BACHELOR OF TECHNOLOGY
(INSTRUMENTATION AND CONTROL ENGINEERING)
THIRD SEMESTER EXAMINATION

Code No.	Paper ID	Paper	L	T/P	Credits	Status
THEORY PAPERS						
ETMA 201		Applied Mathematics – III	3	1	4	
ETIC 203		Sensors and Transducers	3	1	4	M
ETEC 205		Switching Theory and Logic Design	3	1	4	M
ETEE 207		Circuits and Systems	3	1	4	
ETCS 209		Data Structures	3	1	4	
ETIC 211		Basics of Measurements	3	1	4	M
PRACTICAL/VIVA VOCE						
ETIC 251		Sensors and Transducers Lab	0	2	1	M
ETEC 253		Switching Theory and Logic Design Lab	0	2	1	M
ETCS 255		Data Structures Lab.	0	2	1	
ETEE 257		Circuit and Systems Lab*	0	2	1	
		NCC/NSS**#	-	-	-	
TOTAL			**18**	**14**	**28**	

M: Mandatory for award of degree
#NUES (Non University Examination System)
***NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards.*
*** A few lab experiments must be performed using any circuit simulation software e.g. PSPICE/MATLAB/ETAP/Scilab/LabVIEW**

BACHELOR OF TECHNOLOGY
(INSTRUMENTATION AND CONTROL ENGINEERING)
FOURTH SEMESTER EXAMINATION

Code No.	Paper ID	Paper	L	T/P	Credits	Status
THEORY PAPERS						
ETIC-204		Measurements and Instrumentation	3	0	3	M
ETEE-212		Control Systems	3	1	4	M
ETIC-206		Power Electronics	3	1	4	
ETIC-208		Theory and Applications of Integrated Circuits	3	1	4	M
ETIC-210		Electrical Machines	3	1	4	
ETIC-212		Communication Systems	3	1	4	
PRACTICAL/VIVA VOCE						
ETIC-252		Measurements and Instrumentation Lab	0	2	1	M
ETEE-260		Control Systems Lab	0	2	1	M
ETIC-256		Power Electronics Lab	0	2	1	
ETIC-258		Theory and Applications of Integrated Circuits Lab	0	2	1	M
ETIC-254		Electrical Machines Lab	0	2	1	
ETSS-250		NSS/NCC*	-	-	1	
TOTAL			**18**	**15**	**29**	

M: Mandatory for award of degree

**NCC/NSS can be completed in any semester from Semester 1 – Semester 4. It will be evaluated internally by the respective institute. The credit for this will be given after fourth Semester for the students enrolled from the session 2014-15 onwards.*

NOTE: 4 weeks Industrial / In-house Instrumentation Workshop (Lab needs to be developed) will be held after fourth semester. However, Viva-Voce will be conducted in the fifth semester (ETIC 359).

APPLIED MATHEMATICS-III

Paper Code: ETMA-201	**L**	**T/P**	**C**
Paper: Applied Mathematics-III	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objectives*: The objective of this course is to teach the students the applications of fourier series, fourier transform, difference equation and numerical methods to solve various engineering problems.*

UNIT-I

Fourier series: Definition, Euler's formula, conditions for Fourier expansion, functions having points of discontinuity, change of intervals, even and odd functions ,half range series, Harmonic analysis. Fourier Transforms: Definition, Fourier integral, Fourier transform, inverse Fourier transform, Fourier sine and cosine transforms, properties of Fourier transforms (linearity, scaling, shifting, modulation), Application to partial differential equations.

[T2][No. of hrs 11]

UNIT-II

Difference equation: Definition, formation, solution of linear difference equation with constant coefficients ,simultaneous difference equations with constant coefficients, applications of difference equations .Z- transform: Definition, Z- transform of basic functions, properties of Z-transform (linearity, damping, shifting, multiplication),initial value theorem, final value theorem, convolution theorem, convergence of Z- transform, inverse of Z- transform, Application to difference equations.

[T2][No. of hrs 11]

UNIT-III

Numerical Methods: Solution of algebraic and transcendental equations using bisection method, Regula-Falsi method and Newton – Raphson method. Solution of linear simultaneous equations using Gauss-Jacobi's iteration method and Gauss-Seidal's iteration methods.Finite differences: Forward differences, backward differences and Central differences. Interpolation: Newton's interpolation for equi-spaced values. Stirling's central difference interpolation formula, Divided differences and interpolation formula in terms of divided differences , Lagrange's interpolation formula for unequi-spaced values.

[T1,T2] [No. of hrs 11]

UNIT-IV

Numerical Differentiation, maxima and minima of a tabulated function. Numerical Integration: Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's one-third rule and Simpson's three-eighth rule .Numerical solution of ordinary differential equations: Picard's method, Taylor's method,Euler's method, modified Euler's method, Runge-Kutta method of fourth order.

[T1,T2][No. of hrs 11]

Text Books:

[T1] R.K. Jain and S.R.K. Iyengar," Numerical methods for Scientific and Engineering Computation", New Age Publishing Delhi-2014.
[T2] B. S. Grewal,"Higher Engineering Mathematics" Khanna Publications, 2014 Edition.

