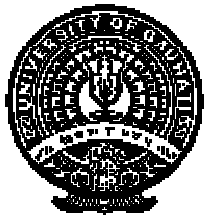

BSc in Electronics
under Gauhati University

Duration – 3 Years Full Time

Revised Programme Structure and

Detailed Curriculum as per L-T-P-C format

2010

PREAMBLE

Gauhati University aims to achieve academic excellence by providing quality education to students and encourage them to reach the pinnacle of success. The University has a tradition that provides rigorous academic programmes with necessary skills to enable students to excel in their careers. The orientation of the revised programmes is towards making them relevant to the contemporary methods of teaching and learning. The expected outcome is enhanced skills to be provided to the students which will be essential to help them seek dignified employment and progression in their careers. Gauhati University in its pursuit of excellence considers such courses to be of significance which in the long run will have far reaching impact in the overall development of the NE Region.

This curriculum prepared by the Department of Electronics and Communication Technology, Gauhati University contains the Programme Structure, detailed Syllabus and other relevant details.

PROGRAMME OBJECTIVE

The main objective of the programme is to provide enhanced skills to students enabling them to consider Electronics as a career and means of livelihood. The programme aims at familiarizing the students with the basic topics in Electronics. The students will also receive inputs on the foundations of Electronics and Communications Technology and also have an exposure to the advancements in related areas. The highlight of the programme is to give wider coverage of Electronics, developing an understanding of the intriguing issues related to Electronics and Communication and related areas. The curriculum has an inbuilt system of seminar presentation which is likely to help the students in developing knowledge on a specific topic and inter-personal communication skills. Last two semesters are mainly devoted to design oriented project which is likely to help the students to develop design and fabrication skills with an ability to tackle and execute a time bound design and development problem. The objective is to provide quality education to the youth of not only Assam but of the entire North East. Such courses will also help in reducing the scarcity in quality manpower in Electronics and related areas in this part of the country.

Justification

- Electronics as a subject in under-graduate level provides a student a career option. Hence, the already existing BSc- Electronics (M) programme needs to be restructured as per the L-T-P-C format to provide the benefits of scientific methods of teaching and learning.
- The restructuring of the BSc- Electronics (M) programme will provide a modular approach to the programme structure so that the planning and execution of the courses forming the programme is carried out with an approach which has been accepted to be beneficial to the students. The contents will receive a modular and unitized treatment enabling the teaching learning process to be completed within the stipulated time and yet provide the students a holistic approach to Electronics and related areas at the under graduate level.
- The restructuring of the BSc- Electronics (M) programme is required to provide the students contemporary knowledge and skills so that they have greater opportunity to opt for a meaningful career in Electronics and subsequently get absorbed.

DETAILED SYLLABUS AND PROGRAMME STRUCTURE

OF BSc ELECTRONICS (MAJOR) IN L-T-P-C FORMAT

BSc ELECTRONICS (MAJOR) PROGRAMME IN L-T-P-C FORMAT

Semester	Course Code	Subject	Marks	L	T	P	C
1	EC M101	Material Science	75	5	1	0	6
	EC M102	Solid State Devices	75	5	1	0	6
	EC M103	Lab Course 1: Solid State Devices	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**
2	EC M 201	IC Process Technology	75	5	1	0	6
	EC M202	Electric Circuits	75	5	1	0	6
	EC M203	Lab Course 2: Electric Circuits	50	0	0	4	16
	Semester total		**200**	**10**	**2**	**4**	**16**
3	EC M301	Linear Active Circuits	75	5	1	0	6
	EC M302	Digital Systems	75	5	1	0	6
	EC M303	Lab Course 3: Linear Active Circuits and Digital Systems	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**
4	EC M401	Microprocessor	75	5	1	0	6
	EC M402	Communication System	75	5	1	0	6
	EC M403	Lab Course 5: Microprocessor & Communication System	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**
5	EC M501	Signals and Systems	75	5	1	0	6
	EC M502	Optoelectronics	75	5	1	0	6
	EC M503	Digital Communication	75	5	1	0	6
	EC M504	Operating System	75	5	1	0	6
	EC M505	Network Analysis	75	5	1	0	6
	EC M506	Seminar	25	0	1	0	6
		Project Phase I	50	0	1	4	
	Semester total		**450**	**25**	**7**	**4**	**36**
6	EC M601	Control System	75	5	1	0	6
	EC M602	Electromagnetics	75	5	1	0	6
	EC M602	Power Electronics	75	5	1	0	6
	EC M603	Programming in C	75	5	1	0	6
	EC M604	Instrumentation	75	5	1	0	6
	EC M605	Project Phase II	75	0	2	4	6
	Semester total		**450**	**25**	**7**	**4**	**36**
	PROGRAMME TOTAL		**1700**	**89**	**21**	**26**	**136**

L- Lectures per week,
T-Tutorials per week,
P- Practicals per week with each session of minimum two hours,
C-Credits

- First two semesters (1^{st} and 2^{nd}) must have atleast one subsidiary course of Physics and Mathematics and English as compulsory courses each of around 5 to 7 credits.
- Semesters 3^{rd} and 4^{th} must have atleast one subsidiary course of Physics and Mathematics and another compulsory Humanities / Management / Language / Environment course each of around 3 to 7 credits.
- Semesters (5^{th} and 6^{th}) will only have the core subject courses and seminar, project based courses.

Semester One

Semester	Course Code	Subject	Marks	L	T	P	C
1	EC M101	Material Science	75	5	1	0	6
	EC M102	Solid State Devices	75	5	1	0	6
	EC M103	Lab Course 1: Solid State Devices	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**

Course Code	Subject	Marks	L	T	P	C
EC M101	Material Science	75	5	1	0	6

Course Objective:

- To develop insights of the student regarding properties, characteristics and governing principles of materials used for Electronic device design.
- To provide the theoretical foundation to students regarding methods of thin film and IC fabrication

Course Contents: **marks**

Module 1: [25]

Introduction:

Crystal binding, ionic, covalent, metallic & Vander wall bond, Unit cell, Bravis lattice; Crystal defects;

Classical free electron theory- Electrical and thermal properties of metals, Relaxation time & mean free path, Qualitative discussion of the Block function, Kronig-Penny model, E-K diagram, Reduced zone representation, Brillouin-zone, concept of effective mass & holes;

Brief idea of dielectric materials, spontaneous polarization, ferroelectric &. Piezoelectric materials;

Introduction to magnetic materials-origin of dipole moment, classification & properties of magnetic materials;

Module 2: [20]

Classification of solids:

conductors, insulator & semiconductors. Properties of conductors & Insulators, Resistivity of conductors & insulators, Temperature coefficient, Insulation resistance, non-linear resistance, incremental & differential resistance, materials for resistors;

Introduction to vacuum tubes-diode, triode, tetrode, & pentode (brief review, V-I characteristics, tube parameters & applications)

Module 3: **[2**0]

Semiconductors:

Energy band theory of semiconductors, Intrinsic, Extrinsic, degenerate, non degenerate, elemental & compound semiconductors.; luminescence-photoluminescence, cathodoluminescence & electroluminiscence; Drift & diffusion process, Einstein's relation, calculation of Fermi level of the semiconductors.. Introduction to III-V semiconductors. Hall effect; introduction to metal-insulator-semiconductor junction;

Module 4: [10]

Special Materials-

Electrical conduction in polymers, polymer materials (OLED), optical fiber materials, Ceramics materials, Solar cell materials, materials for VLSI. Superconducting materials

Suggested Reading:

1. Physics of semiconductor devices- S.M Sze John Wiley
2. Semiconductor devices- J. Singh, Mcgrawhill
3. Semiconductor optoelectronics device- P. Bhattacharya, Pearson Education;
4. Solid State Electronic Devices- Banerjee, Streetman, Pearson Education;
5. An Introduction to Solid State Physics- Charles Kittel, Wiley Publishers.
6. Solid state Electronics- S.Wang.
7. Electrical properties of materials- L.Solymar and D Walsh
8. The Materials Science of Thin Films - M. Ohring, . Academic
9. Microelectronics- Millman, Mcrawhill.

Course Code	Subject	Marks	L	T	P	C
EC M102	Solid State Devices	75	5	1	0	6

Course Objective: To provide the students

- Basic understanding of semiconductor devices and circuits
- Knowledge to develop skills for semiconductor based device design
- Exposure to the underlying phenomena that govern semiconductor behaviour and characteristics.

Course Contents: **marks**

Module 1 [15]

Physics of p-n junction –unbiased and biased, Diode equation, V-I characteristics of p-n junction diodes, Q-point & load line of a diode; resistance of a diode, temperature effect; reverse breakdown- avalanche & zener phenomena; Zener diode, varactor diode, tunnel diode, Schottky diode. Junction capacitance-transition and diffusion capacitances, dependence on barrier width and carrier densities.

Module 2: [10]

Diode as a circuit element, equivalent representation of a diode, diode as a rectifier, half wave & full wave rectifiers, peak inverse voltage, bridge rectifier, effect of filters, Zener diode as regulator, load & line regulation, regulated power supply, basic idea-clipper, clamper, voltage multiplier.

Module -3 [10]

(a) Physics of BJT, Detailed analysis of current flow in BJT, Base-width modulation, Breakdown voltages.

(b) BJT characteristics and equivalent circuit, h-parameters. Biasing- dc load line & bias point, Fixed current bias, collector to base bias, emitter current bias, Thermal stability, ac load line, switching and amplification properties. Biasing transistor switching circuits. Transistor specifications & performance: Transistor data sheet, power dissipation, heat sinking, Decibels and frequency response, Transistor circuit noise, Transistor switching times.

Module -4 [10]

(a) JFET, Detailed analysis of current flow, second order effects, MOSFET, Detailed analysis of current flow, SCR and Power handling devices.

(b)JFET Data sheet & Parameters, FET voltage amplification, FET equivalent circuit, FET Biasing: dc load line & Bias point, Fixed voltage bias circuit, self bias circuit, potential divider bias.

Module -5 [10]

Small signal amplifiers: CE amplifier design, CS FET amplifier design, capacitor coupled two stage CE amplifier, Direct coupling between stages. Large signal amplifier: Transformer coupled class A amplifier and its design, capacitor coupled power amplifier.

Module -6 [10]

Negative Feedback: Concept, Current series and shunt, voltage series and shunt, amplifier circuit design with negative feedback, effects of negative feedback.

Module -7 [10]

OPAMP : Basic OPAMP circuit, Integrated circuit OPAMP, Biasing of OPAMP, Non inverting & inverting circuit, OPAMP non-linear circuits, OPAMP circuit stability, frequency and phase response, frequency compensation, circuits Bandwidth, circuit Stability precautions. Wave shaping circuit, frequency to voltage and voltage to frequency converters, Active Filters, Inductance simulation, OPAMP Voltage comparator, precision rectifier circuit, Schmitt trigger circuit, oscillators.

Suggested reading:

1. Electronic Devices & circuits. - David A. Bell, PHI
2. Semiconductor Devices - Jasprit Singh, John Wiley
3. Transistor- Dennis Le Croissette.
4. Electronic Devises & Circuits Theory - Boylestad & Nashalsky. Pearson Education
5. Electronic Device & Circuit - Millman-Halkias, Tata McGraw Hill.
6. Electronic Design: From Concept to Reality - - Roden,. Carpenter, Wiesrman (SPD).
7. Introduction to Electronic Circuit Design – - Spencer & Ghausi, Pearson Education
8. Electronics Lab Primer- K.K. Sarma, Global Publishing;

Course Code	Subject	Marks	L	T	P	C
EC M103	Lab Course 1: Solid State Devices	50	0	0	4	4

List of experiments:

1 To determine the V-I characteristics of a semiconductor diode and to draw its load line.
2 Study the zener diode:
   a. To study reverse bias characteristics of a zener diode.
   b. To study the load & line regulation of a zener diode voltage regulator
3 To design a halfwave rectifier using diode. Use filtering.
4 To design a double diode fullwave rectifier. Use filtering.
5 To design a fullwave bridge rectifier. Use filtering.
6 To study the static characteristics of the BJT in C-E mode & to determine its h-parameters. Draw the load line
7 To design a single stage RC coupled amplifier using BJT in C-E mode & to determine its voltage gain. Obtain its frequency response plot. Find the bandwidth.
8 To design a complete zener /IC regulated power supply. It may be treated as a mini project.
9 To design and study double stage RC-coupled BJT amplifier.
10 To study op-amp as (i) Inverting amplifier (ii) Non-inverting amplifier (iii) Voltage follower, (iv) Summing amplifier and (v) Subtrator using IC741.
11 To measure the phase difference of a given signal using Lissajous figure.

