operation - Block diagram of general purpose CRO. Vertical deflecting system - vertical amplifier - delay lines - purpose and principle. Horizontal deflection system - basic sweep generator – synchronization – triggering - principle of delayed sweep - XY mode of operation of CRO. Lissajous patterns - applications of CRO - determination of frequency and phase angle - double beam CRO.

**Module – IV**

**High voltage measurements**: Measurement of high DC voltages - series resistance - microammeters – resistance potential divider - generating voltmeters - measurement of high AC voltages - electrostatic voltmeters – sphere gaps - high frequency and impulse voltage measurements with CRO using resistance and capacitance dividers - peak voltmeter - Impulse voltage generators.


**References**:


**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the successful completion of the course, the students will be able to select the appropriate measuring instruments and suitable measurement methods for electrical circuits.
13.405 POWER ELECTRONICS (E)

Teaching Scheme: 2(L) - 2(T) - 0(P)  
Credits: 4

Course Objectives:

To get an overview of different power semiconductor devices, their switching characteristics and application in conversion, control and conditioning of electric power.

Module – I

SCR- structure –VI characteristics-two transistor analogy- turn-on methods- gate control – dynamic (turn on and turn off) characteristics - voltage, current, dv/dt and di/dt ratings-thyristor protection- snubber circuit.


Commutation Techniques – Introduction, Natural commutation, Forced commutation, self commutation, impulse commutation, resonant pulse commutation and complementary commutation (concept only).

Module – II

Gate characteristics of SCRs – single pulse triggering – carrier triggering – isolation using pulse transformers and opto-couplers.

Triggering circuits for SCR - synchronization- R and RC triggering circuits-UJT triggering-simple design of firing circuits using UJT, op-amp and digital IC.

Triac characteristics – device operation and VI characteristics- gate triggering modes-diac triggering circuit for triac in phase control - operation and VI characteristics of GTO. Power transistor, Power MOSFET, IGBTs- turn on and turn off process of IGBTs and MOSFETs.

Module – III

SCR circuits for phase controlled rectifiers- single phase half wave and full wave converters- Semi converter and full converter with R, RL and RLE loads – output voltage expression-effect of freewheeling diode- inverter operation of converter- continuous and discontinuous current mode of operation.

3 phase converters- 3 pulse and 6 pulse converters- output voltage expression for m-phase converter - 3 phase fully controlled bridge converter- 3 phase half controlled bridge converter- effect of source inductance (single phase only).

Module – IV

Choppers- step down and step up choppers- voltage and current commutated choppers-output voltage control of choppers.

Switching regulators - Buck, Boost and Buck-Boost (basic principle only).
Inverters - voltage source inverters - basic parallel inverters - basic series inverters – voltage control in inverters - pulse width modulation- multiple and sinusoidal PWM. Harmonic reduction in inverters. Three phase full bridge inverters- 120° and 180° conduction mode- current source inverter.

References:

**Internal Continuous Assessment (Maximum Marks-50)**

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

**University Examination Pattern:**

*Examination duration: 3 hours  Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.
Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the completion of this course the students will be able to choose appropriate power semiconductor devices and converter circuits for power applications.
13.406 POWER GENERATION, TRANSMISSION AND DISTRIBUTION (E)

Teaching Scheme: 2(L) - 1(T) - 0(P)  
Credits: 3

Course Objective:

This course will enable the students to learn the fundamental concepts of electrical power generation, transmission and distribution.

Module – I

Introduction: Typical Layout of an Electrical Power System - Present Power Scenario in India and the global energy scenario. Generation of Electric Power- Conventional Sources (Qualitative) (Hydro, Thermal, Nuclear and Diesel). Non-Conventional Sources (Qualitative) (Solar, wind, PV, fuel cell, Micro turbine etc.).


Module – II


HVDC Transmission - types of DC links- Application of HVDC back to back links-HVDC developments in India.

Module – III

Mechanical characteristics of transmission lines – sag - sag template. Conductors - types of conductors - copper, Aluminium and ACSR conductors - Volume of conductor required for various systems of transmission-Choice of transmission voltage, conductor size - Kelvin’s law.

Module – IV

Power distribution systems – Radial and Ring Main Systems - DC and AC distribution: Types of distributors - bus bar arrangement - Concentrated and Uniform loading - Methods of solving distribution problems.

Aesthetics of overhead and underground transmission and distribution. Power factor Considerations - Methods of power factor improvement. Tariffs - different types of LT and HT consumers - tariff schemes - uniform tariff and differential tariff - Impact of tariff on the society.

References:


Internal Continuous Assessment (*Maximum Marks-50*)

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours
Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

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

- Choose appropriate generators for any locality
- Determine the type of infrastructure required for power transmission for a particular region
- Choose appropriate distribution system for a specified area
13.407 ELECTRICAL MACHINES LAB. –I (E)

Teaching Scheme: 0(L) - 0(T) - 4(P)  
Credits: 4

Course Objective:

To learn the working and testing methods of DC machines and transformers.

List of Experiments:

1. OCC of DC generator – Critical Resistance and critical speed
2. Load characteristics of dc shunt generators
3. Load characteristics of dc compound generators
4. Load test on dc series motor
5. Load test on DC shunt motor
6. Swinburne's test on dc machine
8. Polarity and transformation ratio test on a single phase transformer
9. OC and SC test on single phase transformer - equivalent circuit - predetermination of regulation and efficiency
10. Sumpner's test on two single phase transformers
11. OC and SC test on three phase transformer
12. Separation of losses in a single phase transformer

Internal Continuous Assessment (Maximum Marks - 50)

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours  
Maximum Total Marks: 100

Questions based on the list of experiments prescribed
80% - Circuit and design (30%);
  Performance (30%)
Results and inference (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

After the successful completion of the course, the students will be able to test and validate DC generators, DC motors and transformers.
Course Objective:

This course will enable the students to get practical knowledge in the design and implementation of digital logic circuits.

List of Experiments:

1. Familiarisation of Logic Gates
2. Verification & Realisation of DeMorgan’s theorem
3. Realisation of SOP & POS functions after K map reduction
4. Half adder & Full adder
5. 4-bit adder/subtractor & BCD adder using IC 7483
7. Study of flip flop ICs (7474 & 7476)
8. Design & Testing of monostable & astable multivibrators using ICs (74121 for Monoshot & 555 for astable)
9. BCD to decimal decoder and BCD to 7-segment decoder & display
10. Realisation of 2-bit comparator using gates and study of four bit comparator IC 7485
11. a) Realization of multiplexer using gates and study of multiplexer IC
    b) Realization of combinational circuits using multiplexers.
12. a) Realization of ripple counters using flip flops
    b) Study of counter ICs (7490, 7493)
13. Design of synchronous up, down & modulo N counters
14. a) Realization of 4-bit serial IN serial OUT registers using flip flops
    b) Study of shift register IC 7495, ring counter, and Johnsons counter
15. Optional – Simulation of some of the above experiments using VHDL.

Internal Continuous Assessment (Maximum Marks-50)

40% - Test
40% - Class work and Record
20% - Regularity in the class
University Examination Pattern:

Examination duration: 3 hours  Maximum Total Marks: 100
Questions based on the list of experiments prescribed
80% - Circuit and design (30%);
   Performance (30%)
   Results and inference (20%)
20% - Viva voce
Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

After successful completion of this course, students will be able to design and implement digital circuits using commonly available functional blocks.