Reference Books:

[R1] E. kresyzig," Advance Engineering Mathematics", Wiley publications
[R2] P. B. Patil and U. P. Verma, " Numerical Computational Methods", Narosa
[R3]. Partial Differential Equations" Schaum's Outline Series, McGraw Hill.
[R4] Michael Greenberg, " Advance Engineering mathematics" , Pearson.
[R5] Schaum's Outline on Fourier Analysis with Applications to Boundary Value Problem, Tata McGraw-Hill

SENSORS AND TRANSDUCERS

Paper Code: ETIC-203	**L**	**T/P**	**C**
Paper: Sensors and Transducers	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

Objective:-To provide the basic understanding about operational characteristics and applications of various sensors and transducers.

UNIT I [Introduction to Sensors]

Definition and differences of sensors and transducers, Classification, static and dynamic characteristics, electrical characterization, mechanical and thermal characterization including bath-tub curve.

Different Sensors:

Mechanical & Electromechanical: Potentiometer, Strain gauges, Inductive sensors—Ferromagnetic type, Transformer type, Electromagnetic, Capacitive sensors— parallel plate, variable permittivity, electrostatic, piezoelectric, Introduction to PZT family**.**

[T1][T2][No. of Hrs:11]

UNIT-II

Thermal sensors: Gas thermometric sensors, Dielectric constant, refractive index thermo-sensors, nuclear thermometers, resistance change type thermometric sensors, Thermoemf sensors.

Magnetic sensors: Basic working principles, Magnetostrictive, Hall effect, Eddy current type, SQUID sensors.

Radiation sensors: Photo-detectors, Photo-emissive, photomultiplier, scintillation detectors.

[T1][T2][No. of Hrs:11]

UNIT-III

Electroanalytical sensors: Electrochemical cell, SHE, Polarization, Reference electrode, Metal electrodes, Membrane electrodes, Electroceramics. Advancement in Sensor technology: Introduction to smart sensors, Film sensors, Introduction to semiconductor IC technology and Micro Electro Mechanical System(MEMS), Nano-sensors. Bio-Sensors.

[T1][T2][No. of Hrs:11]

UNIT-IV

Different Transducers: LVDT, RTD, Thermistor, Wire anemometer, piezoresistors, Variable diaphragm capacitance transducers, Angular movement transducers, seismic mass transducer, interferometer transducer.

Feedback transducer system: Inverse transducer, Self-balancing transducer, Servo-operated manometer, Feedback pneumatic load cell, integrating servo.

[T1][T2][No. of Hrs:12]

Text Books:

[T1] D. Patranabis, “Sensors and Transducers”, PHI Learning Pvt. Ltd., 2nd edition
[T2] D V S Murty, “Transducers and Instrumentation”, PHI Learning Pvt. Ltd.

Reference Book:

[R1] E.O.Doebelin,Dhanesh N Manik, “Measurement Systems”,6th Edition,Mcgraw Hill Edu.
[R2] John P. Bentely, “Principles of Measurement System”, 4th Edition, Pearson Prentice Hall

SWITCHING THEORY AND LOGIC DESIGN

Paper Code: ETEC-205	**L**	**T/P**	**C**
Paper: Switching Theory and Logic Design	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

Objective: The objective of the paper is to facilitate the student with the knowledge of Logic Systems and Circuits, thereby enabling the student to obtain the platform for studying Digital Systems and Computer Architecture.

UNIT- I

Number Systems and Codes:- Decimal, Binary, Octal and Hexadecimal Number systems, Codes- BCD, Gray Code, Excess-3 Code, ASCII, EBCDIC, Conversion between various Codes.

Switching Theory: - Boolean Algebra- Postulates and Theorems, De' Morgan's Theorem, Switching Functions- Canonical Forms- Simplification of Switching Functions- Karnaugh Map and Quine Mc-Clusky Methods.

Combinational Logic Circuits:- Review of basic gates- Universal gates, Adder, Subtractor ,Serial Adder, Parallel Adder- Carry Propagate Adder, Carry Look-ahead Adder, Carry Save Adder, Comparators, Parity Generators, Decoder and Encoder, Multiplexer and De-multiplexer, ALU, PLA and PAL.

[T2,T3][No. of Hrs. 14]

UNIT- II

Integrated circuits: - TTL and CMOS logic families and their characteristics. Brief introduction to RAM and ROM.

Sequential Logic Circuits: - Latches and Flip Flops- SR, , D, T and MS-JK Flip Flops, Asynchronous Inputs.

Counters and Shift Registers:- Design of Synchronous and Asynchronous Counters:- Binary, BCD, Decade and Up/Down Counters , Shift Registers, Types of Shift Registers, Counters using Shift Registers- Ring Counter and Johnson Counter.

[T2,T3][No. of hrs. 10]

UNIT- III

Synchronous Sequential Circuits:- State Tables State Equations and State Diagrams, State Reduction and State Assignment, Design of Clocked Sequential Circuits using State Equations.

Finite state machine-capabilities and limitations, Mealy and Moore models-minimization of completely specified and incompletely specified sequential machines, Partition techniques and merger chart methods-concept of minimal cover table.

[T1][No. of hrs. 10]

UNIT- IV

Algorithmic State Machine: Representation of sequential circuits using ASM charts synthesis of output and next state functions, Data path control path partition-based design.

Fault Detection and Location: Fault models for combinational and sequential circuits, Fault detection in combinational circuits; Homing experiments, distinguishing experiments, machine identification and fault detection experiments in sequential circuits.

