University Institute of Technology (UIT)

Silver Wood Estate, H. P. University Shimla-171005

(NAAC accredited “A-Grade” University)

Syllabus

Bachelor of Technology

In

ELECTRICAL ENGINEERING

(Second Year)

Effective for batch 2019-2020 and onwards

B.Tech. (Electrical Engineering) Second Year

Semester III

SN	Cat.	Code	Course Title	Hours Per week			Credits	Marks	
				L	T	P	C	Ext.	Int.
1	HSMC	HSMC-3001	Principles of Engineering Economics	2	1	0	2	100	50
2	PCC	EE-3001	Network Analysis and Synthesis	3	1	0	3	100	50
3	PCC	EE-3002	Electrical and Electronic Measurements and Measuring Instruments	3	1	0	3	100	50
4	ESC	ES - 3003	Engineering Mathematics - III	3	1	0	3	100	50
5	PCC	EE-3004	Electromagnetic Field Theory	3	1	0	3	100	50
6	PCC	ECE-3003	Digital Electronics and Logic Design	3	1	0	3	100	50
7	PCC	EE-3051	Electrical and Electronic Measurement Laboratory	0	0	2	1	50	50
8	PCC	EE-3052	Network Analysis and Synthesis Laboratory	0	0	2	1	50	50
9	PCC	ECE-3053	Digital Electronics and Logic Design Laboratory	0	0	2	1	50	50
	Total			**29**			**20**	**1200**	

Semester IV

SN	Cat.	Code	Course Title	Hours Per week			Credits	Marks	
				L	T	P	C	Ext.	Int.
1	HSMC	HSMC-4001	Organizational Behavior	2	1	0	2	100	50
2	PCC	EE-4001	Electrical Machines -I	3	1	0	3	100	50
3	PCC	EE-4002	Power Electronics	3	1	0	3	100	50
4	PCC	EE-4003	Power Systems	3	1	0	3	100	50
5	ESC	ES-4001	Numerical Methods	3	1	0	3	100	50
6	PCC	EE-4005	Microprocessor Architecture and Interfacing	3	1	0	3	100	50
7	PCC	EE-4051	Electrical Machines-I Laboratory	0	0	2	1	50	50
8	PCC	EE-4052	Power Electronics Laboratory	0	0	2	1	50	50
9	PCC	EE-4053	Microprocessor Architecture and Interfacing Laboratory	0	0	2	1	50	50
	Total			**29**			**20**	**1200**	

L – **No of lectures per week**

T – **No of tutorials per week**

P – **No of practical per week**

C – **Credits**

Cat – **Course category**

Course Category and Definition:

Course Category	Definitions
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses

Semester - III

Name of the Course	Principles of Engineering Economics		
Course Code	**HSMC – 3001**	**Credits: 2**	**L-2, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Introduction to Engineering Economics: Definitions, Nature and Scope of Economics; Difference between Microeconomics and Macroeconomics; Concepts of Engineering Economics- Engineering Efficiency and Economic Efficiency.

Consumer Demand Analysis: Meaning, Features and Determinants of demand; Law of Demand and its Exceptions; Reasons for Law of Demand; Importance of Law of Demand; Elasticity of Demand.

Section B

Supply Analysis: Meaning, Supply Function, Law of Supply, Determinants of Supply, Fluctuation of supply; Elasticity of supply and its measurement.

Section C

Theory of Production: Production Function, Factors of Production; Law of Variable Proportions; Law of returns to scale Cost, Revenue and Profit Analysis: Cost Classifications for Predicting Cost Behavior; Concept of Profit, Gross Profit and Net Profit; Break Even Point (BEP).

Section D

National Income: Circular Flow of Income, Meaning and Concept of National Income: GNP/GNI, NNP/NNI, Personal Income and Disposable Income; Methods of Computing National Income -Production Method, Income Method, Expenditure Method.

Economic Stabilization: Monetary Policy- Meaning, Objectives, Tools; Fiscal Policy-Meaning, Objectives, Tools.

Text Books:

1. C S Park, "*Contemporary Engineering Economics*", Pearson Education, 2002.
2. J S Chandan, "*Statistics for Business and Economics*", Vikas Publishing.
3. H. L. Ahuja, "*Principles of Microeconomics*", S. Chand (G/L) & Company Ltd, 2002.
4. D. N. Dwivedi, "*Macroeconomics Theory and Policy*", Tata McGraw-Hill Publishing Company, 2010.
5. S Damodaran, "*Managerial Economics*", Oxford University Press, 2010.