Suggested reading:

1. Electronic Devices & circuits. - David A. Bell, PHI
2. Electronic Devises & Circuits Theory - Boylestad & Nashalsky. Pearson Education
3. Electronic Device & Circuit - Millman-Halkias, Tata McGraw Hill.
4. Introduction to Electronic Circuit Design – - Spencer & Ghausi, Pearson Education
5. Electronics Lab Primer- K.K. Sarma, Global Publishing;

Semester Two

Course Code	Subject	Marks	L	T	P	C
EC M201	IC Process Technology	75	5	1	0	6
EC M202	Electric Circuits	75	5	1	0	6
EC M203	Lab Course 2: Electric Circuits	50	0	0	4	4
Semester total		**200**	**10**	**2**	**3**	**16**

Course Code	Subject	Marks	L	T	P	C
EC M201	IC Process Technology	75	5	1	0	6

Course Objective:

To develop insights of the student regarding properties, characteristics and governing principles of materials used for Electronic device design.

To provide the theoretical foundation to students regarding methods of thin film and IC fabrication

Course Contents: **marks**

Module 1: Introduction to I.C s: [15]

Definition ,scale of integration, types-monolithic, hybrid, thick & thin films; capacitance & resistance formation in ICs, idea of IC packages;

Module 2: Thin Film [30]

Basic definitions- thin and thick films, properties of thin films, thin film deposition methods- PVD, CVD, Epitaxy theory of nucleation and growth in thin films; VPE, LPE, MOCVD, MBE techniques Growth of multilayer structure, defects; diffusion, method of control and measurement of film thickness, structure, optical, electrical and mechanical characterization of thin films metallic, semi conducting and insulating films; non crystalline films; various applications of thin films.

Module 3: I.C. Processing [30]

Introduction to silicon planar technology. Fabrication of diode, BJT, FET & MOSFET in ICs; Bulk semiconductor growth: zone refining technique Czochralski growth, vertical and horizontal Bridgman technique. Wafer preparation, oxidation, diffusion, ion implantation, metallization, pattern definition, encapsulation, lithography: advanced processing technique, electron beam lithography, soft x-ray lithography various types of etching plasma etching.

Suggested Reading:

1. The Materials Science of Thin Films - M. Ohring, . Academic
2. Thin film fundamentals - A. Goswami, New Agency Institute Pub.
3. Preparation of thin films- J. George. M. Dekker Inc.
4. Microelectronics- Millman, Mcrawhill.
5. VLSI fabrication principles.- Gandhi. S.K. Wiley
6. VLSI technology Sze S.M- Mcgrawhill
7. Integrated Circuit and fabrication- Elliot, McGrawhill publication

Course Code	Subject	Marks	L	T	P	C
EC M202	Electric Circuits	75	5	1	0	6

Course Objective:
The objective of the course is to provide a brief knowledge of Electrical Engineering and includes some theorems related to electrical, some law's related to flow of current, voltages, basic knowledge of transformer, basic knowledge of electromagnetism, basic knowledge of electrical network.

Course Contents: **marks**

Module I: Basic Electrical Quantities [15]
Basic Electrical definitions-Energy, Power, Charge, Current, Voltage, Electric Field Strength, Magnetic Flux Density, etc., Resistance, Inductance and Capacitance. Ideal Source, Independent Source and Controlled Source

Module II: Network Analysis Techniques & Theorems [15]
Circuit Principles: Ohm's Law, Kirchoff's Current Law, Kirchoff's Voltage Law Network Reduction: Star–Delta Transformation, Source Transformation, Nodal Analysis, Loop analysis. Superposition theorem, Thevenin's Theorem, Norton's theorem and Reciprocity theorem.

Module III: Alternating Current Circuits [15]
Peak, Average and RMS values for alternating currents, Power calculation-reactive power, active power, complex power, power factor, impedance, reactance, conductance; Resonance: series Resonance, parallel resonance, basic definition of Q factor & Band-width. Passive filters- low pass, high pass, band pass and band reject.

Module IV: Transformers [10]
Magnetic circuits, self and mutual inductance; Basic Transformer Operation principle, Construction, Voltage relations, current relations, Linear circuit models, open circuit test, short circuit test, Transformer Efficiency.

Module V: Polyphase circuits [10]
Advantages in favour of polyphase circuits, Generation of three phase emf, phase sequence, connection of three-phase winding, line and phase quantities in star connected circuit, line and phase quantities in delta-connected system, power in three-phase systems with balanced load.

Module VI: Bridges [10]
Basic principles of working of a potentiometer, Generalized Wheatstone bridge, Anderson bridge, Maxwell's bridge, Schering bridge, Wien bridge, simple problems.

Suggested Reading:

1. Network Analysis- G.K. Mittal, Khanna Publishers.
2. Network Theory and filters Design V.K. Aatre, Wily Eastern Ltd.
3. Engineering Circuit Analysis- W.H. Hayt and J.E. Kemmerly, McGraw Hill
4. Network Analysis- M.E. Van Valkenberg, Prentice Hall of India
5. Network Analysis- Ghosh, PHI
6. Linear Circuit Analysis- Liu, Oxford University Press;
7. Network Analysis- Stanlay, Pearson Education;
8. Fundamentals of Electrical Engineering- Del Toro, PHI
9. Electrical Engineering- B.L. Thareja
10. Electric Circuits- Rajeshswaran, Pearson Education;

Course Code	Subject	Marks	L	T	P	C
EC M203	Lab Course 2: Electric Circuits	50	0	0	4	4

List of experiments:

1. To verify voltage and current division rules.
2. To verify the Thevenin's theorem & determine the equivalent circuit.
3. To verify the Norton's theorem & determine the equivalent circuit
4. To verify the Maximum power transfer theorem & determine the matched condition.
5. To design 1st order and 2nd order passive low pass filter and determination of the cut-off frequencies.
6. To design 1st order and 2nd order passive high pass filter and determination of the cut-off frequencies.
7. To design a series tuned circuit using RLC components & to determine its Q-point & bandwidth.
8. To design a parallel tuned circuit using RLC components & to determine its Q-point & bandwidth.
9. To design a passive differentiator and integrator and to determine the respective time constants.
10. To measure self inductance of an inductor by Anderson bridge.
11. Investigation of an inductance in an a. c. circuit.
    a. To verify the current -voltage characteristics for an inductance in a. c. circuit & hence to measure the value of inductance.
    b. To measure the reactance of an inductance coil in L.R. circuit.
    c. To study the variation of reactance of the inductive coil with frequency of the a.c. source & hence to measure its inductance.
12. Investigation of a capacitance in an alternating current circuit:
    a. To verify that the current -voltage relationship for a capacitor in a. c. circuit is linear & hence to measure the value of the capacitance.
    b. To measure the loss factor of a capacitor from the reactance characteristics of a C.R. circuit.
    c. To study the variation of reactance of a capacitor with frequency of the alternating current source & hence to measure the capacitance
13. To find the thermo emf of the given thermocouple using potentiometer.
14. To find the resistance of a potentiometer wire.

Suggested Reading:

1	Network Analysis-	G.K. Mittal, Khanna Publishers.
2	Engineering Circuit Analysis- McGraw Hill	W.H. Hayt and J.E. Kemmerly,
3	Linear Circuit Analysis-	Liu, Oxford University Press;
4	Network Analysis-	Stanlay, Pearson Education;
5	Electric Circuits-	Rajeshswaran, Pearson Education;
6	Electronics Lab Primer-	K. K. Sarma, Global Publishing;

Semester Three

Semester	Course Code	Subject	Marks	L	T	P	C
3	EC M301	Linear Active Circuits	75	5	1	0	6
	EC M302	Digital Systems	75	5	1	0	6
	EC M303	Lab Course 3: Linear Active Circuits and Digital Systems	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**

Course Code	Subject	Marks	L	T	P	C
EC M301	Linear Active Circuits	75	5	1	0	6

Course Objective

To provide exposure and knowledge to the students enabling them to develop insights into working of active devises and their design.

Course content **marks**

Module 1: [20]

Transistor biasing: Fixed bias, emitter bias, voltage divider bias, d.c collector feedback bias; load line, Q- point, stability considerations;

BJT modeling: two port representation of the BJT with z-,y-,h-parameters; r_e & hybrid models of C-E, C-B,C-C(emitter follower) amplifiers;

C-E amplifier in the above four biasing configurations, calculation of voltage gain, current gain, power gain, input impedance and output impedance of respective configurations and types; Hybrid-pi model of C-E amplifier in voltage divider bias configuration, Effect of parasitic capacitances, frequency response in low-,mid- & high- frequency conditions (cut-off frequencies ,bandwidth),respective voltage gains, current gain, input & output impedances;

Module 2: [20]

Unipolar devices: Basic idea of UJT-application as a relaxation oscillator;

Junction field effect transistor: JFET structure & working principle, characteristics, Structure of MOSFET- enhancement & depletion , p & n - channel MOSFET, common gate, common drain configuration, long & short channel effects. FET Biasing: Self bias, fixed bias , voltage divider bias, simple problems, small signal A.C. equivalent circuit of FET as amplifier, hybrid parameters, CS, CD amplifiers, high frequency response, equivalent circuit.

Module 3: [25]

Amplifier:

Tuned amplifier: single & double tuned amplifiers, Analysis of voltage gain & selectivity, IF amplifiers.

Power amplifier: Class A, B, C & AB type, Direct coupled (d.c amplifier, Darlington pair), Transformer coupled amplifier, pushpull amplifier, class B pushpull circuits, complementary symmetry amplifier, distortion in amplifiers.

Feed back amplifiers: General theory of feed back, negative & positive feedback, advantages of negative feedback, types of negative feedback in transistor amplifier- current series, voltage series, current shunt, voltage shunt amplifiers; practical circuits;

Operational amplifier: Differential amplifier; Ideal op-amp characteristics, offset current, offset voltage, CMRR, Basic op-amp application, inverting & noninverting amplifiers, adder, subtractor, voltage to current , current to voltage converters, nonlinear circuits, integrator, differentiator, gyrator, VCO. comparator, Schmitt trigger ,instrumentation amplifier, precision rectifier, Multivibrator- astable, monostable; Active filter-types-low pass, high pass, band pass & band elimination.

Module 4: [10]

Oscillator circuit-Positive feedback & oscillation, Barkhausen criterion; types-RC, LC & crystal oscillators; Wein bridge, phase shift, Hartley, Colpitts & Clapp oscillators as examples; frequency stability & Q-value.

Suggested Reading:

1. Electronic devices & circuit theory- Boylestad & Nashalsky, Pearson Education
2. Electronic Device & Circuit - Millman-Halkias , Tata McGraw Hill.
3. Microelectronics- Millman….,TataMcgrawHill
4. Microelectronic Circuits - Sedra & Smith,Oxford press
5. Solid State Devices- Streetman,PHI.
6. Electronic Fundamentals & Applications – Ryder,PHI.
7. Electronic Principles – Malvino,TataMcGraw Hill

Course Code	Subject	Marks	L	T	P	C
EC M302	Digital Systems	75	5	1	0	6

Course objective:

- To provide insights into design of devices using digital techniques.
- To provide students knowledge about binary sytems, logic families and applications based on binary system.

Course Content **Marks**

Module-1 [15]

Number system and logic gates: Binary, octal and hexadecimal numbers, representation of signed integers, binary arithmetic on signed and unsigned integers and detection of overflow and underflow, Weighted Binary Codes: BCD, 2421, Reflective and sequential codes, Non-weighted codes: Excess-3 Codes, Gray codes, Error detecting codes, Error correcting codes, Alphanumeric Codes: ASCII Code, EBCDIC Codes and Hollerith code. Boolean operators, Rules (postulates and basic theorems) of Boolean algebra, Dual and complement of a Boolean expression, Sum of products and product of sums forms. Canonical forms. Conversion between different forms, Conversion between Boolean expression and truth table;Logic gates, Implementing logic expressions with logic gates (logic circuits).

Module -2 [10]

Digital logic families: Designing of basic logic gates with diode and transistor ; elementary idea of DTL, TTL, RTL, ECL,12L logic family and characteristics ; 7400 series, understanding of the basic NAND gate (TTL)

Module -3 [15]

Combinational Circuits: Boolean expressions and their simplification by algebraic method. Karnaugh map method and Quine-Mc Cluskey method, Don't Care conditions. Multiplexer, demultiplexer, encoder, decoder, Half-adder, Full-adder, magnitude comparator, Parity Checkers: Basic concepts, Design of parity checkers, parity generation, Code converters, Binary –to- Gray and Gray-to-Binary Code converter; Concept of magnitude comparator;

Module -4 [15]

Sequential circuit: Simple R-S flip-flop or Latch, Clocked R-S Flip-flop, D flip-flop. J-K flip-flop, T flip-flop, Master-Slave flip-flop, J-K Master-Slave flip-flop. Asynchronous pre set and clear, edge triggering and level triggering. Registers: Shift registers, parallel/serial in, parallel/serial out. Buffer Counter design: different types of counters like asynchronous and synchronous, UP and Down, ring, Johnson etc. counter design using state diagram, state table and state equation.