[T1][No. of hrs. 10]

Text Book:

[T1] Zyi Kohavi, "Switching & Finite Automata Theory", TMH, 2nd Edition
[T2] Morris Mano, Digital Logic and Computer Design", Pearson
[T3] R.P. Jain, "Modern Digital Electronics", TMH, 2nd Ed,

Reference Books:

[R1] A Anand Kumar, "Fundamentals of Digital Logic Circuits", PHI
[R2] Taub ,Helbert and Schilling, "Digital Integrated Electronics", TMH

CIRCUITS & SYSTEMS

Paper Code: ETEE-207	**L**	**T/P**	**C**
Paper: Circuits & Systems	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No.1 rest of the paper shall consist of four units as per the syllabus, every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objective: *The purpose of this course is for each student to learn and further explore the techniques of advanced circuit analysis. The concepts and analytical techniques gained in this course (e.g., signals, Laplace transformation, frequency response) will enable students to build an essential foundation of many fields within electrical engineering, such as control theory, analog electronic circuits, signal processing.*

UNIT-I

Introduction to signals, their classification and properties, different types of systems, LTI systems and their properties, periodic waveforms and signal synthesis, properties and applications of Laplace transform of complex waveform.

[T1,T2][No. of Hours: 10]

UNIT-II

System modeling in terms of differential equations and transient response of R, L, C, series and parallel circuits for impulse, step, ramp, sinusoidal and exponential signals by classical method and using Laplace transform.

[T1,T2] [No. of Hours: 12]

UNIT-III

Graph theory: concept of tree, tie set matrix, cut set matrix and application to solve electric networks.

Two port networks – Introduction of two port parameters and their interconversion, interconnection of two 2-port networks, open circuit and short circuit impedances and ABCD constants, relation between image impedances and short circuit and open circuit impedances. Network functions, their properties and concept of transform impedance, Hurwitz polynomial.

[T1,T2] [No. of Hours: 10]

UNIT IV

Positive real function and synthesis of LC, RC, RL Networks in Foster's I and II, Cauer's I& II forms, Introduction of passive filter and their classification, frequency response, characteristic impedance of low pass, high pass, Band Pass and Band reject prototype section.

[T1,T2] [No. of Hours: 10]

Text Books:

[T1] W H Hayt "Engineering Circuit Analysis" TMH Eighth Edition

[T2] D. R. Choudhary, "Networks and Systems" New Age International, 1999.

Reference Books:

[R1] S Salivahanan "Circuit Theory " Vikas Publishing House 1st Edition 2014

[R2] Valkenburg, " Network analysis" PHI, 2000.

[R3] Bhise, Chadda, Kulshreshtha, " Engineering network analysis and filter design" Umesh publication, 2000.

[R4] Kuo, "Network analysis and synthesis" John Weily and Sons, 2nd Edition.

[R5] Allan H Robbins, W.C.Miller "Circuit Analysis theory and Practice"Cengage Learning Pub 5th Edition 2013

[R6] Bell "Electric Circuit", 7th Edition, Oxford Publications

DATA STRUCTURES

Paper Code: ETCS-209	**L**	**T/P**	**C**
Paper: Data Structures	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, the rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, the student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objective: To understand the programming and the various techniques for enhancing the programming skills for solving and getting efficient results.

UNIT – 1:

Introduction to programm ing methodologies and design of algorithms. Abstract Data Type, array, array organization, sparse array. Stacks and Stack ADT, Stack Manipulation, Prefix, infix and postfix expressions, their interconversion and expression evaluation. Queues and Queue ADT, Queue manipulation. General Lists and List ADT, List manipulations, Single, double and circular lists.

[T1,T2][No. of hrs. 12]

UNIT – II:

Trees, Properties of Trees, Binary trees, Binary Tree traversal, Tree manipulation algorithms, Expreession trees and their usage, binary search trees, AVL Trees, Heaps and their implementation.

[T1,T2][No. of hrs. 12]

UNIT – III:

Multiway trees, B-Trees, 2-3 trees, 2-3-4 trees, B* and B+ Trees. Graphs, Graph representation, Graph traversal.

[T1,T2][No. of hrs. 12]

UNIT – IV:

Sorting concept, order, stability, Selection sorts (straight, heap), insertion sort (Straight Insertion, Shell sort), Exchange Sort (Bubble, quicksort), Merge sort (only 2-way merge sort). Searching – List search, sequential search, binary search, hashing concepts, hashing methods (Direct, subtraction, modulo-division, midsquare, folding, pseudorandom hashing), collision resolution (by open addressing: linear probe, quadratic probe, pseudorandom collision resolution, linked list collision resolution), Bucket hashing.

[T1,T2][No. of hrs. 12]

Text Books:

[T1] R. F. Gilberg, and B. A. Forouzan, “Data structures: A Pseudocode approach with C”, Thomson Learning.
[T2] A .V. Aho, J . E . Hopcroft, J . D . Ulman “Data Structures and Algorithm”, Pearson Education.

Reference Books:

[R1] S. Sahni and E. Horowitz, “Data Structures”, Galgotia Publications.
[R2] Tanenbaum: “Data Structures using C”, Pearson/PHI.
[R3] T .H . Cormen, C . E . Leiserson, R .L . Rivest “Introduction to Algorithms”, PHI/Pearson.
[R4] A.K.Sharma, “Data Structures”, Pearson
[R5] Ellis Horowitz and Sartaz Sahani “Fundamentals of Computer Algorithms”, Computer Science Press.

BASICS OF MEASUREMENTS

Paper Code: ETIC-211	**L**	**T/P**	**C**
Paper: Basics of Measurements	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No.1 rest of the paper shall consist of four units as per the syllabus, every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objective: To provide the basic understanding about the importance of measurement, information about different types of instruments and gadgets used for measurement and their characteristics besides some of its standards and calibration methods.

