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)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/P				
13.401	Engineering Mathematics -III (E)	4	3	1	-	50	3	100	150
13.402	Digital Electronics and Logic Design (E)	3	2	1	-	50	3	100	150
13.403	Engineering Electromagnetics (E)	3	2	1	-	50	3	100	150
13.404	Electrical Measurements and Measuring Instruments (E)	4	3	1	-	50	3	100	150
13.405	Power Electronics (E)	4	2	2	-	50	3	100	150
13.406	Power Generation, Transmission and Distribution (E)	3	2	1	-	50	3	100	150
13.407	Electrical Machines Lab I (E)	4	0	0	4	50	3	100	150
13.408	Digital Circuits Lab (E)	4	0	0	4	50	3	100	150
	Total	**29**	**14**	**7**	**8**	**400**		**800**	**1200**

13.401 ENGINEERING MATHEMATICS - III (E)

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

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 – $\int_0^{2\pi} f(sinx, cosx)dx$,$\int_{-\infty}^{\infty} f(x)dx$ (with no poles on the real axis). (Proof of theorems not required).

Module – III

Linear programming - Formation of LPP - General linear programming problem - Slack and surplus variables - Standard form - Solution of LPP - basic solution - Basic feasible solution - Degenerate and non-degenerate solutions - Optimal solution - Solution by simplex method - Artificial variables - Big-M method.

Module – IV

Vector spaces and subspaces- Null spaces, Column spaces ,Row space of matrices and linear transformations- Linearly independent sets-Bases –Bases for nulA and ColA-Rank and nullity. Inner product spaces -Length and orthogonality - Orthogonal and orthonormal bases-Gram-Schmidt process.

References:

1. Bali N. P. and M. Goyal, *Engineering Mathematics*, 7/e, Laxmi Publications, India, 2012.
2. Kreyszig E., *Advanced Engineering Mathematics*, 9/e, Wiley India, 2013.
3. Swarup K., P. K. Gupta and Manmohan, *Operations Research*, 13/e, Sultan Chand and Sons, 2008.
4. Sharma S.D, *Operations Research*, Kedar Nath Ram Nath and Co., 2002.
5. Lay D. C., *Linear Algebra with Applications*, 3/e, Pearson Education, 2002.
6. Koneru S. R., *Engineering Mathematics*, 2/e, Universities Press (India) Pvt. Ltd., 2012.

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

Sequential logic circuits: Flip flops - SR, clocked SR, D, JK, master slave and T flip flops - level and edge triggering - conversion of one type of flip flop into another, Shift registers - SISO, SIPO, PIPO and PISO shift registers - left shift register - Universal shift register - applications of shift registers. Counters – ripple counter, synchronous counter, modulo N counter – design of modulo N counter using Karnaugh map method– ring counter – Johnson counter, up-down counter – state diagrams – design of counters for random sequence.

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

1. Floyd T. L., *Digital Fundamentals, 10/e,* Pearson Education, 2011.
2. Tocci R. J. and N. S. Widmer, *Digital Systems: Principles and Applications*, 8/e, Pearson Education, 2002.
3. Kleitz W., *Digital Electronics – A Practical Approach with VHDL*, 9/e, Pearson Education, 2013.
4. Malvino A. P. and D. P. Leach, *Digital Principles and Applications*, 6/e, McGraw-Hill, 2006.
5. Wakerly J. F., *Digital Design, Principles and Practices*, 3/e, Pearson Education, 2002.
6. Taub H. and D. Schilling, *Digital Integrated Electronics*, McGraw-Hill, 1977.
7. Mano M. M., *Logic and Computer Design Fundamentals*, Pearson Education 2006.
8. Nair B. S., *Digital Electronics and Logic Design*, Prentice Hall of India, 2002.
9. Kamal R., *Digital Systems Principles and Design*, Pearson Education, 2007.
10. Givone D. D., *Digital Principles and Design*, Tata McGraw Hill, 2002.
11. Mandal S. K., *Digital Electronics Principles & Applications*, Tata McGraw-Hill, 2013.

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.

Steady magnetic field - Biot-Savart's law - Amperes circuital law - Curl-Stokes theorem - magnetic flux and flux density - scalar and vector magnetic potentials. Magnetic forces - force between differential current elements -magnetic boundary conditions - potential energy. Inductance of co-axial cable, torroidal coil.

Module – IV

Time varying fields and Maxwell's equations – Faraday’s laws - displacement current - Maxwell's equations in point form-integral form.

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:

1. Cheng D. K., *Field and Wave Electromagnetics*, Pearson Education, 2013.
2. Hayt W. H. And J. A. Buck, *Engineering Electromagnetics*, 8/e, McGraw-Hill, 2012.
3. Inan U. S. and A. S. Inan, Engineering Electromagnetics, Pearson Education, 2010.
4. Sadiku M. N. O., *Elements of Electromagnetics*, Oxford University Press, 2010.
5. Murthy T. V. S. A., *Electromagnetic Fields*, S. Chand Ltd., 2008.
6. Gangadhar K. A. and P. M. Ramanathan, *Electromagnetic Field Theory*, Khanna Publishers, 2009.
7. Rao N. N., *Elements of Engineering Electromagnetics*, 6/e, Pearson Education, 2006.
8. Edminister J.A., *Electromagnetics*, Schaum Outline Series, Tata McGraw-Hill, 2006.
9. Premlet B., Electromagnetic Theory with Applications, Phasor Books, 2000.

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

Measuring Instruments: Accuracy & precision - sensitivity & resolution- error analysis - combination of component errors - loading effects. Analog instruments – classification – principles of operation. Electromechanical indicating instruments – operating forces – constructional details-moving system-control system-damping system.