Module -5: [10]

Semiconductor Memory: Classification of memories, Main Memory and Secondary Memory, Sequential Access Memory, Static and Dynamic Memory, Volatile and Non-volatile Memory, Concept of ROM, PROM, EPROM, RAM, DRAM, SDRAM, PSRAM, Memory Decoding, Programmable Logic Devices (PLD), Programmable Logic Array (PLA)

Module -6: [10]

IC Timer 555: Basics of IC555 Timer, Monostable and Astable Multivibrator using IC555, Schmitt Trigger using IC555, Some other applications.

Suggested reading:

1. Digital logic and computer design, -M. Mano. PHI.
2. Modern Digital Electronics - R.P. Jain, TMGH
3. Digital Fundamentals - Jain and Floyd, Pearson Education
4. Digital Electronics - Malvino & Leach, Pearson Education
5. Digital Computer Electronics - Malvino, TMGH
6. Digital Design - Morris Mano, Pearson Education
7. Digital Circuits and Design - S. Salivahanan and S. Arivazhagan, Vikash Publishing House Pvt. Ltd.
8. Digital Techniques - Prof. P. H. Talukdar, N. L. Publications
9. Digital Design - Wakerly, PHI

Course Code	Subject	Marks	L	T	P	C
EC M303	Lab Course 3: Linear Active Circuits and Digital Systems	50	0	0	4	4

Linear Active Circuits -List of experiments:

1. To design clipper and clamper circuits using diode.
2. To design a voltage doubler using diode.
3. Design a two stage BJT RC coupled C-E amplifier and measure its voltage gain. Convert the design into a two stage form to study the frequency response of the two stage C-E amplifier. Determine its cut-off points & bandwidth. Repeat the above in case of a CS- JFET amplifier.
4. Design of a Wein bridge oscillator using BJT/FET/IC.
5. Design an astable multivibrator using BJT.
6. Design of a phase shift oscillator using BJT/ FET/ IC.
7. Design of a first and second order filters as low pass blocks using IC741
8. Design of a first and second order filters as high pass blocks using IC741
9. Design of first and second order filters as band pass blocks using IC741
10. Design of first and second order filters as band elimination blocks using IC741

Suggested Reading:

1. Electronic devices & circuit theory- Boylestad & Nashalsky, Pearson Education
2. Electronic Device & Circuit - Millman-Halkias , Tata McGraw Hill.
3. Microelectronics- Millman….,TataMcgrawHill
4. Microelectronic Circuits - Sedra & Smith,Oxford press
5. Solid State Devices- Streetman,PHI.
6. Electronic Principles – Malvino,TataMcGraw Hill
7. Electronics Lab Primer- K. K. Sarma, Global Publishing
8. Linear Integrate Circuits- T. R. Ganeesh Babu, Suseela, Scitech Publications.

Digital Systems - List of experiments:

1 To verify the logic gates (i) AND gate (ii) OR gate (iii) NAND gate (iv) NOT gate
   (a) Using diode or BJT and resistance.
   (b) Using ICs- 7400 (ii) 7402 (iii) 7408 (iv) 7432 (v) 7486 (vi) 7404
2 To design and RS-flip-flop and study its truth table.
3 To design and study half and full adder circuit using logic gates.
4 To design and study 4:1 Multiplexer circuit using logic gates.
5 Design of a D/A converter using ladder method. Study the DAC 0808.Record the output corresponding to a digital input.
6 Design of a JK-Flip-flop. Display the results using LEDs.
7 Design of a 4-bit counter using IC7470/ 7472 (JK-flipflop). Display the output using LEDs or 7-segment LED display. Repeat the above using IC 74161/74162/74163 (4-bit counter).
8 Design a 8:1 multiplexer using common gates. Study IC74151 (8:1 multiplexer) and verify the truth tables.

Suggested reading:

1. Digital logic and computer design, - M. Mano. PHI.
2. Modern Digital Electronics - R.P. Jain, TMGH
3. Digital Fundamentals - Jain and Floyd, Pearson Education
4. Digital Design - Morris Mano, Pearson Education
5. Digital Circuits and Design - S. Salivahanan and S. Arivazhagan, Vikash Publishing House Pvt. Ltd.
6. Digital Techniques - Prof. P. H. Talukdar, N. L. Publications
7. Digital Design - Wakerly, PHI
8. Electronics Lab Primer- K. K. Sarma, Global Publishing

Semester Four

Semester	Course Code	Subject	Marks	L	T	P	C
4	EC M401	Microprocessor	75	5	1	0	6
	EC M402	Communication System	75	5	1	0	6
	EC M403	Lab Course 5: Microprocessor & Communication System	50	0	0	4	4
	Semester total		**200**	**10**	**2**	**4**	**16**

Course Code	Subject	Marks	L	T	P	C
EC M401	Microprocessor	75	5	1	0	6

Course Objective:
To provide the student the exposure of the working of the microprocessor, architectural details, instructions, programming and applications.

Course Content **Marks**

Module 1: [12]
History & evolution of microprocessor; Introduction to CPU: Components of CPU, block diagram, buses-data, control & address; ALU, Control Unit; main memory & secondary memory; I/O devices; Memory addressing-memory mapped I/O & I/O mapped I/O; address decoding; Memory & I/O interfacing;

Module 2: [13]
Instruction cycle: fetch, decode & execute; zero, one, two & three address instructions; addressing modes(register direct, relative, indirect, immediate, indirect& implied);

Module 3: [30]
Introduction to 8085; block diagram, registers, use of register pairs, PSW, accumulator; addressing modes; Instruction set of 8085; Complete set in details; Instruction set: Data Transfer, Arithmetic, Logic, Branch and Machine Control instructions. Delay and counter; stack & its application; interrupt and its application; Assembly level language programming of 8085;

Module 4: [15]
Interfacing: Memory interfacing;I/O interfacing; interfacing small devices like keyboard,7- segment display,relay, event counter etc; idea of PPIs like 8251, 8255, 8257 & 8279 (block diagram & function only); serial communication standard(RS-232C);

Module 5: [5]
Example of 16-bit processors (introduction to 8086); Examples like 80286, 80386, 80486 and 80586; microcontroller (block diagram & application of 8051);

Suggested reading:

1. Introduction to Microprocessors - Gaokar,New age Publication
2. Fundamentals of Microprocessor - N.Ram.Dhanpat Rai
3. 8085 Microprocessor Programming and Interfacing -N. K. Srinath, PHI
4. Microprocessor Based Design - Slater, PHI
5. Microprocessors - Gilmore, MacGraw Hill Publication
6. Microcomputers and Microprocessors - Uffenbeck, PHI
7. Microprocessor- Chowdhury, Scitech Publications
8. Interfacing Through Microprocessor- E.S. Reddy, Scitech Publications
9. Microcontroller Based System Design- Manoharan, Scitech Publications

Course Code	Subject	Marks	L	T	P	C
EC M402	Communication System	75	5	1	0	6

Course Objective:

To provide the knowledge of basic principles of communication system, types, design details and applications

Course Content **Marks**

Module 1: Basic signal theory**:** [15]

Fourier transform, Convolution theorem, statements of time & frequency domain convolution. Power spectral density, Energy spectral density. Parseval's theorem.

Module 2: Communication system: [10]

Block diagram; Requirements of modulation. Superheterodyne receiver-AGC; .Types of modulation-AM, FM, PM

Module 3: Amplitude modulation, [15]

Basic principle of DSB, SSB (phase discrimination method) and VSB systems, Modulators & demodulators. Modulators: ring modulator, balanced modulator & BJT modulator; Demodulator: diode detector, envelope detector & BJT detector;

Module 4: Angle modulation: [15]

Phase modulation & frequency modulation, Sinusoidal FM, frequency spectrum for sinusoidal FM, Average power, Sinusoidal PM, Equivalence between FM& PM, elementary idea of direct(Armstrong) & indirect modulator(VCO method), elementary idea of demodulators(discriminator, limiter, PLL & ratio detector).

Module 5: Noise: [10]

Different types of noise, Thermal, shot, flicker noise, Noise figure, Equivalent noise temperature; Noise in DSB, SSB, FM systems;

Module 6: Pulse Modulation: [10]

Sampling theorem, Nyquist criteria; PAM- generation and recovery; PCM,- stages like sampling, quantization, encoding, regeneration; noise considerations; Multiplexing: Frequency division multiplexing (FDM) & Time division multiplexing (TDM),

Suggested Reading:

1 Communication Systems- B.P. Lathi, Willey Eastern
2 Radio Engineering, Vol.II- G.K. Mittal, Khanna Publishers
3 Electronic Communications- Schoenbeck, PHI
4 Electronic Communications Systems- Kennedy, TMGH
5 Communication Systems- Simon Haykin, John Wiley ;
6 Electronic Communication- Roddy, Coolen, PHI
7 Monochrome & Colour television- Gulati,Wiley Eastern;
8 Communication System Engineering- Prokais, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC M403	Lab Course: Microprocessor & Communication System	50	0	0	4	4

Microprocessor: List of experiments

1. Move a block of memory starting at location XXXX to a location YYYY. Perform the block move in reverse order as well.
2. Find the sum, maximum & minimum of an array of 8-bit numbers.
3. Compute X+Y-Z+56 using 16-bit numbers.
4. Compute X*Y using 8-bit numbers.
5. For the 8-bit number X find the bits $b_3b_4b_5$ .Output should show $b_3b_4b_5$.
6. Find whether a given number is odd or even. Store the result in a memory location as 1 when even & 0 when odd.
7. Design a relay driven bell. Generate an external interrupt. The bell should ring N seconds after the interrupt.
8. Design a 2-digit 7-segment display driver circuit. Use it to display the contents of memory starting at a given location.
9. Interface a steeper motor to a microprocessor. Write programs to move it clockwise and counter clockwise.
   Interface a d.c. motor to a microprocessor .Rotate it clockwise and counter clockwise.

Communication System: List of experiments:

1 Design of an AM modulator using diode/ BJT/ FET.
2 Design of an AM demodulator using diode / BJT/ FET
3 Design of an FM modulator using diode/ BJT/ FET.
4 Design of an FM demodulator using diode / BJT/ FET
5 Study of Phase modulation / pulse modulation using trainer kits.
6 Generation of PCM using discrete components/ trainer kits/ software.

Semester Five

Semester	Course Code	Subject	Marks	L	T	P	C
5	EC M501	Signals and Systems	75	5	1	0	6
	EC M502	Optoelectronics	75	5	1	0	6
	EC M503	Digital Communication	75	5	1	0	6
	EC M504	Operating System	75	5	1	0	6
	EC M505	Network Analysis	75	5	1	0	6
	EC M506	Seminar	25	0	1	0	6
		Project Phase I	50	0	1	4	
	Semester total		**450**	**25**	**7**	**4**	**36**

Course Code	Subject	Marks	L	T	P	C
EC M501	Signals and Systems	75	5	1	0	6

Course Objective

- To provide insights into signals and types, methods of processing and transformation.
- To expose students to types of discrete systems, types and application.

Course Content **Marks**

Module 1: Signal and System classification: [10]
Signals- Periodic, aperiodic; even-odd; exponential, sinusoidal; unit impulse & unit step functions; System with & without memory; invariability & inverse system; causality, linearity, time invariance;

Module 2: Signal Representation: [10]
Signal space and orthogonal bases; Fourier series representation of continuous-time and discrete-time signals; continuous-time; Fourier transform and its properties; Parseval's relation, time-bandwidth product; discrete-time Fourier transform and its properties; relations among various Fourier representations;

Module 3: Sampling: [10]
Sampling theorem and its implications: spectra of sampled signals; reconstruction: ideal interpolator, zero-order hold, first-order hold; aliasing and its effects. Time-frequency analysis: time-frequency representation and the uncertainty principle, short-time Fourier transforms and wavelet transforms.