UNIT-I

Introduction to Measurement:

Significance of measurement, Different methods of measurement, Classification of measuring instruments, Application of measurement systems, typical measurement schemes.

Units and Standards:

MKS, SI units of engineering parameters, Details of different standards-mass, length, time, frequency, temperature, EMF, ampere, sub standards and lab standards .

Performance Characteristics:

Definition of range, span, accuracy, precision, drift, sensitivity, reproducibility, repeatability, dead zone, resolution, hysteresis, threshold, zero error, noise, linearity, loading effect, static characteristics .

[T1][T2][No. of Hours: 10]

UNIT -II

Testing & Calibration of measurement setup:

Dynamic Characteristics:

Dynamic response; Transient response; speed of response, fidelity, measuring lag etc, Linear approximation, Introduction to compensation techniques.

Significance of testing and calibration, Calibration curve, Standards for calibration, Different calibration procedures-primary, secondary, direct, indirect, routine calibration, Calibration setup:-pressure gauge, level etc. Calibration of Ammeter, Voltmeter and Wattmeter, Energy meter.

[T1][T2][No. of Hours: 12]

UNIT-III

Analysis of Errors:

Definition; Types of errors; Calculation methods of different errors; Gaussian curve; Precision Index; Variance; Standard deviation; Uncertainty in measurement,Chi-Square Test,Curve fitting methods.

Galvanometers:

D'Arsonaval Galvanometer— construction, Torque equation, Dynamic characteristic, Balastic Galvanometer— construction, working principle.

[T1][T2][No. of Hours: 10]

UNIT -IV

Displays and Recorders:

Indicating Instruments- Construction, Operating principle of spring control, gravity control and damping.

Recorders- Working Principle of chart recorder, strip chart, circular chart, magnetic tape recorder, thermal recorders, printer.

Electronic Display- LCD, LED, alphanumeric, storage Oscilloscope.

[T1][T2][No. of Hours: 12]

Text Books:

[T1] B. C. Nakra., K. K. Chaudhry, "Instrumentation, Measurement and Analysis", 4th Edition, McGraw Hill Education.

[T2] Albert D.Helfrick, William D.Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI India

Reference Books:

[R1] E.O.Doebelin,Dhanesh N Manik, “Measurement Systems”,6th Edition, McGraw Hill Edu.
[R2] M.M.S.Anand, “Electronic Instruments and Instrumentation Technology”, PHI, 2005
[R3] A.K. Sawhney, Puneet Sawhney – “A course in Electrical and Electronic Measurements and Instrumentation”.

SENSORS AND TRANSDUCERS LAB

Paper Code: ETIC-251	**L**	**T/P**	**C**
Paper: Sensors and Transducers Lab	**0**	**2**	**1**

List of Experiments:

1. Study of various sensors e.g., Thermocouple, RTD, Thermistor, Magnetic Sensorns, Load Cells, Film Sensors.
2. Characteristics of (Resistive and Thermo emf) temperature sensor
3. Measurement of displacement using LVDT
4. Measurement of strain and torque using strain gauges
5. Measurement of speed using photoelectric sensors, tachogenerators and stroboscope.
6. Calibration and measurement of temperature using PRT.
7. Static and Dynamic Characteristics of sensors.
8. Liquid level measurement using capacitive measurement system.
9. Pressure measurement using load cell.
10. Study and operation of Electrochemical Cell.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

SWITCHING THEORY AND LOGIC DESIGN LAB

	L	T/P	C
Paper Code: ETEC-253			
Paper: Switching Theory and Logic Design Lab	**0**	**2**	**1**

List of Experiments:

1. Realize all gates using NAND & NOR gates
2. Realize Half Adder, Full Adder, Half subtracter, Full subtracter
3. Realize a BCD adder
4. Realize a Serial Adder
5. Realize a four bit ALU
6. Realize Master-Save J K Flip-Flop, using NAND/NOR gates
7. Realize Universal Shift Register
8. Realize Self-Starting, Self Correcting Ring Counter
9. Realize Multiplexer and De-Multiplexer
10. Realize Carry Look ahead Adder / Priority Encoder
11. Simulation of PAL and PLA
12. Simulation Mealy and Moore State machines

NOTE: - At least 8 Experiments out of the list must be done in the semester

DATA STRUCTURES LAB

Paper Code: ETCS-255	**L**	**T/P**	**C**
Paper: Data Structures Lab	**0**	**2**	**1**

List of Experiments :

1. Perform Linear Search and Binary Search on an array.

   Description of programs:

   a. Read an array of type integer.
   b. Input element from user for searching.
   c. Search the element by passing the array to a function and then returning the position of the element from the function else return -1 if the element is not found.
   d. Display the position where the element has been found.

2. Implement sparse matrix using array.

   Description of program:

   a. Read a 2D array from the user.
   b. Store it in the sparse matrix form, use array of structures.
   c. Print the final array.

3. Create a linked list with nodes having information about a student and perform
   I. Insert a new node at specified position.
   II. Delete of a node with the roll number of student specified.
   III. Reversal of that linked list.

