DEPARTMENT OF PHYSICS
DIBRUGARH UNIVERSITY

STRUCTURE OF FOUR YEAR UNDER GRADUATE PROGRAMME (FYUGP) FOR

ELECTRONICS

IN DIBRUGARH UNIVERSITY AND ITS AFFILIATED COLLEGES

AS PER NEP-2020 GUIDELINES

Approved by the Board of Studies in Electronics held on February 9, 2023

1. ***Preamble:***

The model curriculum for B. Sc. Honours in Electronics is designed as per NEP 2020 guidelines and intended to enable the graduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The objective of this programme is to prepare the students for the society at large.

The programme is in the best interest of the students to provide outcome-based courses at the undergraduate level with the teaching-learning experiences in a more student-centric manner. This will strengthen students' experiences as they engage themselves in the programme of their choice. The Under-Graduate Programmes will prepare the students for both academia and employability.

The new curriculum of B.Sc. Honours in Electronic offers the undergraduates a complete package to have an in-depth understanding of basic to advance electronics. They can equip themselves to the fundamentals of electronics to a complete skill set compatible to industry standards. The curriculum will prepare the students to pursue higher education as well compete in the job market.

It is hoped that the B.Sc. Honours in Electronics programme will help students in making an informed decision regarding the goals that they wish to pursue in further education and life.

2. ***Introduction:***

The B.Sc. Honours in Electronics curriculum framework is intended to prepare the graduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The curriculum is designed to help students to analyse, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the stake holders. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the students with competencies like problem solving and analytical reasoning which provide them high professional competence. The University is expected to encourage its faculty concerned to make suitable pedagogical innovations, in addition to teaching learning processes suggested in the model curriculum, so that the Course/Programme learning outcomes can be achieved. The B.Sc. Honours programme is prepared on the basics and curricular structure of CBCS provided by the UGC.

Programme Duration:
The B.Sc. Honours in Electronics programme will be of four years duration. Each year will be called an academic year and will be divided into two semesters. Hence, there will be a total of eight semesters.

Multiple exit system is available in the program. Students on exit after first year shall be awarded Undergraduate Certificate on securing the requisite 44 credits in Sem I and II. Students on exit shall be awarded Undergraduate Diploma after securing the requisite 88 credits on completion of Sem III and Sem IV. Students on exit shall be awarded 3 Year Bachelor Degree with Honours after securing the requisite 132 credits on completion of Sem V and Sem VI.

Students on exit shall be awarded 4 Year Bachelor Degree with Honours or Honours with Research after securing the requisite 176 credits on completion of Sem VII and Sem VIII.

Design of Programme:
The teaching-learning will involve theory classes (L) of one hour duration, tutorials (T) and practical (P) classes. The curriculum will be delivered through various methods including chalk and talk, power point presentations, audio, video tools, E-learning/E-content, lab sessions, virtual labs, simulations, experiments, field trips/Industry visits, seminars, workshops, projects, models, class discussions and other suggestive ways. The assessment broadly will comprise of Internal Assessment (Continuous Evaluation) and End Semester Examination. Each theory paper will be of 80 marks with 20 marks for Internal Assessment. The internal Assessment will be through sessional test, assignment, oral presentation, short project, attendance in the classes and other suggested methods.

Programme Structure:
The programme will consist of four-credit courses and three-credit courses. Four credit courses without practical will comprise of theory classes only. For theory or tutorial classes, one credit indicates a one-hour lecture per week while for practical one credit indicates a two-hour session per week.
The programme includes Core Courses (CC) and elective courses. The core courses are all compulsory courses. There are three kinds of elective courses: Discipline-Specific Elective (DSE), Generic Elective (GE) and Skill Enhancement Course (SEC). In addition, there are two compulsory Ability Enhancement Courses (AEC).

3. Aim:

The overall aims of the B.Sc. Honours in Electronics are to provide students with learning experiences that develop broad knowledge and understanding of key concepts of electronic science and equip students with advanced scientific/technological capabilities for analyzing and tackling the issues and problems in the field of electronics. Develop ability to apply knowledge and skills they have acquired to the solution of specific theoretical and applied problems in electronics. Develop abilities in students to design and develop innovative solutions for benefits of society, by diligence, leadership, team work and lifelong learning. Provide students with skills that enable them to get employment in industries or pursue higher studies or research assignments or turn as entrepreneurs.

4. Graduate attributes:

Graduates Attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Graduate Attributes of B.Sc. Honours in Electronics are listed below:

- **Disciplinary Knowledge:** Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to

discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

- **Communication:** Communicate with the scientific/technological community, and with society at large, regarding complex scientific/technological activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

- **Problem Solving and Critical Thinking:** Think laterally and originally, conceptualize and solve scientific/technological problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
  Analyse complex scientific/technological problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

- **Usage of modern tools:** Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex scientific/technological activities with an understanding of the limitations.

- **Collaborative and Multidisciplinary work:** Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

- **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

- **Moral and Ethical Practices:** Acquire professional and intellectual integrity, professional code of conduct, ethics of research, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

5. Programme Learning Outcomes:

The Programme B.Sc. Honours in Electronics needs to develop a specialized skill set among the graduates to cater the need of industries. In recent years, Electronic Science has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries that work in this frontier area are in need of highly skilled and

scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the research organizations, academicians and industries. The key areas of study within subject area of Electronics comprises of Semiconductor Devices, Analog and Digital Circuit Design, Microprocessors & Microcontroller systems, Communication Techniques, IoT and computation techniques for Electronics, computer coding/programming in high level languages and with applied fields such as embedded system, advanced computer and data communication, robotics, control systems, VLSI Design, Nanoelectronics, Artificial Intelligence, Internet of Things etc. etc.