Ammeters and Voltmeters: moving coil - moving iron- electrodynamometer- construction-torque equation –effect of shunt and multipliers.

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

Magnetic Measurements: Ballistic Galvanometer –principle-logarithmic decrement factor – calibration. Flux meter and Gauss meter - principle - calibration –applications – determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses

Instrument transformers: Need of instrument transformers. Constructional details-Theory of current transformer - Phasor diagram, expression for ratio error and phase angle error. Theory of potential transformer - Phasor diagram - expression for ratio error and phase angle error. Testing of current transformers - mutual inductance method and Biffi method. Testing of potential transformers (absolute method only)-applications.

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.

Measurement of insulation resistance - loss of charge method, insulation megger. Measurement of earth resistance using earth megger, determination of resistivity of earth.

High current measurements - DC Hall effect sensors - high current AC magnetic potentiometers. Study of Phasor Measurement Units (PMU), Measurement of rotational speed – tachogenerators.

References:

1. Golding E.W. and F. C. Widdies, *Electrical Measurements and Measuring Instruments*, 5/e, Wheeler, 2011.
2. Sawhney A. K., *A Course in Electrical and Electronic Measurements & Instrumentation*, Dhanpat Rai & Sons, 2004.
3. Helfrick A. D. and W. D. Cooper: *Modern Electronic Instrumentation and Measurement Technique*, Prentice Hall, 1992.
4. Naidu M. S. and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, 2009.
5. Stout M. B., *Basic Electrical Measurements*, Prentice Hall, 1992.
6. Kalsi H. S., *Electronic Instrumentation*, 3/e, Tata McGraw Hill, New Delhi, 2012.
7. Gupta J. B., *A Course in Electronic and Electrical Measurements and Instrumentation*, S. K. Kataria & Sons, 2013.

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.

Series and parallel connections of SCR – static and dynamic equalization circuit. Thermal equivalent circuit - heat sink.

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- 120^0 and 180^0 conduction mode-current source inverter.

References:

1. Mohan N., T. M. Undeland and W. P. Robbins., *Power Electronics, Converters, Application and Design*, John Wiley and Sons, 2007.
2. Rashid M. H., *Power Electronic Circuits, Devices and Applications*, Pearson Education, 2013.
3. Sen P .C., *Power Electronics*, Tata McGraw-Hill, 1987.
4. Singh M. D. and K. B. Khanchandani, *Power Electronics*, Tata McGraw Hill, New Delhi, 2008.
5. Dubey G. K., S. R. Doradla, A. Joshi and R. M. K. Sinha, *Thyristorised Power Controllers*, Wiley Eastern, 1986.
6. Bimbhra P. S., *Power Electronics*, Khanna Publishers, 2010.
7. Krein P.T., *Elements of Power Electronics*, Oxford University Press, 1998.
8. Lander C. W., *Power Electronics*, Tata McGraw Hill, 1993.
9. Agrawal J. P., *Power Electronic Systems – Theory and Design*, Pearson Education, 2013.
10. Vithayathil J., *Power Electronics-Principles and Applications*, Tata McGraw Hill, 2010.

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.).

Ethics and Environmental aspects of Distributed Generation, Cost of generation, Economic aspects —Load curve, significance of diversity factor, load factor, plant factor - Simple problems.

Module – II

Modelling of Transmission System: Resistance, inductance and capacitance of three phase transmission lines -symmetrical and unsymmetrical spacing -double circuit lines -bundled conductors -effect of earth on transmission line capacitance – problems. Performance of Lines - short and medium lines - equivalent Pi and T networks – problems. Long lines - equivalent circuit of a long line Ferranti Effect, Power flow, receiving end power circle diagram.

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. Cables -types of cables -insulation resistance -voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating. Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators. Corona -disruptive critical voltage -visual critical voltage -power loss due to corona -Factors affecting corona -interference on communication lines.

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:-

1. Stevenson W. D., *Elements of Power System Analysis*, 4/e, McGraw Hill, 1982.
2. Wadhwa C. L., *Generation, Distribution and Utilization of Electrical Energy*, New Age International, 2002.
3. Wadhwa C. L., *Electrical Power Systems*, 33/e, New Age International, 2004.
4. Weedy B. M., B. J. Cory, N. Jenkins, J. B. Ekanayake and G. Strbac, *Electric Power System*, John Wiley & Sons, 2012.
5. Kothari D. P. and I. J. Nagrath, *Power System Engineering*, 2/e, Tata McGraw Hill, 2008.
6. Gupta B. R.**,** *Power System Analysis and Design*, S. Chand, New Delhi, 2006.
7. Uppal S. L. and S. Rao, *Electrical Power Systems*, Khanna Publishers, 2009.
8. Cotton H. and H. Barber, Transmission & Distribution of Electrical Energy, 3/e, Hodder and Stoughton, 1978.
9. Soni, M.L., P. V. Gupta and U. S. Bhatnagar, *A Course in Electrical Power*, Dhanpat Rai & Sons, New Delhi, 1984.
10. Gupta J.B., *Transmission & Distribution of Electrical Power*, S.K. Kataria & Sons, 2009.
11. Kundur P., *Power system Stability and Control*, McGraw Hill, 1994.
12. Kothari D.P., K.C. Singal and R. Ranjan, Renewable Energy Sources and Emerging Technologies, Prentice Hall, 2009.

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
7. Hopkinson's test.
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.

13.408 DIGITAL CIRCUITS LAB (E)

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

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
6. Realization of RS, T, D & JK flip flops using gates.
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.