4. Create doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
5. Create circular linked list having information about an college and perform Insertion at front perform Deletion at end.
6. Create a stack and perform Pop, Push, Traverse operations on the stack using Linear Linked list.
7. Create a Linear Queue using Linked List and implement different operations such as Insert, Delete, and Display the queue elements.
8. Create a Binary Tree (Display using Graphics) perform Tree traversals (Preorder, Postorder, Inorder) using the concept of recursion.
9. Implement insertion, deletion and display (inorder, preorder and postorder) on binary search tree with the information in the tree about the details of a automobile (type, company, year of make).
10. To implement Insertion sort, Merge sort, Quick sort, Bubble sort, Bucket sort, Radix sort, Shell sort, Selection sort, Heap sort and Exchange sort using array as a data structure.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

CIRCUITS AND SYSTEMS LAB

Paper Code: ETEE-257	**L**	**T/P**	**C**
Paper: Circuits and Systems Lab	**0**	**2**	**1**

List of Experiments

1. Study the transient response of series RLC circuit for different types of waveforms on CRO and verify using MATLAB
2. Study the time response of a simulated linear system and verify the unit step and square wave response of first order and second order, type 0,1 system
3. Using MATLAB determine current in various resistors connected in network using mesh current and node voltage analysis.
4. To determine Z and Y parameters of the given two port network.
5. To determine ABCD parameters of the given two port network.
6. To verify Reciprocity Theorem for the given two port network.
7. To determine Hybrid parameters of the given two port network.
8. To design Cascade Connection and determine ABCD parameters of the given two port network.
9. To design Series-Series Connection and determine Z parameters of the given two port network.
10. To design Parallel-Parallel Connection and determine Y parameters of the given two port network.
11. To design Series-Parallel Connection and determine h parameters of the given two port network
12. Study the frequency response of different filter circuits.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

MEASUREMENTS AND INSTRUMENTATION

Paper Code: ETIC-204	**L**	**T/P**	**C**
Paper: Measurements and Instrumentation	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No.1 rest of the paper shall consist of four units as per the syllabus, every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

Objective:- To provide the basic understanding regarding ac measurements and instrumentation, working principles of associated meters and instrumentation schemes.

UNIT - I

Potentiometer and Bridges:-

A. C. Potentiometer: Theory and operation of coordinate and polar types A. C. Potentiometer, Errors and Applications.

A. C. Bridges: Configurations, Errors and accuracies, different types of bridges and their application, De Sauty Bridge, Schering Bridge, Anderson Bridge, Maxwell Bridge, Wein Bridge, Use of Shielding in Bridges, Wagner Earth Connection, Grounding and Guarding.

[T1][T2][No. of Hours: 10]

UNIT - II

Instrument Transformers:

Construction, operation, ratio and phase errors in current transformers, compensation techniques for errors in current transformers, testing of current transformers, absolute and comparison methods, Construction, operation, ratio and phase errors in potential transformers, compensation techniques for errors in potential transformers, testing of potential transformers.

[T1][T2][No. of Hours: 10]

UNIT - III

AC instruments and Meters:

Induction type instruments; Theory, operation, adjustments and calibration of single phase energy meter, Polyphase energy meter, Ampere Hour Meters, Measurement of Volt-ampere and reactive volt amperes, Power Factor Meters, Frequency Meters, Synchroscopes, Phase sequence Indicators, maximum demand meters.

Regulated Power Supplies, Function Generator: Sine, Cosine, Square and triangular wave, Instrumentation amplifier and their applications.

[T1][T2][No. of Hours: 12]

UNIT - IV

Electronic Measuring Instruments:

General purpose Cathode Ray Oscilloscope: Construction & working, principles, various controls, applications in measurement, Digital storage Oscilloscope (DSO).

Digital Instruments:- Voltmeter, Multimeter, Multi-parameter indicator, Signal Conditioning, Introduction to active filters and their applications.

[T1] [T2][No. of Hours: 12]

Text Books:

[T1] P.Purkait,B.Biswas,Sanatanu Das,C. Koley, “Electrical and Electronic Measurements and Instrumentation”, McGraw Hill Edu.

[T2] Albert D.Helfrick,William D.Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI India,

Reference Books:

[R1] E.W. Golding & Widdis, “Electrical Measurements & Measuring Instruments”, Wheeler Publication.

[R2] H. S. Kalsi, “Electronic Instrumentation”, 3rd Edition, McGraw Hill Edu.

[R3] Kishore-Electronic Instrumentation and Measurement”, Pearson

CONTROL SYSTEMS

Paper Code: ETEE-212	**L**	**T/P**	**C**
Paper: Control Systems	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Q. No.1 rest of the paper shall consist of four units as per the syllabus, every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks.

***Objective**: To teach the fundamental concepts of Control systems and mathematical modeling of the system. To study the concept of time response and frequency response of the system. To teach the basics of stability analysis of the system*

Unit I: Control Systems - - Basics & Components

Introduction to basic terms, classifications & types of Control Systems, block diagrams & signal flow graphs. Transfer function, determination of transfer function using block diagram reduction techniques and Mason's Gain formula.

Control system components: Electrical, Mechanical, Electronic, A.C., D.C. types ,Servo Motors, Stepper Motors, Tacho Generators, Synchros, Magnetic Amplifiers, Servo Amplifiers.

[T1,T2][No. of Hrs. 11]

Unit II: Time – Domain Analysis

Time domain performance specifications, transient response of first & second order systems, steady state errors and static error constants in unity feedback control systems, response with P, PI and PID controllers, limitations of time domain analysis.

[T1,T2][No. of Hrs. 10]

Unit III : Frequency Domain Analysis

Polar and inverse polar plots, frequency domain specifications and performance of LTI systems, Logarithmic plots (Bode plots), gain and phase margins, relative stability. Correlation with time domain performance close loop frequency responses from open loop response. Limitations of frequency domain analysis, minimum/non-minimum phase systems.