Module 4: Linear time invariant [LTI] system [15]
Review of basic principles of Fourier Transform- Sampling of analog signal, Representation of discrete time signals in terms of impulses; convolution; convolution sum representation of LTI systems; properties of LTI systems-commutative, distributive, associative; LTI systems with & without memory, causality, linearity, stability of LTI systems; Unit impulse response of an LTI system; Interconnection of LTI systems; Correlation, cross correlation and autocorrelation

Module 5: Discrete Fourier Transform [20]
Definition, properties; linear & non-linear phase; DFT-definition & properties; Discrete linear and periodic convolution; IDFT. Relation of DFT to other transformation; FFT- Decimation in time and frequency; Radix-2 and radix-4 algorithms; Spectrum analysis using FFT; Discrete power spectral density;

Module 6 : z-transform [10]
Definition, properties; inverse z-transform; relation with other transforms; Convolution, correlation- cross correlation and autocorrelation;

Suggested Reading:

1. Signals & Systems- Oppenheim & Willsky, PHI.
2. Digital Signal Processing- Mitra,Tata McgrawHill
3. Digital Signal processing- Proakis, Pearson Education;
4. Digital Signal processing- Salivahanan, Vallavaraja, Gnanapriya, TMGH
5. Digital Signal Processing- Bandopadyaya, PHI
6. Signal, System and Transforms- Philip, Pearson Education
7. Signals and Sysems- Babu, Scitech Publications.

Course Code	Subject	Marks	L	T	P	C
EC M502	Optoelectronics	75	5	1	0	6

Course Objective:
The course intends to provide the basic foundations that govern Optoelectronics and its applications. The course also focuses on different aspects of optical properties of semiconductors.

Course Content **Marks**

Module I - Electronic properties of semi conductors [10]
Effect of pressure and temperature on band gap, density of carriers in intrinsic and extrinsic semiconductors, consequence of heavy doping, conduction processes in semiconductors, electron-hole pair formation and recombination, PN junction, carrier recombination and diffusion, injection efficiency, heterojunction, internal quantum efficiency, double heterojunction, quantum well, quantum dot and superlattices;

Module 2 - Optical properties in semiconductors [10]
Exciton absorption, donor-acceptor and impurity band absorption, long wavelength absorption, Franz-Keldysh and Stark effect, absorption in quantum wells and quantum-confined Stark effect, Kramer-Kronig relations, Stokes shift in optical transitions, luminescence from quantum wells;

Module 3 - Optoelectronic devices [15]
LED, LED materials, device configuration and efficiency, light output from LED, LED structure, device performance characteristics, manufacturing process of LED and applications, laser diode, threshold current and power output, heterojunction lasers, distributed feedback lasers, cleaved-coupled-cavity laser, quantum well lasers, surface emitting and rare earth doped lasers, laser mounting and fibre coupling, mode locking of SC;

Module 4 – Photodetectors [15]
Thermal detectors, photoconductors, junction photodiodes, avalanche photo diode, optical heterodyning and electro-optic measurements, fiber coupling, phototransistor, modulated barrier photo diode, Schottky barrier photo diode, MSM photo diode, detectors for long wavelength operation, micro cavity photo diode; Solar cells: I-V characteristics and spectral response, materials and design considerations of solar cells;

Module 5- Display devices [25]
Photoluminescence, electroluminescence and cathodoluminescence displays, displays based on LED, plasma panel and LCD; Optoelectronic modulation and switching devices: analog and digital modulation, Franz-Keldysh and Stark effect modulator, quantum well electro-absorption modulators, electro- optic, acousto-optic and magneto-optic modulators, SEED

Suggested reading:

1. Optical Fiber Communications - Gerd Keiser, Mc.Graw hill International
2. Opto- Electronics, An Introduction- J. Wilson and J.F.B. Hawks, PHI
3. Fundamentals of Fiber optics in Telecommunication and Sensor system.- Bishnu Pal, New Age International (P) Ltd.
4. Optics (Fourth edition)- Eugene Hecht, Pearson Education.
5. Optical information processing- Mir Mojtaba Mirsalehi
6. Semiconductor Optoelectronic Devices - Pallab Bhattacharya, Pearson Education
7. Semiconductor Optoelectronics - Jasprit Singh, John Wiley

Course Code	Subject	Marks	L	T	P	C
EC M503	Digital Communication	75	5	1	0	6

Course Objective

The course provides basic foundation of different aspects of Digital Communication and its applications.

Course Content **Marks**

Module 1. Random Process: [15]

Probability theory, random variable, statistical averages, transformation of random variables, random process, stationarity, mean, correlation and covariance, ergodicity, transmission of a random process through a linear filter, power spectral density, Gaussian process;

Module 2: Pulse modulation [15]

Sampling theorem, pulse analog modulations (PAM), Shaping of the transmitted signals spectrum, Equalization, Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM), Coding, Synchronization, Quantization; PCM-Limitations of PCM; Companding; DM, DPCM-preliminary idea; coding speech at low bit rate, APCM; CODEC;

Module 3: Digital Modulation techniques [30]

Amplitude shift keying (ASK), Frequency Shift Keying (FSK), phase shift keying (PSK), Dual Phase Shift Keying (DPSK) schemes, Coherent binary PSK/ FSK; Coherent quadri- PSK; Coherent minimum shift keying; differential PSK Comparison of digital modulation schemes, M-array signaling scheme; QAM; Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM).

Module 4: Spread Spectrum modulation [15]

Definition; types-direct sequence & frequency hoping; pseudo-noise generation; Idealized model of a spread spectrum modulator; DS- & FH-spread spectrum modulation generation and detection; application; CDMA, GSM;

Suggested reading

1. Communication Systems- Simon Haykin, Wiley Eastern
2. Digital & Data Communication- Miller, Jaico.
3. Digital Communication- Simon Haykin, Willey Eastern
4. Communication System Engineering- Proakis, Pearson Education;
5. Digital Communication- Sklar, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC M504	Operating System	75	5	1	0	6

Course Objective:

The course provides an insight into the different aspects of working of operating system, different tasks handled by operating systems, different roles played by them, types and examples.

Course Content **Marks**

Module 1: Introduction [15]

Operating system-definition, types, different parts; trends- parallel computing, distributed computing; Open systems; Hardware, software, firmware;

Module 2: Process Scheduling [15]

Definition of a process; process states, transitions, process control, suspend and process, interrupt processing, nucleus of an operating system; parallel processing; Mutual exclusion, Critical Section; Solution of mutual exclusion; Semaphores; Deadlock- occurrence, prevention, detection and recovery;

Module 3: Storage management [10]

Storage organization, management strategies, hierarchy; virtual storage, paging, segmentation;

Module 4: File system and I/O management [20]

File system (function of a file system)- data hierarchy, blocking and buffering, file organization, queued and basic access methods, backup and recovery; I/O management (functions of I/O management subsystem), Distributed computing- OSI view, OSI network management, MAP, TOP, GOSIP, TCP/IP; OS security- requirements, external security, operational security, surveillance, threat monitoring; Introduction to Cryptography;

Module 5: Case Study [15]

UNIX- Shell, Kernel, File System, Process Management, Memory Management, I/O System, Distributed UNIX; Example of operating system-MS-DOS, Windows, OS/2, Apple Macintosh & Linux;

Suggested Reading:

1. Operating System- Deitel, Pearson Education
2. Operating System- Tanenbaum, PHI

Course Code	Subject	Marks	L	T	P	C
EC M504	Network Analysis	75	5	1	0	6

Course objective:
To provide the student the exposure of advanced skills of network analysis and synthesis.

Course Content **Marks**

Module–1: Review of network theorems: [10]
Superposition, Maximum power transfer, Thevenin's and Norton's theorem.

Module – 2: [20]
Transient response and Laplace tranformation of networks: Step function response of linear R-L, R-C, and R-L-C network. Network analysis using Laplace transformation: Laplace Transformation and inverse Laplace tranformation, Application of Laplace transformation in R-L, R-C and R-L-C networks; Response to R-L, R-C and R-L-C networks to step & sinusoidal voltage, impedance and transfer function of a two port network. Phasor diagram, Driving point impedance and transfer impedance, magnitude and phase response curves in S-planes, Poles and Zeroes, Method of partial fractions.

Module –3: Fourier analysis: [10]
Fourier analysis of a periodic signal, Fourier integral, Power and Energy relationship in Network by Fourier method.

Module –4: Network parameters of two port network: [10]
Short circuit admittance, open circuit impedance, transmission and Hybrid parameters, T-section and Π section representation of a two port network, Symmetrical, Ladder and Lattice network.

Module – 5: Network Syntheses: [10]
Positive real functions; Hurwitz Polynomials, Realizability condition of network, Foster 1^{st} and 2^{nd} form ofnetwork synthesis for one port network, Cauer 1^{st} and 2^{nd} form.

Module – 6: Network Filters: [10]
Filter Approximation and Frequency Transformation; Passive Filters, High pass, Low pass, Band pass and band elimination filters, m-derived filters, Butterworth approximation; Chebychev and Bessel response.

Module -7: Graph theory [5]
Graph of a network and its parts; Oriented graph; Tree; Co-tree; Loops; Tie-set; Cut- set matrix; Incidence matrices; Network equilibrium equations

Suggested Reading:

1. Network Analysis- G.K. Mittal, Khanna Publishers.
2. Network Theory and filters Design V.K. Aatre, Wily Eastern Ltd.
3. Engineering Circuit Analysis- W.H. Hayt and J.E. Kemmerly, McGraw Hill
4. Network Analysis- M.E. Van Valkenberg, Prentice Hall of India
5. Network Analysis- Ghosh, PHI
6. Linear Circuit Analysis- Liu, Oxford University Press;
7. Network Analysis- Stanlay, Pearson Education;
8. Network Analysis-

Course Code	Subject	Marks	L	T	P	C
EC M505	Seminar and Project Phase I	75	0	2	4	6

Seminar & Term Paper:

Marks	L	T	P	C
25	0	1	0	1

A. Seminar

Each student shall collect information on an allotted topic related to the subject, analyze it and formulate an approach to make a presentation. The students shall submit a report on the allotted topic which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic.

B. Term Paper -METHODOLOGY

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consists of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

1. Choosing a Subject

The subject chosen should not be too general.

2. Finding Sources of materials

a. The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
b. Begin by making a list of subject-headings under which you might expect the subject to be listed.
c. The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

3. Collecting the notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

a. Get facts, not just opinions. Compare the facts with author's conclusion.
b. In research studies, notice the methods and procedures, results & conclusions.
c. Check cross references.

4. Outlining the paper

a. Review notes to find main sub-divisions of the subject.

b. Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

5. Writing the first draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- statement of purpose
- main body of the paper
- statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

6. Editing & Preparing the final Paper

a. Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
b. Read the paper to ensure that the language is not awkward, and that it "flows" properly.
c. Check for proper spelling, phrasing and sentence construction.
d. Check for proper form on footnotes, quotes, and punctuation.
e. Check to see that quotations serve one of the following purposes:
f. Show evidence of what an author has said.
g. Avoid misrepresentation through restatement.
h. Save unnecessary writing when ideas have been well expressed by the original author.
i. Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

7. Term papers should be composed of the following sections:

1) Title page
2) Table of contents
3) Introduction
4) Review
5) Discussion & Conclusion
6) References
7) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

Discussion

The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

Conclusion
The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

a) summary of question posed
b) summary of findings
c) summary of main limitations of the study at hand
d) details of possibilities for related future research

References
From the very beginning of a research project, you should be careful to note all details of articles gathered.
The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography. The key to a good bibliography is consistency. Choose a particular convention and stick to this.

Appendix
The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not
included in the main text due to their subsidiary nature or to space constraints in the main text.

Assessment Scheme:
Continuous Evaluation: 40%
(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)
Final Evaluation: 60%
(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)
Total marks- 25.

Project Phase I:

Marks	L	T	P	C
50	0	1	4	5

Students individually or two at the most will carry out a detail study on a topic and implement a related system. The study must include literature survey, similar work done previously, proposed work, modifications to be included, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The report may contain four chapters like introduction, present work, experimental results and further development. It should also have a bibliography, datasheets, annexure as required. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. It can involve research and development oriented works and be carried out with an eye on the needs of the

industry. At the beginning of the semester, the HoD must assign the supervision of project works to the faculty members after obtaining mutual consent between the respective supervisors and the students. It is the responsibility of the student to approach a faculty member with a request to offer him / her a project work. The student must inform the HoD about this communication.

The work must be defended through a presentation in front of a panel constituted for the purpose. The panel should be constituted for the evaluation of the reports submitted by the students as part of the project works with the HoD as the chairperson, one internal and an external examiner (locally arranged) and the supervisor. The report must be submitted atleast two days before the scheduled date of presentation and checked and signed by the supervisor. The report must have a declaration of authenticity by the student and a certificate of execution and completion of the work given by the supervisor / HOD. Any report without the signature of the supervisor cannot be considered for evaluation.