Name of the Course	Network Analysis and Synthesis		
Course Code	**EE – 3001**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Network Analysis Techniques: Reciprocity Theorem, Milliman's Theorem, Telegen's Theorem and Maximum Power Transfer Theorem – Applications of Network Theorems to network analysis both with dc and ac inputs and magnetic coupling.

Applications of Laplace Transform: Introduction, some basic theorems, solutions of Linear Differential Equations for electric network-problems, partial fraction expansion-Heaviside's Expansion Theorem, The convolution Integral-evaluation; Application of Laplace Transform analysis of electrical circuits – Linear time invariant first and second order circuits. Zero input response, Zero state response and complete response. Impulse response of first and second order circuits, time varying circuits, Introduction to Fourier Transform.

Section B

Network Functions: Ports and terminal pairs, network functions, Poles and zeros, necessary conditions for driving point functions and transfer functions, Time domain behavior from pole-zero plot.

Two Port Networks: Introduction, Characterization of linear time invariant two port networks, Z-,Y-, h- and transmission parameters, Interrelationship between these parameters, Interconnection of 2-port networks, Image parameters, Attenuation and phase shift in symmetrical T- and pi- networks.

Section C

Filters and Active Networks: Classifications of filters, Filter networks, pass band and stop band types, Constant k-low pass and high pass filters, Characteristics impedance and cut off frequency, m-derived filters.

Graph Theory and Network Equations: Introduction, graph of a network, trees, co- trees and loops, incidence matrix, Cut-set matrix, Tie-set matrix and loop currents, Analysis of networks using graph theory, duality, and general network transformations.

Section D

Network Synthesis: Introduction, Hurwitz polynomials, positive real functions, driving point and transfer impedance function, LC-network, synthesis of dissipative network, Two-terminal R-L network, Two-terminal R-C networks, Synthesis of R-L and R-C networks by Cauer and Foster – methods.

Text Books:

1. Van-Valkenburg M E, "Network Analysis*",*Prentice Hall, New Delhi
2. Sudhakar, A, "Circuits and Networks", Tata McGraw-Hill
3. Hayt, W., "Engineering Circuit Analysis", Tata McGraw-Hill

Reference Books:

4. Bell D A, "Electric Circuit," Oxford University press
5. Van-Valkenburg M E, "Introduction to Modern Network Synthesis", Wiley and Son
6. Suresh Kumar," Introduction to Modern Network Synthesis", Dorling Kindsley

Name of the Course	Electrical and Electronic Measurements and Measuring Instruments		
Course Code	**EE – 3002**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Analog Measuring Instruments: Classification of analog instruments, operating forces in indicating instruments, T/W ratio, pointers and scales. Working principle, theory, construction and salient features of electromechanical indicating / registering instrument viz. PMMC, Electrodynamometer, Moving iron, Rectifier type, Induction type for the measurement of dc and ac voltage, current, power, energy (1-phase induction type wattmeter), power factor (single phase Electrodynamometer), Volt ohmmeter or multimeter.

Section B

Measurement of Resistances: Classification of resistances, measurement of medium resistance, Measurement of low resistance (Kelvin double bridge, Ammeter-Voltmeter) and Measurement of high resistance including loss of charge method and Mega ohm bridge method.

AC Bridges: General theory of ac bridge, Measurement of self inductance, Measurement of capacitance, Measurement of mutual inductance, Measurement of frequency, Sources of error in ac bridges and their minimization.

Section C

Potentiometer: Introduction to basic principle, Laboratory type Crompton's potentiometer, Dual range potentiometer, Volt ratio box, application of dc potentiometer, self balancing potentiometer.

Magnetic Measurement: Working principle and theory of Ballistic galvanometer, Measurement of flux density, Determination of B-H curve, hysteresis loop, Ewing Double bar permeameter, Hopkinson permeameter, separation of iron losses by wattmeter and Bridge methods.

Section D

Instrument Transformers: Theory and construction of current and potential transformers, transformation ratio and phase angle errors and their minimization, effects of pf, secondary burden and frequency.