[T1,T2][No. of Hrs. 10]

Unit IV : Stability & Compensation Techniques

Concepts, absolute, asymptotic, conditional and marginal stability, Routh – Hurwitz and Nyquist stability criterion, Root locus technique and its application.

Concepts of compensation, series/parallel/ series-parallel/feedback compensation, Lag/Lead/Lag-Lead networks for compensation, compensation using P, PI, PID controllers.

[T1,T2] [No. of Hrs. 11]

Text Books:

[T1] B. C. Kuo, "Automatic Control System", Prentice Hall of India, 7th edition 2001.
[T2] Nagraath Gopal "Control Systems Engineering -Principles and Design" New Age Publishers

Reference Books:

[R1] Norman S. Nise, "Control systems engineering" John Wiley & Sons (Asia) Singapore.
[R2] Raymond T. Stefani, Design of Feedback Control System, Oxford University Press.
[R3] K. Ogata, "Modern control engineering", Pearson 2002.
[R4] S. P. Eugene Xavier, "Modern control systems", S. Chand & Company.
[R5] M. Gopal "Control Systems-Principles and Design" TMH 4th Edition 2012

POWER ELECTRONICS

Paper Code: ETIC-206	**L**	**T/P**	**C**
Paper: Power Electronics	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

Objective*: The objective of the paper is to facilitate the student with the basics of Power Electronics that are required for an engineering student.*

UNIT- I

Introduction

Characteristics and switching behaviour of Power Diode, SCR, UJT, TRIAC, DIAC, GTO, MOSFET, IGBT, MCT and power BJT, two-transistor analogy of SCR, firing circuits of SCR and TRIAC, SCR gate characteristics, SCR ratings. Protection of SCR against over current, over voltage, high dV/dt, high dI/dt, thermal protection, Snubber circuits, Methods of commutation, series and parallel operation of SCR, Driver circuits for BJT/MOSFET.

[T1,T2][No. of hrs. 11]

UNIT- II

A.C. to D.C. Converter: Classification of rectifiers, phase controlled rectifiers, fully controlled and half controlled rectifiers and their performance parameters, .three phase half wave, full wave and half controlled rectifiers and their performance parameters, effect of source impedance on the performance of single phase and three phase controlled rectifiers, single-phase and three phase dual converter.

[T1, T2, T3][No. of hrs. 11]

UNIT- III

D.C. to D.C. Converter: Classification of choppers as type A, B, C, D and E, principle of operation, switching mode regulators: Buck, Boost, Buck-Boost, Cuk regulators.

A.C. to A.C. Converter: AC voltage Controllers**,** Cyclo-converters : single phase to single phase, three phase to single phase, three phase to three phase Cyclo-converter circuit and their operation, Matrix converter.

[T1, T2, T3][No. of hrs. 11]

UNIT-IV

D.C. to A.C. Converter: single phase single pulse inverter: Square wave, quasi square. Three phase single pulse inverters (120° and 180° conduction) Modulation Techniques and reduction of harmonics, PWM techniques, SPWM techniques, SVM, Carrier less modulation. , PWM Inverter, Bidirectional PWM converters, voltage source inverters and current source inverter, Multi level Inverter: cascaded and NPC Inverters.

[T1, T2, T3][No. of hrs. 11]

Text Books:

[T1] M.H. Rashid, “Power Electronics: Circuits, Devices and Applications” Pearson Publications.
[T2] Daniel W. Hart, “Power Electronics “Tata McGraw-Hill
[T3] H.C. Rai, “Power Electronics Devices, Circuits, Systems and Application”, Galgotia Publications, 3rd Edition

References Books:

[R1] Singh, Kanchandani, “Power Electronics”, Tata McGraw-Hill.
[R2] Ned Mohan, Tore M. Undeland and Robbins, “Power Electronics: Converters, Applications and Design” Wiley India Publication
[R3] V R Moorthi, “Power Electronics: Devices, Circuits and Industrial Applications”, Oxford Publication.
[R4] Kassakian, Schlecht, Verghese, “Principles of Power Electronics”, Pearson Publications
[R5] P. S. Bimbhra “Power Electronics”, Khanna Publishing.

THEORY AND APPLICATION OF INTEGRATED CIRCUITS

Paper Code: ETIC-208	**L**	**T/P**	**C**
Paper: Theory and Application of Integrated Circuits	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks.

Objective: The objective of the paper is to facilitate the students with the knowledge of solid state device with theoretically infinite number of operating states or infinite discrete I/O states. And all the advantages of different transistor configuration is put into a single IC Op-amp.

UNIT- I: Fundamentals of IC Fabrication and Circuit Configurations for Linear IC

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Differential Amplifier, Differential Amplifier Configurations, Bipolar differential Amplifier, AC and DC characteristics. Current mirror and BJT Current Source. Current source as Active load. Voltage Sources, voltage reference. Operational Amplifiers IC 741, DC and AC performance characteristics, Open and closed loop configurations.

[T1, T2] [No. of Hrs. 11]

UNIT- II: Applications of Operational Amplifiers

Inverting and non inverting Amplifier, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

[T1, T2] [No. of Hrs. 11]

UNIT- III : Analog Multiplier, PLL, A/D and D/A Convertor

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2R Ladder type, A/D Converters – specifications – Flash type – Successive Approximation type – Single Slope type – Dual Slope type – A/D Converter using Voltage-to-Time Conversion.

[T1, T2] [No. of Hrs. 11]

UNIT- IV : Waveform Generators and Special Function ICs

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Opto-couplers.