Evaluation scheme: 1. Presentation- 50 %, 2. Report- 50% .

Semester Six

Semester	Course Code	Subject	Marks	L	T	P	C
6	EC M601	Control System	75	5	1	0	6
	EC M602	Electromagnetics	75	5	1	0	6
	EC M603	Power Electronics	75	5	1	0	6
	EC M604	Programming in C	75	4	0	2	6
	EC M605	Instrumentation	75	5	1	0	6
	EC M606	Project Phase II	75	0	2	4	6
	Semester total		**450**	**24**	**6**	**6**	**36**

Course Code	Subject	Marks	L	T	P	C
EC M601	Control System	75	5	1	0	6

Course Objective:
To familiarize the students with control system- its working principles, methods of design and analysis, transform methods and application.

Course Content **Marks**

Module 1: [10]
Concepts of closed-loop and open-loop systems: Importance and Application of Control System; Conceptual Block diagram of a control system and types- open loop and closed loop, Continuous and discrete data systems, Feedback theory;

Module 2: [10]
Representation of feedback control system: Block diagram, signal flow graphs, Mason's gain formula; Transfer function concept- Time and frequency domain analysis of first and second order systems to step, ramp and other inputs; error analysis, Types of systems;

Module 3: [20]
Stability: Routh Hurwitz stability criteria, Root locus, Nyquist criteria, Relative and absolute stability; Polar and Bode Plot, Gain and phase margins;

Module 4: [15]
Discrete Control Systems & Control System Design: Z-transform,
Simulation diagram and flow graphs. Effects of proportional, integral and derivative control, Discrete Vs Continuous control systems.

Module 5: [20]
State Variable Analysis: Importance of state variable analysis; Definition of state, state space, state vector; SV representation of physical systems and electrical networks; Eigen value and eigen vector; Determination of transfer function using SVA; Resolvent Matrix and State transition matrix; Solution of homogeneous and non-homogeneous systems using SVA;

Suggested reading:

1. Control Systems Engineering - I.G. Nagrath, M. Gopal; Wiley Eastern Ltd.
2. Automatic Control Systems- B.C. Kuo, Prentice-Hall of India.
3. Modern Control Engineering- K. Ogata, Prenticd-Hall of India.
4. Control System – S. Ghosh, Pearson Education
5. Control System Engineering- Bhattacharjya- Pearson Education;
6. Control System- Babu, Scitech Publications

Course Code	Subject	Marks	L	T	P	C
EC M602	Electromagnetics	75	5	1	0	6

Course Objective

To provide exposure to students to the principles governing Electromagnetics, working, radiating systems, waveguides, transmission lines and antenna and the respective applications.

Course Content **Marks**

Module 1: Fundamentals concepts [15]

Vector Analysis, Electrostatics in Vacuum & Dielectrics, Boundary Value Problems, Magnetostatic Field, Electromagnetic Field; Maxwell's equations and solutions;

Module 2 : [15]

Uniform plane waves: Uniform plane waves in time domain in free space, sinusoidal time-varying uniform plane waves in free space, wave equation and solution for material medium, uniform plane waves in Dielectrics and conductors, Poynting Vector, Power dissipation and energy storage,

Module 3: [15]

Transmission lines 1(TL1)(time domain analysis): TL equations and solutions, Determination of line parameters, line terminated by resistive load, bounce diagram,TL discontinuity, Reactive and nonlinear resistive elements.

Module 4: [15]

TL 2 (sinusoidal steady state analysis): short circuited line, Line terminated by arbitrary load, TL line matching; Quarter wave transformer matching, single stub matching, Double stub matching, the smith chart and applications, the lossy line.

Module 5: [15]

Metallic Waveguides and resonators: uniform plane wave propagation in an arbitrary distinction, TE and TM waves in a parallel-plate waveguide Rectangular waveguide and cavity Resonator, Losses in Waveguides and Resonators.

Suggested Reading:

1. Elements of Engineering Electromagnetics – N.N. Rao, Pearson Education
2. Field and Wave Electromagnetics – D.K. Cheng, Pearson Education
3. Electromagnetic Waves & Radiating systems – Jordan & Balmain, TMGH
4. Electromagnetic Field Theory and Transmission Lines-Raju, Pearson Education
5. Antenna and Wave Propagation- Raju, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC M603	Power Electronics	75	5	1	0	6

Course Objective:
To provide the know-how to students regarding power electron devices, working principles, types, modifications, design details and applications.

Course Content **Marks**

Module 1: [15]
Introduction to power electronics: Basic terminologies, definitions, comparison of conventional and power electronics, calculation of power, power factor, single/three phase, star and delta connections, power measurement techniques and equipment, heating effect, noise factors, shielding, protections, circuit breakers, ground leakage detection, MCBs ELCBs, etc. Single phasing preventors.

Module 2: [20]
Power electronics circuits: Controlled rectifiers and filters: Single phase half wave and full wave-Semi converter and full converter, Dual converter, Three phase half wave, semi and full wave converter, three phase dual converter, simple LC and cascaded LC filters, Power factor improvement. Inverters: Principle of operation, voltage driven inverters, current driven inverters; Choppers: Basic principles, Type A, B and C choppers Series and parallel turn-off choppers, Morgan choppers and Jones choppers. Triggering and protection circuit: Thyristor firing, circuit-using transistor, UJT, PUT etc. thyristor gate protection circuit, di/dt and dv/dt protection for thyristors;

Module 3: [20]
AC power supply systems: CVTs, Stabilizers, tap changers, UPS types (on-line and off line) etc; Introduction to SMPS.

Module 4: [20]
Special application DC power supplies: CVCC, voltage mode and current mode SMPS, Tracking and foldback systems, Low voltage, low current, high voltage and high current power supplies, SMPS for computers;

Suggested Reading:

1. Power Electronics – Rashid, PHI
2. Power Electronics- P.C. Sen, TMH Ltd.
3. Thyristor engineering- M.S. Berdi, Khanna publications.
4. Thyristors and their applications-N.Rammurthy

Course Code	Subject	Marks	L	T	P	C
EC M604	Programming in C	75	4	0	2	6

Course Objective:
The objective of this course module is to acquaint the students with the basics of computers system, its components, data representation inside computer and to get them familiar with various important features of procedure oriented programming language i.e. C.

Course Content **Marks**

Module I: [15]

Introduction

Introduction to computer, history, von-Neumann architecture, memory system (hierarchy, characteristics and types),H/W concepts(I/O Devices),S/W concepts(System S/W & Application S/W, utilities).Data Representation: Number systems, character representation codes, Binary ,octal, hexadecimal and their interconversions. Binary arithmetic, floating point arithmetic, signed and unsigned numbers, Memory storage unit.

Module II: [15]

Programming in C

History of C, Introduction of C, Basic structure of C program, Concept of variables, constants and data types in C, Operators and expressions: Introduction, arithmetic, relational, Logical, Assignment, Increment and decrement operator, Conditional, bitwise operators, Expressions, Precedence of Arithmetic operators, Operator precedence of Arithmetic Operators, Operator precedence and associativity. Managing Input and output Operation, formatting I/O.

Module III: [15]

Fundamental Features in C

C Statements, conditional executing using if, else, nesting of if, switch and break Concepts of loops, example of loops in C using for, while and do-while, continue and break. Storage types(automatic, register etc.), predefined processor, Command Line Argument.

Module IV: [20]

Arrays and Functions

One dimensional arrays and example of iterative programs using arrays, 2-D arrays Use in matrix computations. Concept of Sub-programming, functions Example of user defined functions. Function prototype, Return values and their types, calling function, function argument, function with variable number of argument, recursion.

Module V: [10]

Advanced features in C:

Pointers, relationship between arrays and pointers Argument passing using pointers, Array of pointers. Passing arrays as arguments. Strings and C string library. Structures and Unions. Defining C structures, Giving values to members, Array of structure, Nested structure, passing strings as arguments; File Handling.

Suggested Reading:

- Let us C- Kanitkar,BPB Publishers;
- Programming in C-Balaguswamy,TataMacgrawHill

List of Assignments: Write programmes using C to perform the following:

a. Find prime numbers upto N.
b. Find the greatest common divisor of a number
c. Find factorial of a number using & without using recursion.
d. Write a function to find the sum of series.
e. Find sum, average, minimum & maximum of an array of numbers.
f. For a given string write functions to
    i. Convert it to upper case.
    ii. Find the length
    iii. Reverse the string.
    iv. Write a main function and then give function calls.
g. Check whether a string is palindrome or not.
h. Generate the following pattern.

```
    *
   * *
  *   *   *
```

i. Find the sum of two matrices.
j. Find the sum of diagonal elements of a matrix.
k. Use bubble sort method to sort an array of numbers.

Course Code	Subject	Marks	L	T	P	C
EC M605	Instrumentation	75	5	1	0	6

Course Objective:
To familiarize the student with the principles of instrumentation system, working of different instruments, methods of application and types.

Course Content **Marks**

Module 1:
Instrumentation scheme & error: [10]
Electronic instruments & their characteristics, a generalized instrumentation scheme, classification of instrumentation error & their statistical behaviour; Basic instrumentation circuits- Operational amplifier application, Instrumentation amplifier, Noise measurements and noise reduction techniques

Module 2:
Measurements: [10]
Measurement of current ,voltage & power at audio & radio frequencies; electrostatic rectifier & thermocouple type instruments; advantage of electronic voltmeters, vacuum tube voltmeters(diode type only); True RMS-Responding voltmeter, digital voltmeter, Q meter, power factor meter; DC ammeters; ohmmeter, multimeter-analog & digital

Module 3: [15]
Signal generators:
Basic circuits for generation of square wave & triangular wave. Block diagram of laboratory square-wave & pulse generator. Function generator (block diagram), sine wave generation by a sine shaper (qualitative idea);sweep generator

Module 4: [15]
Cathode Ray Oscilloscope:
Motion of charged particles in electric & magnetic fields in simultaneous electric & magnetic field (cross & parallel) Block diagram of CRO, CRT: construction principles of focusing & deflection of electron beam,CRT screens vertical deflection system, vertical amplifier, delay line, horizontal amplifier, synchronization; CRO probes, trigger circuits, application of CRO in measuring voltage, frequency, phase, different types of CRO- DSO; Frequency domain measurements-Distortion analyzer, Wave and spectrum analyzer spectrum analyzer;

Module 5: [15]
Transducers:
Definition, types-active & passive, analog & digital; active-thermocouple & piezoelectric transducers, passive- potentiometric devices, thermistors, LVDT; Basic idea-displacement & temperature transducer;

Module 6: [10]
Digital Instrumentation
Digital measurement techniques, Time and frequency measurements, Interface of instruments with computer, Virtual Instruments. Digital transducers; Sensors-conventional and bio-sensors;

Suggested reading:

1. Instrumentation, Measurement and Feedback- B.E. Jones, Tata McGraw Hill
2. Electronics Measurements and Instrumentation- B.E. Oliver and J.M. Cage, McGraw Hill
3. Electrical & Electronic Measurements- Sawhnay….,Dhanpat Rai Publications
4. Process Control- Johnson, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC M606	Project Phase II	75	0	2	4	6

Students individually or two at the most will carry out a detail study on a topic and implement a related system. The study must include literature survey, similar work done previously, proposed work, modifications to be included, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. The phase II involves the complete design of the work and the preparation of the report in continuation of the work carried out in the previous semester. The work must be defended through a presentation in front of a panel constituted by internal and external examiners.

GUIDELINES FOR PROJECT Work

At the beginning of the semester, the HoD must assign the supervision of project works to the faculty members after obtaining mutual consent between the respective supervisors and the students. It is the responsibility of the student to approach a faculty member with a request to offer him / her a project work. The student must inform the HoD about this communication.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting
- from the project;

- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

1. **Title or Cover Page**. The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.
2. **Acknowledgements** (optional)-Acknowledgment to any advisory or financial assistance received in the course of work may be given.
3. **Abstract-** A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project
4. **Table of Contents**- Titles and subtitles are to correspond exactly with those in the text.
5. **Introduction**- Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
6. **Present Work and Methods**- This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.
7. **Results and Discussion**- Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow. Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.
8. **Conclusion**- A conclusion should be the final section in which the outcome of the work is mentioned briefly.

9. **Future prospects**
10. **Appendices-** The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
11. **References / Bibliography**

Stress should be given on latex based report generation.