Cathode Ray Oscilloscope: Principle and working of CRO, Block diagram presentation of CRO and brief description of various elements of CRO – CRT, horizontal Deflecting system, Vertical deflecting system, CRO screen, Measurement of voltage, frequency and phase angle using CRO, CRO probes.

Text Books:

1. Cooper W D, "Electronic Instrumentation and Measurement Techniques", Prentice Hall, New Delhi
2. Bell David A, "Electronic Instrumentation and Measurements", Prentice Hall, Inc, New Delhi

Reference Books:

1. Reissland Martin V, "Electrical Measurements Fundamentals, Concepts, Applications", New Age International
2. Doebelin Ernest O, "Measurement Systems: Application and Design", Tata McGrawHill Ltd., New Delhi

Name of the Course	Engineering Mathematics - III		
Course Code	**ES – 3003**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section-A

Linear dependence of vectors and rank of matrices, linear transformations and inverse of matrices, reduction to normal form, bilinear form and quadratic form, consistency and solution of linear algebraic system of equation, Eigen values, Eigen vectors and their applications to system of ordinary differential equations, Cayley Hamilton theorem, orthogonal, unitary, hermitian and similar matrices.

Section-B

Differential calculus of functions of several variables, partial differentiation, homogeneous functions and Euler's theorem, Taylor's and Maclaurin's series, Taylor's theorem for functions of two variables maxima and minima of functions of several variables, Langrange's method of multipliers.

Section-C

Double and triple integrals, change of order of integration, change of variables, applications to evaluation of area, surface area, and volume.

Scalar and vector fields differentiation of vectors, velocity and acceleration, vector differential operators Del, Gradient, Divergence and Curl and their physical interpretations, formulae involving these operators, line, surface and volume integrals, solenoidal and irrotationalvecotors, Green's theorem, Gauss divergence theorem, Stoke's theorem and their applications.

Section-D

Formulation and classification of partial differential equations, solution of first order linear equations, standard forms of non- linear equations, Charpit's method, linear equations with constant coefficients, non- homogenous linear equations, Monge's method for non-homogenous equations of second order, separation of variables methods for solution for solution of heat, wave and Laplace equation.

Text Books:

1. E Kreyszig," Advanced Engineering Mathematics", 8th Ed. John Wiley, Singapore (2001)
2. R K Jain and S R K Iyengar, Advanced Engineering Mathematics", 2nd Ed, Narosa Publishing House, New Delhi (2003).
3. I A N Sneddon, "Elements of Partial Differential Equations", Tata McGraw Hill, Delhi(1974).
4. B S Grewal, "Higher Engineering Mathematics", Thirty –fifth edition, Khanna Publishers, Delhi.

Name of the Course	Electromagnetic Field Theory		
Course Code	**EE – 3004**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Introduction Review of vector analysis: scalar And vector products: gradient, divergent and curl of a vector and their physical explanation Transformation amongst rectangular, cylindrical and spherical coordinate systems.

Electrostatics: Review of the fundamental postulates of Electrostatics in free space, Coulomb's Law, Gauss's Law and applications, Electric potential, Conductors and Dielectrics in static Electric Field, Electric flux density, boundary conditions for electrostatic fields, Capacitance and capacitors, Electrostatic energy and Forces, Poisson's and Laplace's Equations, Uniqueness of Electrostatic solutions, method of images.

Section B

Magneto statics: Review of the fundamental postulates of magneto statics in free space, vector magnetic potential, Biot-Savart Law and applications, magnetic Dipole, Magnetic field intensity and relative permeability, boundary conditions for Magneto static fields, magnetic forces and torques.

Section C

Time varying fields and Maxwell's Equations: Introduction, Faraday's law of Electromagnetic

Plane Electromagnetic Waves: Introduction, Plane waves in lossless media, plane waves in lossy media, Group velocity, Flow of Electromagnetic Power and the pointing Vector, Normal Incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

Section D

Transmission lines and waveguides: Introduction, transmission line parameters, transmission line equations, input impedance, SWR, and Power, smith chart, micro strip transmission lines, rectangular waveguides, TM and TE modes, wave propagation in the guide, wave guide resonators, source and characteristic of EMI and control techniques.