[T1, T2] [No. of Hrs. 11]

Text Books:

[T1] Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd Edition, TMH, 2007.
[T2] D. Roy Choudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000

Reference Books:

[R1] Ramakant A. Gayakwad, OP-AMP and Linear ICs, Prentice Hall/Pearson Education, 4th Edition, 2001.
[R2] K Lal Kishore, Operational Amplifier and Linear Integrated Circuits, Pearson Education, 2006.
[R3] S.Salivahanan & V.S. Kanchana Bhaskaran, Linear Integrated Circuits, TMH, 2008.
[R4] J.Michael Jacob, Applications and Design with Analog Integrated Circuits, Prentice Hall of India, 1996.

ELECTRICAL MACHINES

Paper Code: ETIC-210	**L**	**T/P**	**C**
Paper: Electrical Machines	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 12.5 marks

Objective: The objective of this paper is to make students understand principle of electromechanical energy conversion and electrical machines.

UNIT- I : Principles of Electromechanical Energy Conversion.
DC machines: construction, armature windings, induced EMF equation, torque production, magnetization curve. Types of generators and motors, characteristics, commutation and interpoles, armature reaction, Speed control of dc motor and starting.
PMDC machine: Introduction and need of brushless motors.

[T1, T2][No. of Hrs. 11]

UNIT- II: **Transformers**: construction, ideal and practical transformer, equivalent circuits, voltage regulation, maximum efficiency criterion. Open circuit and short circuit tests. Phasor diagrams on no load, full load, lagging and leading power factor loads. Three phase transformer.
Introduction to polyphase induction machines, production of rotating magnetic flux vector, principle of operation, importance of air gap, comparison with transformer, types of rotor.

[T1, T2][No. of Hrs. 10]

UNIT- III: **Induction motors**: Development of an equivalent circuit, estimation of parameters, no load and block rotor tests. Torque slip characteristics, starting of induction motors methods, deep bar and double cage rotor, power relations, speed control of induction motors.
Single phase induction motor, double field revolving theory, starting methods of single phase induction motors, universal motor and introduction to switched reluctance motor.

[T1, T2][No. of Hrs. 11]

UNIT- IV: **Synchronous Machine**: construction, pitch factor and distribution factor, induced emf equation, equivalent circuits and phasor diagrams, power relations, OCC and SCC characteristics for voltage regulation of alternator, salient pole and cylindrical rotor machines and phasors. Effect of excitation and V curves. Power factor correction and parallel operation of synchronous generator.

[T1, T2][No. of Hrs. 10]

Text books:

[T1] I.J Nagrath and D.P.Kothari, “Electrical Machines”, Tata Mc Graw Hill, 2010, Fourth Edition
[T2] Bhag S. Guru, Huseyin R. Hiziroglu, “Electric Machinery and Transformers”, Oxford Pub., 3rd Ed.

Reference Books:

[R1] M. V. Deshpande, **“**Electrical Machines” PHI
[R2] PC Sen, “Principles of Electric Machinery and Power Electronics”, Wiley and Sons, Third Edition**.**
[R3] Ashfaq Hussain, “Electrical Machines”, Dhanpat Rai
[R4] Fitzgeral, A.E. , C.Kingslay & Umans, “Electrical Machines”, Mc Graw Hill.
[R5] Ghosh, “ Electrical Machines”, Pearson

COMMUNICATION SYSTEMS

Paper Code: ETIC-212	**L**	**T/P**	**C**
Paper: Communication Systems	**3**	**1**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 12.5 marks

Objective: This is the first course which introduces the concepts of communication systems, channels and various analog modulation methods. Further, an insight into the behavior of noise is dealt.

UNIT I

Introduction: Overview of Communication system, Communication channels, Mathematical Models for Communication Channels

Introduction of random Variables: Definition of random variables, PDF, CDF and its properties, joint PDF, CDF, Marginalized PDF, CDF, WSS wide stationery, strict sense stationery, non stationery signals, UDF, GDF, RDF, Binomial distribution, White process, Poisson process, Wiener process.

[T1, T2][No. of Hrs. 11]

UNIT II

Analog Modulation: Modulation- Need for Modulation, Amplitude Modulation theory: DSB-SC, SSB, VSB. Modulators and Demodulators. Angle Modulation, Relation between FM and PM Wave. Generation of FM wave- Direct and Indirect Methods. Bandwidth of FM (NBFM, WBFM)

Pulse Analog Modulation: Sampling-Natural and Flat top. reconstruction, TDM-Pulse Amplitude Modulation (TDM-PAM), Pulse Width Modulation (PWM), Pulse Position Modulation(PPM), Generation and Recovery.

Pulse Digital Modulation: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), ADPCM.

[T1, T2][No. of Hrs. 11]

UNIT III

Digital Modulation and Transmission: Advantages of digital communication. Modulation schemes: ASK, PSK, FSK. Spectral Analysis. Comparison. Digital Signaling Formats-Line coding.

Information and Coding Theory: Entropy, Information, Channel Capacity. Source Coding Theorem: Shannon Fano Coding, Huffman Coding.

[T1, T2][No. of Hrs. 11]

UNIT IV

Fiber Optical System: Basic Optical Communication System. Optical fibers versus metallic cables, Light propagation through optical fibers. Acceptance angle and acceptance cone, Fiber configurations. Losses in optical fibers. Introduction to Lasers and light detectors. Applications: Military, Civil and Industrial applications.

Advanced Communication Systems: Introduction to cellular radio telephones. Introduction to satellite Communication.