ASSESSMENT OF THE PROJECT

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The work must be defended through a presentation in front of a panel constituted for the purpose. The panel should be constituted for the evaluation of the reports submitted by the students as part of the project works with the HoD as the chairperson, one internal and an external examiner (locally arranged) and the supervisor. The report must be submitted atleast two days before the scheduled date of presentation and checked and signed by the supervisor. The report must have a declaration of authenticity by the student and a certificate of execution and completion of the work given by the supervisor. Any report without the signature of the supervisor cannot be considered for evaluation.

Evaluation:
Dissertation / report: 30%;
Work: 40%;
Presentation / Viva Voce: 30%;

DETAILED SYLLABUS AND PROGRAMME STRUCTURE OF BSc ELECTRONICS (GENERAL) IN L-T-P-C FORMAT

BSc ELECTRONICS (GENERAL) PROGRAMME IN L-T-P-C FORMAT

Semester	Course Code	Subject	Marks	L	T	P	C
1	EC E101	Solid State Devices	75	5	1	0	6
	Semester total		**75**	**5**	**1**	**0**	**6**
2	EC E201	Electric Circuits	75	5	1	0	6
	Semester total		**75**	**5**	**1**	**0**	**6**
3	EC E301	A. Linear Active Circuits	50	4	0	0	4
		B. Digital Systems					
	EC E302	Lab Course: Linear Active Circuits & Digital Systems	50	0	0	4	4
	Semester total		**100**	**4**	**0**	**4**	**8**
4	EC E401	A. Microprocessor	50	4	0	0	4
		B. Communication System					
	EC E402	Lab Course: Microprocessor & Communication System	50	0	0	4	4
	Semester total		**100**	**4**	**0**	**4**	**8**
5	EC E501	Signals and Systems	100	5	3	0	8
	EC E502	A. Project Phase I	75	0	1	6	7
		B. Seminar & Term Paper	25	0	1	0	1
	Semester total		**200**	**5**	**5**	**6**	**16**
6	EC E601	Control System	100	5	3	0	8
	EC E602	Project Phase II	100	0	2	6	8
	Semester total		**200**	**5**	**5**	**6**	**16**
	PROGRAMME TOTAL		**750**	**28**	**12**	**20**	**60**

L- Lectures per week,
T-Tutorials per week,
P- Practicals per week with each session of minimum two hours,
C-Credits

Semester One

Course Code	Subject	Marks	L	T	P	C
EC E101	Solid State Devices	75	5	1	0	6

Course Code	Subject	L	T	P	C
EC E101	Solid State Devices	5	1	0	6

Course Objective: To provide the students

- Basic understanding of semiconductor devices and circuits
- Knowledge to develop skills for semiconductor based device design
- Exposure to the underlying phenomena that govern semiconductor behaviour and characteristics.

Course Contents: **marks**

Module 1 [15]

Physics of p-n junction –unbiased and biased, Diode equation, V-I characteristics of p-n junction diodes, Q-point & load line of a diode; resistance of a diode, temperature effect; reverse breakdown- avalanche & zener phenomena; Zener diode, varactor diode, tunnel diode, Schottky diode. Junction capacitance-transition and diffusion capacitances, dependence on barrier width and carrier densities.

Module 2: [10]

Diode as a circuit element, equivalent representation of a diode, diode as a rectifier, half wave & full wave rectifiers, peak inverse voltage, bridge rectifier, effect of filters, Zener diode as regulator, load & line regulation, regulated power supply, basic idea-clipper, clamper, voltage multiplier.

Module -3 [10]

(a) Physics of BJT, Detailed analysis of current flow in BJT, Base-width modulation, Breakdown voltages.
(b) BJT characteristics and equivalent circuit, h-parameters. Biasing- dc load line & bias point, Fixed current bias, collector to base bias, emitter current bias, Thermal stability, ac load line, switching and amplification properties. Biasing transistor switching circuits. Transistor specifications & performance: Transistor data sheet, power dissipation, heat sinking, Decibels and frequency response, Transistor circuit noise, Transistor switching times.

Module -4 [10]

(a) JFET, Detailed analysis of current flow, second order effects, MOSFET, Detailed analysis of current flow, SCR and Power handling devices.
(b)JFET Data sheet & Parameters, FET voltage amplification, FET equivalent circuit, FET Biasing: dc load line & Bias point, Fixed voltage bias circuit, self bias circuit, potential divider bias.

Module -5 [10]

Small signal amplifiers: CE amplifier design, CS FET amplifier design, capacitor coupled two stage CE amplifier, Direct coupling between stages. Large signal amplifier: Transformer coupled class A amplifier and its design, capacitor coupled power amplifier.

Module -6 [10]

Negative Feedback: Concept, Current series and shunt, voltage series and shunt, amplifier circuit design with negative feedback, effects of negative feedback.

Module -7 [10]

OPAMP : Basic OPAMP circuit, Integrated circuit OPAMP, Biasing of OPAMP, Non inverting & inverting circuit, OPAMP non-linear circuits, OPAMP circuit stability, frequency and phase response, frequency compensation, circuits Bandwidth, circuit

Stability precautions. Wave shaping circuit, frequency to voltage and voltage to frequency converters, Active Filters, Inductance simulation, OPAMP Voltage comparator, precision rectifier circuit, Schmitt trigger circuit, oscillators.

Suggested reading:

1. Electronic Devices & circuits. - David A. Bell, PHI
2. Semiconductor Devices - Jasprit Singh, John Wiley
3. Transistor- Dennis Le Croissette.
4. Electronic Devises & Circuits Theory - Boylestad & Nashalsky. Pearson Education
5. Electronic Device & Circuit - Millman-Halkias, Tata McGraw Hill.
6. Electronic Design: From Concept to Reality - - Roden,. Carpenter, Wiesrman (SPD).
7. Introduction to Electronic Circuit Design – - Spencer & Ghausi, Pearson Education
8. Electronics Lab Primer- K.K. Sarma, Global Publishing;

Semester Two

Course Code	Subject	Marks	L	T	P	C
EC E201	Electric Circuits	75	4	2	0	6
Semester total		**75**	**5**	**1**	**0**	**6**

Course Code	Subject	Marks	L	T	P	C
EC E201	Electric Circuits	75	5	1	0	6

Course Objective:
The objective of the course is to provide a brief knowledge of Electrical Engineering and includes some theorems related to electrical, some law's related to flow of current, voltages, basic knowledge of transformer, basic knowledge of electromagnetism, basic knowledge of electrical network.

Course Contents: **marks**

Module I: Basic Electrical Quantities [15]
Basic Electrical definitions-Energy, Power, Charge, Current, Voltage, Electric Field Strength, Magnetic Flux Density, etc., Resistance, Inductance and Capacitance. Ideal Source, Independent Source and Controlled Source

Module II: Network Analysis Techniques & Theorems [15]
Circuit Principles: Ohm's Law, Kirchoff's Current Law, Kirchoff's Voltage Law Network Reduction: Star–Delta Transformation, Source Transformation, Nodal Analysis, Loop analysis. Superposition theorem, Thevenin's Theorem, Norton's theorem and Reciprocity theorem.

Module III: Alternating Current Circuits [15]
Peak, Average and RMS values for alternating currents, Power calculation-reactive power, active power, complex power, power factor, impedance, reactance, conductance; Resonance: series Resonance, parallel resonance, basic definition of Q factor & Band-width. Passive filters- low pass, high pass, band pass and band reject.

Module IV: Transformers [10]
Magnetic circuits, self and mutual inductance; Basic Transformer Operation principle, Construction, Voltage relations, current relations, Linear circuit models, open circuit test, short circuit test, Transformer Efficiency.

Module V: Polyphase circuits [10]
Advantages in favour of polyphase circuits, Generation of three phase emf, phase sequence, connection of three-phase winding, line and phase quantities in star connected circuit, line and phase quantities in delta-connected system, power in three-phase systems with balanced load.

Module VI: Bridges [10]
Basic principles of working of a potentiometer, Generalized Wheatstone bridge, Anderson bridge, Maxwell's bridge, Schering bridge, Wien bridge, simple problems.

Suggested Reading:

1. Network Analysis- G.K. Mittal, Khanna Publishers.
2. Network Theory and filters Design V.K. Aatre, Wily Eastern Ltd.
3. Engineering Circuit Analysis- W.H. Hayt and J.E. Kemmerly, McGraw Hill
4. Network Analysis- M.E. Van Valkenberg, Prentice Hall of India
5. Network Analysis- Ghosh, PHI
6. Linear Circuit Analysis- Liu, Oxford University Press;
7. Network Analysis- Stanlay, Pearson Education;
8. Fundamentals of Electrical Engineering- Del Toro, PHI
9. Electrical Engineering- B.L. Thareja
10. Electric Circuits- Rajeshswaran, Pearson Education;

Semester Three

Semester	Course Code	Subject	Marks	L	T	P	C
3	EC E301	Linear Active Circuits	25	4	0	0	4
		Digital Systems	25				
	EC E302	Lab Course: Linear Active Circuits and Digital Systems	50	0	0	4	4
	Semester total		**100**	**4**	**0**	**4**	**100**

Course Code	Subject	Marks	L	T	P	C
EC E301	Linear Active Circuits	25	4	0	0	4
	Digital Systems	25				

Linear Active Circuits: Course content marks-25

Course Objective

To provide exposure and knowledge to the students enabling them to develop insights into working of active devises and their design.

Module 1: [8]

Transistor biasing: Fixed bias, emitter bias, voltage divider bias, d.c collector feedback bias; load line, Q- point, stability considerations;

BJT modeling: two port representation of the BJT with z-,y-,h-parameters; r_e & hybrid models of C-E, C-B,C-C(emitter follower) amplifiers;

C-E amplifier in the above four biasing configurations, calculation of voltage gain, current gain, power gain, input impedance and output impedance of respective configurations and types; Hybrid-pi model of C-E amplifier in voltage divider bias configuration, Effect of parasitic capacitances, frequency response in low-,mid- & high- frequency conditions ;

Module 2: [5]

Unipolar devices: Basic idea of UJT-application as a relaxation oscillator;

Junction field effect transistor: JFET structure & working principle, characteristics, Structure of MOSFET- enhancement & depletion , p & n - channel MOSFET, common gate, common drain configuration, long & short channel effects. FET Biasing: Self bias, fixed bias , voltage divider bias, simple problems, small signal A.C. equivalent circuit of FET.

Module 3: [8]

Tuned amplifier: single & double tuned amplifiers, Analysis of voltage gain & selectivity, IF amplifiers.

Power amplifier: Class A, B, C & AB type, Direct coupled (d.c amplifier, Darlington pair), Transformer coupled amplifier, pushpull amplifier, class B pushpull circuits, complementary symmetry amplifier, distortion in amplifiers.

Feed back amplifiers: General theory of feed back, negative & positive feedback, advantages of negative feedback, types of negative feedback in transistor amplifier- current series, voltage series, current shunt, voltage shunt amplifiers; practical circuits;

Operational amplifier: Ideal op-amp characteristics, offset current, offset voltage, CMRR, Basic op-amp application, inverting & noninverting amplifiers, adder, subtractor, integrator, differentiator. Schmitt trigger; Active filter-types-low pass, high pass, band pass & band elimination.

Module 4: [4]

Oscillator circuit-Positive feedback & oscillation, Barkhausen criterion; types-RC, LC & crystal oscillators; Wein bridge, phase shift, Hartley, Colpitts & Clapp oscillators as examples;

Suggested Reading:

1 Electronic devices & circuit theory- Education — Boylestad & Nashalsky, Pearson
2 Electronic Device & Circuit - Hill. — Millman-Halkias , Tata McGraw
3 Microelectronics- — Millman….,TataMcgrawHill
4 Microelectronic Circuits - — Sedra & Smith,Oxford press
5 Solid State Devices- — Streetman,PHI.
6 Electronic Fundamentals & Applications – Ryder,PHI.
7 Electronic Principles – — Malvino,TataMcGraw Hill

Digital Systems Course Content **Marks: 25**

Course objective:

- To provide insights into design of devices using digital techniques.
- To provide students knowledge about binary sytems, logic families and applications based on binary system.

Module-1 **[4]**

Number system and logic gates: Binary, octal and hexadecimal numbers, representation of signed integers, binary arithmetic on signed and unsigned integers and detection of overflow and underflow, Weighted Binary Codes: BCD, 2421, Excess-3 Codes, Gray codes, Error detecting codes, Error correcting codes, Alphanumeric Codes: ASCII Code, EBCDIC Codes. Boolean operators, Rules (postulates and basic theorems) of Boolean algebra, Dual and complement of a Boolean expression, Sum of products and product of sums forms. Canonical forms. Conversion between different forms, Conversion between Boolean expression and truth table; Logic gates, Implementing logic expressions with logic gates (logic circuits).