Text Books:

1. Hayt W H and J A Buck, “Engineering Electromagnetics”, Tata McGraw Hill Publishing
2. Edminister J A, “Schaum’s outline of theory and problems of Electromagnetics”, Tata McGraw Hill Publishing Co., NewDelhi

Reference Books:

3. Kraus J D, “Electromagnetics”, McGraw Hill, NewYork
4. Sadiku M N O, “Elements of Electromagnetics”, Oxford University Press
5. Jordon E C and K G Balmain, “Electromagnetic waves and radiating systems”, Prentice Hall, New Delhi

Name of the Course	Digital Electronics and Logic Design		
Course Code	**ECE – 3003**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section-A

Number Systems And Boolean Algebra: Subtraction using 1's & 2's complements and using 9's&10's complements, Binary codes, Error detecting and Correcting codes, Theorems of Boolean algebra, Canonical forms, Logic gates.

Section-B

Combinational Circuits: Representation of logic functions, Simplification using Karnaugh map, Tabulation method, Implementation of combinational logic using standard logic gates, Multiplexers and De multiplexers, Encoders and Decoders, Code Converters, Adders, Subtractors, Parity Checker and Magnitude Comparator.

Section-C

Sequential Circuits: Flip flops - SR, JK, D and T flip flops - Level triggering and edge triggering, Excitation tables - Counters - Asynchronous and synchronous type Modulo counters, design with state equation state diagram, Shift registers, type of registers, circuit diagrams

Digital Logic Families: Introduction to bipolar Logic families: RTL, DCTL, DTL, TTL, ECL and MOS Logic families: NMOS, PMOS, CMOS, Details of TTL logic family - Totem pole, open collector outputs, TTL subfamilies, Comparison of different logic families.

Section-D

D/A And A/D Converters: Weighted resistor type D/A Converter, Binary ladder D/A converter, Steady state accuracy test, D/A accuracy and resolution, Parallel A/D Converter, counter type A/D converter, Successive approximation A/D converter, Single and Dual slope A/D converter, A/D accuracy and resolution.

Semiconductor Memories: Memory organization, Classification, and characteristics of memories, Sequential memories, ROMs, R/W memories, Content Addressable memories, Charged-Coupled Device memory, PLA, PAL and Gate Array.

Text Books:

1. Mano M. Morris, "Digital Design", 3rd edition, Pearson Education 2006.
2. Jain R. P. "Modern Digital Electronics", 3rd edition, Tata McGraw-Hill 2003.
3. Malvino and Leach "Digital principles and Applications", 5th edition, Tata McGraw Hill, 2003.
4. James W. Bignell and Robert Donovan, "Digital Electronics", 5th edition, Delmar Publishers, 2007.
5. Flecther "An Engineering Approach to Digital Design", 1st edition, PHI, 2009.
6. Tocci Ronald J. "Digital Systems-Principles and Applications" 10th edition, PHI, 2009.
7. Flecther "An Engineering Approach to Digital Design", 1st edition, PHI,2009.
8. Tocci Ronald J. "Digital Systems-Principles and Applications" 10th edition, PHI, 2009.

Name of the Course	Electrical and Electronic Measurement Laboratory			
Course Code	**EE-3051**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

List of Experiments:

1. To measure amplitude and frequency of the signal using CRO (Y-t mode)
2. To measure frequency of an unknown signal and phase angle between two signals obtaining Lissajous pattern using a CRO
3. Measurement of medium resistance with the help of a Wheat stone Bridge
4. Measurement of low resistance with the help of a Kelvin Double Bridge
5. Measurement of high resistance using a Meggar
6. Measurement of capacitance and inductance by Maxwell's Bridge
7. Measurement of capacitance by Schering Bridge
8. Measurement of frequency by Wein's Bridge
9. To study potentiometer and to plot EMF Vs. Displacement characteristics of a potentiometer
10. To plot calibration curve for PMMC, Moving Iron and Electrodynamometer type of voltmeters
11. To measure power consumed by a 3-phase load and to find its power factor using 2-Wattmeter method
12. To plot calibration curve for a single phase energy meter
13. To find Q-factor of the coil using series resonance method and verify it using LCR-Q meter
14. To draw a B-H loop of toroidal specimen by the Flux meter
15. To measure iron losses in the magnetic specimen using Wattmeter method

Name of the Course	Network Analysis and Synthesis Laboratory			
Course Code	**EE-3052**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

Course Objectives:

- Provide hands-on experience to the students so that they are able to put theoretical concepts to practice
- Solve and verify the electrical networks using mesh and nodal analysis
- Solve and verify the electrical networks using network theorems
- To impart knowledge about the experimental determination of two-port network parameters