[T1, T2][No. of Hrs. 11]

Text Books:

[T1] George Kennedy, “Electronics Communication System”, TMH 1993
[T2] B.P. Lathi, “Analog& Digital Communication”, Oxford University Press 1999.

Reference Books:

[R1] Simon Haykin, “Introduction to Analog & Digital Communication”, Wiley, 2000
[R2] Tannenbaum, “Computer networks”, Pearson, 5th Edition
[R3] K. Sam Shanmugam, “Digital & Analog Communication system”, John Wiley & Sons 1998.

MEASUREMENTS AND INSTRUMENTS LAB

Paper Code: ETIC-252	**L**	**T/P**	**C**
Paper: Measurements and Instruments Lab	**0**	**2**	**1**

List of Experiments:

1. To measure inductance using Maxwell / Anderson Bridge.
2. To measure Capacitance using Schering Bridge.
3. To measure the low resistance using Kevin Double Bridge.
4. To perform calibration of single phase energy meter (Analog Vs. Digital).
5. Unknown voltage measurement using potentiometer.
6. To measure frequency and Phase of various signals using CRO.
7. Testing of phase error and ratio error of current transformer (CT).
8. Study the characteristics of instrumentation amplifier.
9. Study the frequency response of passive filters.
10. Measurement of power line parameters (V, I, W, F, VAR, KWH, KVR etc) using series R-L-C load.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

CONTROL SYSTEMS LAB

Paper Code: ETEE-260	**L**	**T/P**	**C**
Paper: Control Systems Lab	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. Comparison of open loop & closed loop control in speed control of D.C. motor & to find the transfer function.
2. To study the characteristics of positional error detector by angular displacement of two servo potentiometers
    a. excited with dc
    b. excited with ac
3. To study synchro transmitter in terms of position v/s phase and voltage magnitude with respect to rotor voltage magnitude /phase.
4. To study remote position indicator systems using synchro transmitter/receiver.
5. To plot speed- torque curves for ac servomotor for different voltages.
6. To study ac motor position control system & to plot the dynamic response & calculate peak time, settling time, peak overshoot, damping frequency, steady state error etc.
7. To study the time response of simulated linear systems.
8. To study the performance of PID Controller.
9. Plot impulse response, unit step response, unit ramp response of any 2^{nd} order transfer function on same graph using MATLAB.
10. To draw the magnetization (Volt Amps) characteristics of the saturable core reactor used in the magnetic amplifier circuits.
11. Plot root locus for any 2^{nd} order system (with complex poles). For Mp=30%, find the value of K using MATLAB.
12. To design lead-lag compensator for the given process using Bode plots in MATLAB.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

POWER ELECTRONICS LAB

Paper Code: ETIC-256	**L**	**T/P**	**C**
Paper: Power Electronics Lab	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. To study and analyze V-I characteristics of SCR and TRIAC.
2. To study the switching characteristics of MOSFET and IGBT
3. To study R and RC and UJT based firing circuits using SCR.
4. To study single phase Semi-converter and Full converters feeding R and RL load
5. To study A.C phase control using SCR (half and full wave) using DIAC and TRIAC for dimmer application.
6. To study single-phase cyclo- converter feeding R and RL loads.
7. To study the operation and duty cycle control of buck and boost converter feeding R loads.
8. To study the operation and duty cycle control of Type-C chopper.
9. To study the THD in operation of single phase Square wave and Quasi square wave Inverter.
10. To study the operation of SPWM Inverter.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

THEORY AND APPLICATION OF INTEGRATED CIRCUITS LAB

Paper Code: ETIC-258	**L**	**T/P**	**C**
Paper: Theory and Application of Integrated Circuits Lab	**0**	**2**	**1**

List of Experiments:

1. Measure the DC characteristics of Operational amplifier 741.
2. To construct and test the performance of an Inverting, Non-inverting amplifier and Differential amplifier using IC µA 741.
3. To construct and test the performance of an Integrator and Differentiator using IC µA 741.
4. To design and verify the operation of instrumentation amplifier using IC µA 741.
5. To design and verify the operation of the Active low pass, High pass and Band pass filters using IC µA 741.
6. To design and construct an Astable, Monostable multivibrators and Schmitt trigger using IC µA 741.
7. To design and test RC phase shift and Wien bridge oscillators using IC µA 741.
8. To design and construct an Astable and Monostable multivibrators using NE555 Timer.
9. To design and construct a PLL Characteristics and Frequency multiplier using NE 565.
10. To design and construct a DC Power Supply using LM317 and LM78XX and LM79XX.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

ELECTRICAL MACHINE LAB

	L	T/P	C
Paper Code: ETIC-254			
Paper: Electrical Machine Lab	**0**	**2**	**1**

List of Experiments

1. To obtain magnetization characteristics of DC shunt generator and determine critical field resistance and critical speed.
2. To perform load test on DC shunt generator and determine the characteristics.
3. To perform speed control of DC shunt motor by field and armature control.
4. To perform Open circuit and short circuit tests on single phase transformer for parameter estimation of the transformer.
5. To obtain star-star, star-delta, and delta-delta connections for three phase transformers.
6. To perform parallel operation of two single phase transformers with non linear load.
7. To perform block rotor test and no load test on induction motor(three phase) for parameter estimation.
8. To perform SCC and OCC of an alternator and calculate voltage regulation at UPF, .8 leading and .8 lagging pf.

NOTE:- At least 8 Experiments out of the list must be done in the semester.