Module -2 **[8]**

Combinational Circuits: Boolean expressions and their simplification by algebraic method. Karnaugh map method and Quine-Mc Cluskey method, Don't Care conditions. Multiplexer, demultiplexer, encoder, decoder, Half-adder, Full-adder, magnitude comparator, Parity Checkers: Basic concepts, Design of parity checkers, parity generation, Code converters, Binary –to- Gray and Gray-to-Binary Code converter; Concept of magnitude comparator;

Module -3 **[5]**

Sequential circuit: Simple R-S flip-flop or Latch, Clocked R-S Flip-flop, D flip-flop. J-K flip-flop, T flip-flop, Master-Slave flip-flop, J-K Master-Slave flip-flop. Asynchronous pre set and clear, edge triggering and level triggering. Registers: Shift registers, parallel/serial in, parallel/serial out. Buffer Counter design: different types of counters like asynchronous and synchronous, UP and Down, ring, Johnson etc. counter design using state diagram, state table and state equation.

Module -4: **[5]**

Semiconductor Memory: Classification of memories, Main Memory and Secondary Memory, Sequential Access Memory, Static and Dynamic Memory, Volatile and Non-volatile Memory, Concept of ROM, PROM, EPROM, RAM, DRAM,

Module -5: **[3]**

IC Timer 555: Basics of IC555 Timer, Monostable and Astable Multivibrator using IC555;

Suggested reading:

1 Digital logic and computer design, -M. Mano. PHI.
2 Modern Digital Electronics - R.P. Jain, TMGH
3 Digital Fundamentals - Jain and Floyd, Pearson Education
4 Digital Electronics - Malvino & Leach, Pearson Education
5 Digital Computer Electronics - Malvino, TMGH
6 Digital Design - Morris Mano, Pearson Education
7 Digital Circuits and Design -S. Salivahanan and S. Arivazhagan, Vikash Publishing House Pvt. Ltd.
8 Digital Techniques - Prof. P. H. Talukdar, N. L. Publications
9 Digital Design - Wakerly, PHI

Course Code	Subject	Marks	L	T	P	C
EC E302	Lab Course: Linear Active Circuits and Digital Systems	50	0	0	4	4

Linear Active Circuits: List of experiments:

1 To design clipper and clamper circuits using diode.
2 To design a voltage doubler using diode.
3 Design a two stage BJT RC coupled C-E amplifier and measure its voltage gain. Convert the design into a two stage form to study the frequency response of the two stage C-E amplifier. Determine its cut-off points & bandwidth. Repeat the above in case of a CS- JFET amplifier.
4 Design of a Wein bridge oscillator using BJT/FET/IC.
5 Design an astable multivibrator using BJT.
6 Design of a phase shift oscillator using BJT/ FET/ IC.
7 Design of a first and second order filters as low pass blocks using IC741
8 Design of a first and second order filters as high pass blocks using IC741
9 Design of first and second order filters as band pass blocks using IC741
10 Design of first and second order filters as band elimination blocks using IC741

Suggested Reading:

1 Electronic devices & circuit theory- Boylestad & Nashalsky, Pearson Education
2 Electronic Device & Circuit - Millman-Halkias , Tata McGraw Hill.
3 Microelectronics- Millman….,TataMcgrawHill
4 Microelectronic Circuits - Sedra & Smith,Oxford press
5 Solid State Devices- Streetman,PHI.
6 Electronic Principles – Malvino,TataMcGraw Hill
7 Electronics Lab Primer- K. K. Sarma, Global Publishing

Digital Systems: List of experiments:

1 To verify the logic gates (i) AND gate (ii) OR gate (iii) NAND gate (iv) NOT gate
   a. Using diode or BJT and resistance.
   b. Using ICs- 7400 (ii) 7402 (iii) 7408 (iv) 7432 (v) 7486 (vi) 7404
2 To design and RS-flip-flop and study its truth table.
3 To design and study half and full adder circuit using logic gates.
4 To design and study 4:1 Multiplexer circuit using logic gates.
5 Design of a D/A converter using ladder method. Study the DAC 0808.Record the output corresponding to a digital input.
6 Design of a JK-Flip-flop. Display the results using LEDs.
7 Design of a 4-bit counter using IC7470/ 7472 (JK-flipflop). Display the output using LEDs or 7-segment LED display.
8 Repeat the above using IC 74161/74162/74163 (4-bit counter).
9 Design a 8:1 multiplexer using common gates. Study IC74151 (8:1 multiplexer) and verify the truth tables.

Suggested reading:

1 Digital logic and computer design, -M. Mano. PHI.
2 Modern Digital Electronics - R.P. Jain, TMGH
3 Digital Fundamentals - Jain and Floyd, Pearson Education
4 Digital Electronics - Malvino & Leach, Pearson Education
5 Digital Computer Electronics - Malvino, TMGH
6 Digital Design - Morris Mano, Pearson Education
7 Digital Circuits and Design - S. Salivahanan and S. Arivazhagan, Vikash Publishing House Pvt. Ltd.
8 Digital Techniques - Prof. P. H. Talukdar, N. L. Publications
9 Digital Design - Wakerly, PHI
10 Electronics Lab Primer- K. K. Sarma, Global Publishing

Semester Four

Semester	Course Code	Subject	Marks	L	T	P	C
4	EC E401	A. Microprocessor	50	4	0	0	4
		B. Communication System					
	EC E403	Lab Course : Microprocessor & Communication System	50	0	0	4	4
	Semester total		**100**	**4**	**0**	**4**	**8**

Course Code	Subject	Marks	L	T	P	C
EC E401	A. Microprocessor B. Communication System	50	4	0	0	4

Microprocessor : Course Content **Marks: 25**

Course Objective:
To provide the student the exposure of the working of the microprocessor, architectural details, instructions, programming and applications.

Module 1: [4]
History & evolution of microprocessor; Introduction to CPU: Components of CPU, block diagram, buses-data, control & address; ALU, Control Unit; main memory & secondary memory; I/O devices; Memory addressing-memory mapped I/O & I/O mapped I/O; address decoding; Memory & I/O interfacing;

Module 2: [5]
Instruction cycle: fetch, decode & execute; zero, one, two & three address instructions; addressing modes(register direct, relative, indirect, immediate, indirect& implied);

Module 3: [10]
Introduction to 8085; block diagram, registers, use of register pairs, PSW, accumulator; addressing modes; Instruction set of 8085; Complete set in details; Instruction set: Data Transfer, Arithmetic, Logic, Branch and Machine Control instructions. Delay and counter; stack & its application; interrupt and its application; Assembly level language programming of 8085;

Module 4: [3]
Interfacing: Memory interfacing;I/O interfacing; interfacing small devices like keyboard,7- segment display,relay, event counter etc; idea of PPIs like 8251, 8255, 8257 & 8279 (block diagram & function only); serial communication standard(RS-232C);

Module 5: [3]
Example of 16-bit processors (introduction to 8086); Examples like 80286, 80386, 80486 and 80586; microcontroller (block diagram & application of 8051);

Suggested reading:

1 Introduction to Microprocessors -Gaokar,New age Publication
2 Fundamentals of Microprocessor - N.Ram.Dhanpat Rai
3 8085 Microprocessor Programming and Interfacing -N. K. Srinath, PHI
4 Microprocessor Based Design - Slater, PHI
5 Microprocessors - Gilmore, MacGraw Hill Publication
6 Microcomputers and Microprocessors - Uffenbeck, PHI

Communication System: Course Content **Marks: 25**

Course Objective:
To provide the knowledge of basic principles of communication system, types, design details and applications

Module 1: Communication system: [3]
Block diagram; Requirements of modulation. Superheterodyne receiver-AGC; .Types of modulation-AM, FM, PM

Module 2: Amplitude modulation, [8]
Basic principle of DSB, SSB (phase discrimination method) and VSB systems, Modulators & demodulators. Modulators: ring modulator, balanced modulator & BJT modulator; Demodulator: diode detector, envelope detector & BJT detector;

Module 3: Angle modulation: [8]
Phase modulation & frequency modulation, Sinusoidal FM, frequency spectrum for sinusoidal FM, Average power, Sinusoidal PM, Equivalence between FM& PM, elementary idea of direct(Armstrong) & indirect modulator(VCO method), elementary idea of demodulators(discriminator, limiter, PLL & ratio detector).

Module 4: Noise: [3]
Different types of noise, Thermal, shot, flicker noise, Noise figure, Equivalent noise temperature; Noise in DSB, SSB, FM systems;

Module 5: Pulse Modulation: [3]
Sampling theorem, Nyquist criteria; PAM- generation and recovery; PCM,-stages like sampling, quantization, encoding, regeneration; noise considerations; Multiplexing: Frequency division multiplexing (FDM) & Time division multiplexing (TDM),

Suggested Reading:

1. Communication Systems- B.P. Lathi, Willey Eastern
2. Radio Engineering, Vol.II- G.K. Mittal, Khanna Publishers
3. Electronic Communications- Schoenbeck, PHI
4. Electronic Communications Systems- Kennedy, TMGH
5. Communication Systems- Simon Haykin, John Wiley ;
6. Electronic Communication- Roddy, Coolen, PHI
7. Monochrome & Colour television- Gulati,Wiley Eastern;
8. Communication System Engineering- Prokais, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC E403	Lab Course : Microprocessor & Communication System	50	0	0	4	4

Microprocessor List of experiments

1 Move a block of memory starting at location XXXX to a location YYYY. Perform the block move in reverse order as well.
2 Find the sum, maximum & minimum of an array of 8-bit numbers.
3 Compute X+Y-Z+56 using 16-bit numbers.
4 Compute X*Y using 8-bit numbers.
5 For the 8-bit number X find the bits $b_3b_4b_5$ .Output should show $b_3b_4b_5$.
6 Find whether a given number is odd or even. Store the result in a memory location as 1 when even & 0 when odd.
7 Design a relay driven bell. Generate an external interrupt. The bell should ring N seconds after the interrupt.
8 Design a 2-digit 7-segment display driver circuit. Use it to display the contents of memory starting at a given location.
9 Interface a steeper motor to a microprocessor. Write programs to move it clockwise and counter clockwise.
10 Interface a d.c. motor to a microprocessor .Rotate it clockwise and counter clockwise.

Communication System List of experiments:

1 Design of an AM modulator using discrete components/ trainer kits/ software.
2 Design of an AM demodulator using discrete components/ trainer kits/ software
3 Design of an FM modulator using discrete components/ trainer kits/ software
Design of an FM demodulator using discrete components/ trainer kits/ software

Semester Five

Semester	Course Code	Subject	Marks	L	T	P	C
5	EC E501	Signals and Systems	100	5	3	0	8
	EC E502	Project Phase I	75	0	1	6	7
		Seminar & Term Paper	25	0	1	0	1
	Semester total		**200**	**5**	**8**	**3**	**16**

Course Code	Subject	Marks	L	T	P	C
EC E501	Signals and Systems	100	5	3	0	8

Course Objective

- To provide insights into signals and types, methods of processing and transformation.
- To expose students to types of discrete systems, types and application.

Course Content **Marks**

Module 1: Signal and System classification: [20]
Signals- Periodic, aperiodic; even-odd; exponential, sinusoidal; unit impulse & unit step functions; System with & without memory; invariability & inverse system; causality, linearity, time invariance;

Module 2: Signal Representation: [10]
Signal space and orthogonal bases; Fourier series representation of continuous-time and discrete-time signals; continuous-time; Fourier transform and its properties; Parseval's relation, time-bandwidth product; discrete-time Fourier transform and its properties; relations among various Fourier representations;

Module 3: Sampling: [10]
Sampling theorem and its implications: spectra of sampled signals; reconstruction: ideal interpolator, zero-order hold, first-order hold; aliasing and its effects. Time-frequency analysis: time-frequency representation and the uncertainty principle, short-time Fourier transforms and wavelet transforms.