List of Experiments:

1. To verify maximum power transfer theorem.
2. To verify superposition theorem.
3. Determination of peak and average voltage in ac circuits.
4. To check polarity markings of a transformer and to determine self and mutual inductance of windings.
5. To measure inductance of a coil by:
    i. Three voltmeter method.
    ii. Three ammeter method.
    iii. Voltmeter, ammeter and wattmeter method.
6. To find Z, Y, ABCD and H parameters for a two port network.
7. To obtain time constant for a RC circuit when:
    i. RC circuit is switched on with a dc supply.
    ii. Capacitor is discharged through resistance.
8. To charge and discharge a condenser through a resistance using neon bulb.
9. To study characteristics of various active filters.
10. To study RC circuits with varying EMF.
11. To study change over logic in typical offline UPS and its implementation in respect of UPS trainer.
12. To study working of pulse width modulated and Q-sine wave inverter.

Course Outcomes:

Upon successful completion of the course, the students will be able to

- Apply the fundamentals of circuit theory in solving and verifying various Laws and Theorems
- Express given electrical circuit in terms of A,B,C,D and Z,Y parameter models and solve the circuits
- Be able to determine time constants from RC and RL circuits.

Name of the Course	Digital Electronics and Logic Design Laboratory			
Course Code	**ECE-3053**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

List of Experiments:

1. Design and verification of the truth tables of Half and Full adder circuits.
2. Design and verification of the truth tables of Half and Full subtractor circuits.
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC7483.
4. Design and implementation of code converters using logic gates

   (i) BCD to excess-3 code
   (ii) Binary to gray code
5. Verification of the truth table of the Multiplexer using IC 74150.
6. Verification of the truth table of the De-Multiplexer using IC 74154.
7. Design and test of an SR flip-flop using NOR/NAND gates.
8. Verify the truth table of a D flip-flop (7474) and JK flip-flop (7476).
9. Design and implementation of 3-bit synchronous up/down counter.
10. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters using JK flip-flop.
11. Operate the counters 7490, 7493. Verify the frequency division at each stage and with a low frequency clock (say 1 Hz) display the count on LEDs.
12. Operate the universal shift register 74194.
13. Verify the truth table of decoder driver 7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock.
14. Design and test D/A converter using R-2R Ladder Network

Semester - IV

Name of the Course	Organizational Behavior		
Course Code	**HSMC – 4001**	**Credits: 2**	**L-2, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

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2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

OVERVIEW OF MANAGEMENT: Definition - Management - Role of managers - Evolution of Management thought- Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

PLANNING: Nature and purpose of planning - Planning process - Types of plans – Objectives - - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making

Section B

ORGANIZING: Nature and purpose of organizing - Organization structure - Formal and informal groups Organization - Line and Staff authority - Departmentation - Span of control- Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - - Performance Appraisal.

Section C

DIRECTING: Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

Section D

CONTROLLING: Process of controlling - Types of control - Budgetary and non-budgetary control Q techniques - Managing Productivity - Cost Control - Purchase Control – Maintenance Control - Quality Control - Planning operations.

Text Books and Reference Books:

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.
3. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.

Name of the Course	Electrical Machines-I		
Course Code	**EE – 4001**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Principle of Electromechanical Energy Conversion: Review of magnetic circuits, Principle of energy conversion, singly and doubly excited magnetic system, Dynamic equations. **D C Motors:** Construction and principle of operation, armature winding, torque equation, characteristics of d. c. motors and their applications, Braking and speed control, Brushless DC machines.

Section B

Transformers: Construction and working principle, type of single-phase transformer, concept of ideal transformer, emf equation, transformer on load, phasor diagram on no load and on load, equivalent circuit, O.C and S.C tests, Regulation and efficiency, Pulse transformer. Low, intermediate and high frequency response, Three Phase Transformers, Auto Transformer: Principle of operation, advantages, phasor diagram, equivalent circuit

Section C

Three Phase Induction Motors: Construction and principle of operation, slip-torque equation, characteristics, phasor diagram at standstill and on load, equivalent circuit, No load and blocked rotor tests, methods of speed control, applications.

Section D

Specialty Motors: Construction and principle of operation, Double revolving field theory, types of single phase induction motor, equivalent circuit, phasor diagram, characteristics, hysteresis motor, reluctance motor, universal motor and their characteristics, applications.

Text Books:

1. Hubert C I, Electric Machines: Theory, Operating Applications, and Controls", Pearson Education
2. Nagrath I J and Kothari D P, "Electric Machines", Tata McGraw Hill

Reference Books:

3. Say M G "Alternating Current Machines", ELBS
4. Mcpherson George, Laramore R D, "Introduction to Electric Machines and Transformers", John Wiley and Sons
5. Fitzegerald A F, Kingsley C and Umans S D, "Electrical Machinery", Tata- McGraw Hill

Name of the Course	Power Electronics		
Course Code	**EE – 4002**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Characteristics of Various Solid State Devices: Semiconductor Power diodes, Power transistors, MOSFET, SCR Thyristor and its two transistor model, Triac, Gate turn off thyristor (GTO), Insulated gate bipolar transistor (IGBT), Comparison of switching power devices, Static Characteristics and Principles of operation, turn on and turn off characteristics, triggering circuits.

Section B

AC to DC Converters: Line commutated thyristor based converters, phase controlled rectifiers, bridge converters - fully controlled, half controlled, uncontrolled (single phase and three phase configuration), bidirectional ac to dc voltage source converters, issues of line current harmonics, power factor, distortion factor and source inductance, Resonant Converters, inverter operation, applications in drives.

Section C

DC to DC Converters: Thyristor choppers, voltage, current and load commutation, step up and step down Choppers, basic principles of DC-DC switch mode Converters, buck, boost and buck-boost converters and applications.

Section D

DC to AC Inverters DC-AC switched mode converters, Voltage source inverters, single phase and three phase inverter, harmonic reduction techniques and Sinusoidal Pulse Width Modulation, current source inverter.

AC to AC Converters: Single phase and 3-phase AC voltage controllers using thyristors , phase control and integral cycle control, AC choppers, single phase cyclo-converters, applications, effects of harmonics and electromagnetic interference, applications in drives.

Text Books and References:

1. Modern Power Electronics by B.K.Bose, IEEE Press, New York.
2. An Introduction to Thyristor and their applications by M.Ramamoorty, East West Press, New Delhi.
3. Power Electronics by P.S.Bhimbra, Khanna Publishers, Delhi.
4. Thyristorised Power Controllers by Dubey, Doradla, Joshi and Sinha, New age International Pub., New Delhi.
5. Power Electronics-Circuits, Devices and Applications by M.H. Rashid, Pearson Education.

Name of the Course	Power System		
Course Code	**EE – 4003**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Introduction to Power System, Load Characteristics and Economic Aspects: Basic structure of power system, sources of electric energy: conventional and non-conventional; cogeneration, combined heat and power, captive power plants, distributed generation. Commonly used terms and factors, curves useful in system operation and planning, economics of power factor improvement, interconnection of power stations and tariffs.

Transmission Line Parameters: Types of conductors, Ampere's law, inductance of a conductor, inductance of a single phase line, inductance of a three-phase line, inductance of three-phase double circuit line, bundled conductors, skin effect , proximity effect, Guy's theorem, Capacitance of single phase line, capacitance of a three-phase line, capacitance of double circuit three phase line, effect of earth on capacitance.

Section B

Transmission Line Performance: Classification of lines, models, circuit constants of transmission lines: short, medium and long lines; Ferranti effect, power flow through a line, sending and receiving end power circle diagram, reactive power generation/absorption of line, compensation and voltage control.

Section C

Insulators for Overhead Transmission lines and Mechanical Design of Transmission line: Types of insulators, ratings, voltage distribution across suspension insulators, string efficiency, methods to improve string efficiency. Calculation of sag and tension, equivalent span length and sag, effect of ice and wind loading, stringing chart, sag template, conductor vibrations and vibration dampers.

Section D

Corona and Radio interference: Critical voltages, corona loss, advantages and disadvantages of corona, factors affecting corona loss, effect of corona on line design, radio interference

Distribution System and Insulated Cables: Effect of voltage on transmission efficiency, Kelvin's law, radial and ring main distributors, interconnectors, methods of feeding distributors, ac distribution, three-phase, four wire distribution system, stepped and tapered mains. Cable conductors, insulating materials, insulation resistance, electrostatic stress in cables, grading of cables, capacitance of a three-core cable, dielectric loss, dielectric power factor, classification of cables, cable performance.