Module 4: Linear time invariant [LTI] system [20]
Review of basic principles of Fourier Transform- Sampling of analog signal, Representation of discrete time signals in terms of impulses; convolution; convolution sum representation of LTI systems; properties of LTI systems-commutative, distributive, associative; LTI systems with & without memory, causality, linearity, stability of LTI systems; Unit impulse response of an LTI system; Interconnection of LTI systems; Correlation, cross correlation and autocorrelation

Module 5: Discrete Fourier Transform [20]
Definition, properties; linear & non-linear phase; DFT-definition & properties; Discrete linear and periodic convolution; IDFT. Relation of DFT to other transformation; FFT- Decimation in time and frequency; Radix-2 and radix-4 algorithms; Spectrum analysis using FFT; Discrete power spectral density;

Module 6 : z-transform [20]
Definition, properties; inverse z-transform; relation with other transforms; Convolution, correlation- cross correlation and autocorrelation;

Suggested Reading:

1 Signals & Systems- Oppenheim & Willsky, PHI.
2 Digital Signal Processing- Mitra,Tata McgrawHill
3 Digital Signal processing- Proakis, Pearson Education;
4 Digital Signal processing- Salivahanan, Vallavaraja, Gnanapriya, TMGH
5 Digital Signal Processing- Bandopadyaya, PHI
6 Signal, System and Transforms- Philip, Pearson Education

Course Code	Subject	Marks	L	T	P	C
EC E502	Project Phase I	75	0	1	6	7
	Seminar & Term Paper	25	0	1	0	1

Subject	Marks	L	T	P	C
Project Phase I	75	0	1	6	7

Students individually or two at the most will carry out a detail study on a topic and implement a related system. The study must include literature survey, similar work done previously, proposed work, modifications to be included, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The report may contain four chapters like introduction, present work, experimental results and further development. It should also have a bibliography, datasheets, annexure as required. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. It can involve research and development oriented works and be carried out with an eye on the needs of the industry. At the beginning of the semester, the HoD must assign the supervision of project works to the faculty members after obtaining mutual consent between the respective supervisors and the students. It is the responsibility of the student to approach a faculty member with a request to offer him / her a project work. The student must inform the HoD about this communication.

The work must be defended through a presentation in front of a panel constituted for the purpose. The panel should be constituted for the evaluation of the reports submitted by the students as part of the project works with the HoD as the chairperson, one internal and an external examiner (locally arranged) and the supervisor. The report must be submitted atleast two days before the scheduled date of presentation and checked and signed by the supervisor. The report must have a declaration of authenticity by the student and a certificate of execution and completion of the work given by the supervisor. Any report without the signature of the supervisor cannot be considered for evaluation.

Evaluation scheme:

1. Presentation- 50 %
2. Report- 50%

Subject	Marks	L	T	P	C
Seminar & Term Paper	25	0	1	0	1

A. Seminar: Marks 10

Each student shall collect information on an allotted topic related to the subject, analyze it and formulate an approach to make a presentation. The students shall submit a report on the allotted topic which shall be evaluated by the concerned internal faculty. He/She then would present a seminar on the concerned topic.

Examination Scheme:

Report: 20%

Presentation: 30%

B. Term Paper: Marks 15

METHODOLOGY

A term (or research) paper is primarily a record of intelligent reading in several sources on a particular subject. The students will choose the topic at the beginning of the session in consultation with the faculty assigned. The progress of the paper will be monitored regularly by the faculty. At the end of the semester the detailed paper on the topic will be submitted to the faculty assigned. The evaluation will be done by Board of examiners comprising of the faculties.

GUIDELINES FOR TERM PAPER

The procedure for writing a term paper may consists of the following steps:

1. Choosing a subject
2. Finding sources of materials
3. Collecting the notes
4. Outlining the paper
5. Writing the first draft
6. Editing & preparing the final paper

1. Choosing a Subject

The subject chosen should not be too general.

2. Finding Sources of materials

a. The material sources should be not more than 10 years old unless the nature of the paper is such that it involves examining older writings from a historical point of view.
b. Begin by making a list of subject-headings under which you might expect the subject to be listed.
c. The sources could be books and magazines articles, news stories, periodicals, scientific journals etc.

3. Collecting the notes

Skim through sources, locating the useful material, then make good notes of it, including quotes and information for footnotes.

a. Get facts, not just opinions. Compare the facts with author's conclusion.
b. In research studies, notice the methods and procedures, results & conclusions.
c. Check cross references.

4. Outlining the paper

a. Review notes to find main sub-divisions of the subject.
b. Sort the collected material again under each main division to find sub-sections for outline so that it begins to look more coherent and takes on a definite structure. If it does not, try going back and sorting again for main divisions, to see if another general pattern is possible.

5. Writing the first draft

Write the paper around the outline, being sure that you indicate in the first part of the paper what its purpose is. You may follow the following:

- statement of purpose
- main body of the paper
- statement of summary and conclusion

Avoid short, bumpy sentences and long straggling sentences with more than one main ideas.

6. Editing & Preparing the final Paper

- Before writing a term paper, you should ensure you have a question which you attempt to answer in your paper. This question should be kept in mind throughout the paper. Include only information/ details/ analyses of relevance to the question at hand. Sometimes, the relevance of a particular section may be clear to you but not to your readers. To avoid this, ensure you briefly explain the relevance of every section.
- Read the paper to ensure that the language is not awkward, and that it "flows" properly.
- Check for proper spelling, phrasing and sentence construction.
- Check for proper form on footnotes, quotes, and punctuation.
- Check to see that quotations serve one of the following purposes:
- Show evidence of what an author has said.
- Avoid misrepresentation through restatement.
- Save unnecessary writing when ideas have been well expressed by the original author.
- Check for proper form on tables and graphs. Be certain that any table or graph is self-explanatory.

7. Term papers should be composed of the following sections:

1) Title page
2) Table of contents
3) Introduction
4) Review
5) Discussion & Conclusion
6) References
7) Appendix

Generally, the introduction, discussion, conclusion and bibliography part should account for a third of the paper and the review part should be two thirds of the paper.

Discussion
The discussion section either follows the results or may alternatively be integrated in the results section. The section should consist of a discussion of the results of the study focusing on the question posed in the research paper.

Conclusion
The conclusion is often thought of as the easiest part of the paper but should by no means be disregarded. There are a number of key components which should not be omitted. These include:

a) summary of question posed
b) summary of findings
c) summary of main limitations of the study at hand
d) details of possibilities for related future research

References
From the very beginning of a research project, you should be careful to note all details of articles gathered.
The bibliography should contain ALL references included in the paper. References not included in the text in any form should NOT be included in the bibliography. The key to a good bibliography is consistency. Choose a particular convention and stick to this.

Appendix
The appendix should be used for data collected (e.g. questionnaires, transcripts, ...) and for tables and graphs not
included in the main text due to their subsidiary nature or to space constraints in the main text.

Assessment Scheme:
Continuous Evaluation: 40%
(Based on abstract writing, interim draft, general approach, research orientation, readings undertaken etc.)
Final Evaluation: 60%
(Based on the organization of the paper, objectives/ problem profile/ issue outlining, comprehensiveness of the research, flow of the idea/ ideas, relevance of material used/ presented, outcomes vs. objectives, presentation/ viva etc.)

Semester Six

Semester	Course Code	Subject	Marks	L	T	P	C
6	EC E601	Control System	100	5	3	0	8
	EC E602	Project Phase II	100	0	2	6	8
	Semester total		**200**	**5**	**5**	**6**	**16**

Course Code	Subject	Marks	L	T	P	C
EC E601	Control System	100	5	3	0	8

Course Objective:
To familiarize the students with control system- its working principles, methods of design and analysis, transform methods and application.

Course Content **Marks**

Module 1: [20]
Concepts of closed-loop and open-loop systems: Importance and Application of Control System; Conceptual Block diagram of a control system and types- open loop and closed loop, Continuous and discrete data systems, Feedback theory;

Module 2: [20]
Representation of feedback control system: Block diagram, signal flow graphs, Mason's gain formula; Transfer function concept- Time and frequency domain analysis of first and second order systems to step, ramp and other inputs; error analysis, Types of systems;

Module 3: [30]
Stability: Routh Hurwitz stability criteria, Root locus, Nyquist criteria, Relative and absolute stability; Polar and Bode Plot, Gain and phase margins;

Module 4: [10]
Discrete Control Systems & Control System Design: Z-transform,
Simulation diagram and flow graphs. Effects of proportional, integral and derivative control, Discrete Vs Continuous control systems.

Module 5: [20]
State Variable Analysis: Importance of state variable analysis; Definition of state, state space, state vector; SV representation of physical systems and electrical networks; Eigen value and eigen vector; Determination of transfer function using SVA; Resolvent Matrix and State transition matrix; Solution of homogeneous and non-homogeneous systems using SVA;

Suggested reading:

1 Control Systems Engineering - Eastern Ltd. — I.G. Nagrath, M. Gopal; Wiley
2 Automatic Control Systems- — B.C. Kuo, Prentice-Hall of India.
3 Modern Control Engineering- — K. Ogata, Prenticd-Hall of India.
4 Control System – — S. Ghosh, Pearson Education
5 Control System Engineering- Education; — Bhattacharjya- Pearson

Course Code	Subject	Marks	L	T	P	C
EC E602	Project Phase II	100	0	2	6	8

Students individually or two at the most will carry out a detail study on a topic and implement a related system. The study must include literature survey, similar work done previously, proposed work, modifications to be included, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. The phase II involves the complete design of the work and the preparation of the report in continuation of the work carried out in the previous semester. The work must be defended through a presentation in front of a panel constituted by internal and external examiners.

GUIDELINES FOR PROJECT Work

At the beginning of the semester, the HoD must assign the supervision of project works to the faculty members after obtaining mutual consent between the respective supervisors and the students. It is the responsibility of the student to approach a faculty member with a request to offer him / her a project work. The student must inform the HoD about this communication.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty guide and corrected by the student at each stage. The File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated goals.
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting
- from the project;

- Any problems that have arisen that may be useful to document for future reference.

Report Layout

The report should contain the following components:

1. **Title or Cover Page**. The title page should contain the following information: Project Title; Student's Name; Course; Year; Supervisor's Name.
2. **Acknowledgements** (optional)-Acknowledgment to any advisory or financial assistance received in the course of work may be given.
3. **Abstract-** A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project
4. **Table of Contents**- Titles and subtitles are to correspond exactly with those in the text.
5. **Introduction**- Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
6. **Present Work and Methods**- This section should aim at experimental designs, materials used. Methodology should be mentioned in details including modifications if any.
7. **Results and Discussion**- Present results, discuss and compare these with those from other workers, etc. In writing these section, emphasis should be given on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow. Note that in writing the various secions, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary never write in "point" form.
8. **Conclusion**- A conclusion should be the final section in which the outcome of the work is mentioned briefly.

9. **Future prospects**
10. **Appendices-** The Appendix contains material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
11. **References / Bibliography**

Stress should be given on latex based report generation.

ASSESSMENT OF THE PROJECT

Essentially, marking will be based on the following criteria: the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The work must be defended through a presentation in front of a panel constituted for the purpose. The panel should be constituted for the evaluation of the reports submitted by the students as part of the project works with the HoD as the chairperson, one internal and an external examiner (locally arranged) and the supervisor. The report must be submitted atleast two days before the scheduled date of presentation and checked and signed by the supervisor. The report must have a declaration of authenticity by the student and a certificate of execution and completion of the work given by the supervisor. Any report without the signature of the supervisor cannot be considered for evaluation.

Evaluation:
Dissertation / report: 30%;
Work: 40%;
Presentation / Viva Voce: 30%;

Laboratory Requirements:

Each group of students should normally contain two members. Under any circumstances the maximum number of students in a group should not exceed three. The following are the minimum required instruments for the Major course:

Circuit Lab:

- Multimeter: a.c / dc voltage, current (10 μA to 10A),3 ½ digit resolution.1 number per group.
- C.R.O-dual trace, min 20 MHz; 1 number per group.
- Function generator: 1 MHz minimum (sine, square & triangular); I number per group.
- Variable D.C. supply-(30v), overload indication; 1 number per group;

Computational laboratory:

- Latest configuration computer.
- 1 computer per 3 students enrolled..
- 1 computer per student should be provided for practical & project works as required.
- 1 square meter space per computer.
- U.P.S with atleast ½ hour backup.
- Atlest one dotmatrix printer per 25 students.
- Matlab & pSpice packages; windows & linux OS; any version of C (& C++).

Microprocessor laboratory:

1 Microprocessor kit per student for practical;

1 square meter space per kit.

Minimum configuration of microprocessor kit:

8085 processor
16 KB RAM
I/O ports
1 Timer I.C
Hexadecimal keyboard & display
Serial port (RS-232C) to connect to a P.C
Power supply
Connectors
Add-on cards:-for D/A converters, steeper motor, d.c motor etc as required.

Environment Conditions:

- Power Supply using online UPS (for a set-up of 30 students a 6 KVA system with 40 min.s back-up. IGFET technology, built-in isolation transformer);
- Dust free, AC room;
- Ergonomically designed Electronic Work Bench in each lab.
- Special facility for soldering etc.
- Fire extinguisher, first aid medical box, electrical safety measures,
- Stock entry, inventory management and book-keeping;