Text Books and References:

1. Electric Power systems by C.L. Wadhwa, New Age international, New Delhi.
2. Electric Power generation transmission and distribution by S.N. Singh, Prentice-hall of India, Private Limited, New Delhi.
3. Elements of Power System Analysis by W.B. Stevenson McGraw Hill.
4. Power System Engineering by D.P. Kothari and I.J. Nagrath, Tata McGraw Hill, New Delhi.

Name of the Course	Numerical Methods		
Course Code	**ES – 4001**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section-A

Solution of algebraic and transcendental equations: Bisection method, method of false position, secant method, Iteration method Newton-Raphson method.

Solution Of Simultaneous Algebraic Equations : Gaus elimination method, Jacobi's method, Gauss-Seidal method.

Section-B

Finite Differences & Interpolation: Forward and Backward difference operators, Newton's Forward and Backward interpolation formulae, Central Difference Interpolation formulae, Gauss's forward and Backward Interpolation formulae, Lagrange's interpolation formulae and Newton's Divided Difference formulae.

Section- C

Numerical Methods To Solve Differential Equations: Solution of first order differential equations using Taylor's Series, Euler's, Picard's and Runge-Kutta method upto 4^{th} order, Predictor- Corrector methods, Simultaneous differential equations of first order, differential equations of second order.

Section- D

Numerical Integration: Numerical integration using Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Two point and three point Gauss quadrature method.

Text Books:

1. Sastry SS, Introductary Methods of Numerical Analysis, Prentice Hall of India
2. Chapra SC and Canale RP, Numerical Methods for Engineers, McGraw Hill Book Company
3. Grewal, BS, "Numerical Methods", Khanna Publishers
4. Computer Oriented Numerical Methods By: V. Rajaraman, PHI Learning Pvt. Ltd

Name of the Course	Microprocessor Architecture and Interfacing		
Course Code	**EE – 4005**	**Credits: 3**	**L-3, T-1, P-0**
Lectures to be delivered	**52 (1 Hr Each) (L = 39, T = 13 for each semester)**		
Semester End Examination	**Max. Time: 3 hrs.**	**Max. Marks: 100**	**Min. Pass Marks: 40**
Continuous Assessment (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)	**Max. Marks: 50**		

INSTRUCTIONS

1. **For Paper Setters:** The question paper will consist of five sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. **For candidates:** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non- programmable calculators is allowed.

Section A

Introduction to 8-Bit Microprocessor: General 8-bit Microprocessor and its architecture – Intel 8085 Microprocessor, Pin Configuration, CPU Architecture, Registers, ALU Control Unit, Stack.

Section B

Microprocessor Instruction Set (INTEL 8085): Complete instruction set of INTEL 8085, instruction format, types of instructions, various addressing modes, Timing diagrams – T-states, machine cycles, instruction cycle.

Assembly Language Programming: Programming of Microprocessors using 8085 instructions, use of Arithmetic, logical, Data transfer, stack and I/O instructions in programming, Interrupt in 8085.

Section C

Peripherals and Interfacing for 8085 Microprocessors: Memory interfacing, I/O interfacing – memory mapped and peripheral mapped I/O, Data transfer schemes – Programmed, Interrupt driven and Direct memory Access (DMA) data transfers, Block diagram representation, Control word formats, modes and Simple programming of 8255A PPI, 8254 Programmable Interval Timer, Interfacing of Data converters (A/D & D/A), Serial I/O and data communication

Section D

Introduction to 8086 Microprocessors: Architecture of 8086, block diagram, register set, flags, Queuing, concept of segmentation, Pin description, operating modes, addressing modes and interrupts.

Pentium Microprocessors: Introduction to Pentium processors

Text Books:

1. Gaonkar R S, “Microprocessor architecture, programming and application with 8085”,Wiley
2. Ram B, “Fundamentals of Microprocessors and Microcomputers”, Dhanpat Rai and Sons

Reference Books:

3. Liu Yu-Cheng, “Microcomputer Systems”, The 8086/8088 family,” Prentice Hall.
4. Mathur AP, ”Introduction to Microprocessors”, Tata McGraw Hill.
5. Ray AK and Bhurchandi KM. “Advanced Microprocessor and peripherals: Architecture programming and interfacing”, Tata McGraw Hill.

Name of the Course	Electrical Machines-I Laboratory			
Course Code	**EE-4051**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

Course Outcomes: On successful completion of this course the student will be able to:

- Perform various configuration test on electrical single phase AC transformer
- Understand the working of single phase and three phase electrical motors along with their construction
- Acquire knowledge about the functioning of DC motor and generator

List of Experiments:

1. To perform Ratio, Polarity and the Load Test on a Single Phase Transformer
2. To perform Open Circuit and Short Circuit Test on a Single Phase Transformer and hence determine its Equivalent Circuit Parameters
3. To perform Parallel Operation on two Single Phase Transformers
4. Speed Control of a DC Shunt Motor
5. To obtain Magnetization characteristics of
   a) a separately excited DC Generator
   b) a Shunt Generator
6. To obtain the load characteristics of
   a) a DC Shunt Motor
   b) a DC Cumulative Compound Generator
7. To perform no-load test and blocked rotor test on a three-phase induction motor and hence determine its equivalent circuit parameters
8. To perform load test on a three-phase induction motor and obtain its various performance characteristics
9. To perform the retardation test on a three phase induction motor and obtain its moments of inertia
10. To perform no-load and blocked-rotor test on a single phase induction motor and hence determine its equivalent circuit parameters
11. To study dc shunt motor starters.
12. To perform reversal and speed control of Induction motor.
13. Identification of different windings of a dc compound motor.

Name of the Course	Power Electronics Laboratory			
Course Code	**EE-4052**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

Course Objectives:

- To learn the operation and characteristics of different power semiconductor switches.
- To understand and analyze the operation of controlled rectifier, chopper and cyclo-converter.

List of Experiments:

1. To determine the V-I characteristics of silicon controlled rectifier (SCR).
2. To study the output and transfer characteristics of MOSFET.
3. To study output and transfer characteristics of IGBT.
4. To determine the V-I characteristics of DIAC.
5. To determine the V-I characteristics of TRIAC.
6. To observe output waveform across RC load of a chopper which is a voltage commutated SCR.
7. To study the action of voltage commutated chopper and plot output waveform.
8. To study action of single phase half wave rectifier with resistive load.
9. To study operation of single- phase full wave rectifier.
10. To study the operation of single phase to single phase step down cyclo-converter

Course Outcomes: Upon successful completion of the course, the students will be able to

- Explain the basic operation of various power semiconductor devices and its applications.
- Analyze power electronic circuits.
- Apply power electronics circuits for different loads.

Name of the Course	Microprocessor Architecture and Interfacing Laboratory			
Course Code	**EE-4053**	**Credits-1**	**L-0, T-0, P-2**	
Lectures to be Delivered	**39 hrs. (Lab Session=13(3 hrs. each))**			
Semester End Examination	**Max Marks: 50**		**Min Pass Marks: 20**	**Maximum Time: 3 hrs**
Laboratory Continuous Assessment	**Lab work 30%, Lab Record Viva/Handson25%, attendance**		**Max Marks: 50**	**Min Pass Marks: 25**

Instructions for paper setter / candidates

Laboratory examination will consist of two parts:

- Performing a practical exercises assigned by the examiner (25 marks).
- Viva-voce examination (25 marks)
- Viva-voce examination will be related to the practical performed / project executed by the candidate related to the paper during the course of the semester.

Course Outcomes:

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

- Program 8085 Microprocessors using assembly language
- Interface peripheral devices such as PPI, Timer, ADC/ DAC with microprocessor
- Learn implementation of microprocessor based applications such as of Stepper Motor Controller, Traffic Light Controller, PID controller and Data Acquisition System
- Analyze, comprehend, design and simulate microprocessor based systems used for control and monitoring

List of Experiments:

At least 8 experiments are to be performed out of the following list:

1. a) Familiarization with the 8085 kit (trainer kit)
   b) To execute at least 8 programs on the above kit.

2. a) Familiarization with the 8085 kit(trainer-cum-development)
   b) To execute at least 5 program on the above kit.

3. Study of 8155card
4. Study of 8212card
5. Study of 8255card
6. Study of 8253card
7. Study of 8251card
8. Study of latch, buffer, decade, RAM study card.
9. Study of 8257/8237 DMA control study card.
10. Study of DC motor study card.
11. Study of traffic control study card.
12. Study of A to D and D/A converter.
13. Familiarization with 8086 trainer kit