The present learning outcomes-based model curriculum of B.Sc. Honours in Electronics is designed to provide better learning experience to the graduates. Besides, imparting disciplinary knowledge, curriculum is aimed to equip the graduates with competencies like problem solving, analytical reasoning and leadership which provide them high professional competence

The following program outcomes of B.Sc. Honours in Electronics

- Ability to apply knowledge of mathematics & science in solving electronics related problems
- Ability to design and conduct electronics experiments, as well as to analyse and interpret data
- Ability to design and manage electronic systems or processes that conforms to a given specification within ethical and economic constraints
- Ability to identify, formulate, solve and analyse the problems in various disciplines of electronics
- Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility
- Ability to communicate effectively in term of oral and written communication skills
- Recognize the need for, and be able to engage in lifelong learning
- Ability to use techniques, skills and modern technological/scientific/engineering software/tools for professional practices

6. ***Teaching Learning process:***

As a programme B.Sc. Honours in Electronics is designed to encourage the acquisition of knowledge of electronics, understanding and professional skills required for the industrial/professional jobs. Development of practical/experimental skills should constitute an important aspect of the teaching-learning process. Methods which actively involve students are more effective than lectures for encouraging them to take intense approaches which are likely to result in developing understanding and encouraging critical thinking. Students learn more effectively when lectures include activities which engage their thoughts and motivation.

The following general approaches are suggested for more outcome oriented and participative learning.

a) **Lectures:** Lectures should be designed to provide the learners with interesting and fresh perspectives on the subject matter. Lectures should be interactive in a way that students work with their teachers to get new insights in the subject area, on which they can build their own bridges to higher learning. In order to make every lecture outcome oriented, faculty may specify the lecture outcomes in the beginning and at the end, the main points covered during the lecture should be summarized.

b) **Case Studies**: Real case studies, wherever possible, should be encouraged in order to challenge students to find creative solutions to complex problems faced by electronics industry, community, society and various aspects of knowledge domain concerned. Student may be asked to communicate findings of the study in the form of a report and seminar.

c) **SWAYAM Portal:** The platform provides the best teaching learning e-resources to all. Students can enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology on SWAYAM portal. The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts.

d) **Lab Sessions:** In traditional laboratory a student follow a given procedure to obtain pre-determined outcome. This allows student to manipulate equipment, learn standard techniques, collect data, interpret data and write report. It has to be recognized that for students to obtain the necessary laboratory skills, to use lab facilities effectively, requires a significant commitment of time for both the instructor and the student.
In order to enhance the lab experience of the students following should be implemented:

- **Simulations:** Simulations can be used as a pre-lab experience to give students some idea of what they will encounter in an actual experiment. Student should be given opportunity to work on simulation tools like MATLAB, Scilab, MULTISIM/ PSPICE, LabVIEW etc. to support their laboratory work.
- **Optional Experiments:** Students must be given wide range of options in selecting the experiments. After completion of mandatory experiments, they should be required to select few out of the multiple optional laboratory experiments relating to their field of interest. Hence, experiments designed for a particular course should be more than the minimum required experiments.
- **Problem solving:** Instead of following an established procedure given in laboratory manual, student will be given a scientific problem and will be able to design his/her own way of solving the problem. Student involvement in the laboratories increases if the experiments are designed and executed by the students themselves.
- **Mini Projects:** Mini-projects provide opportunities for the students to develop project management skills while working in a team. They may be assigned circuit/system design related problems for solving.

- **Virtual Remote Laboratory:** Virtual and remote laboratories are e-learning resources that enhance the accessibility of experimental setups providing a distance teaching framework which meets the student's hands-on learning needs. The use of virtual remote laboratory should be encouraged as it enhances student's life-long learning capabilities along with routine subject/experimental skills.
- **Lab Report:** The Lab report should clearly reflect the student's experience during the lab sessions. Primarily student should be able to establish the science behind the experiment. That is, laboratory procedure is expected to yield certain results and to a certain extent, the quality of the experiment depends on whether or not those results are obtained. One should be able to clearly relate the theory with the laboratory findings. The lab report should systematically include the introduction, procedure of experiment, data collection, results and conclusion of experiment.

e) Project-based learning: Students learn to work on their individual skills regarding critical thinking and problem solving, creativity and innovation, collaboration/teamwork and leadership, communications, learning self-reliance and project management. Project-based learning can be used in single sequences (a combination of lecture and project-based learning) or as the predominant teaching method in a module. Accordingly, the assessment has to consider both the result and the working process. Adequate examination requirements for individual marking are practical tests of the result/product, presentations with discussions and seminar papers of the working process and the result/product.

f) Summer training/internship: Industrial training in Electronics is necessary in industrial career exposure. The benefits of such training contribute to the development of generic employability skills and provide a direction for the graduates at the outset of their careers.

After the period of training, it is expected that students should achieve the course outcomes below:

- Recognize the duties, responsibilities and ethics of profession.
- Ability to communicate effectively in the work environment.
- Understand general and specific work procedures in electronics industry.
- Gain exposure and practical experience in the relevant field.
- Ability to prepare technical reports for the training.
- Ability to apply knowledge learned to solve problems in the industry.

g) Industrial/Field Visits: Industrial/Field visit are important to help bridge the gap between education and hands-on experience. They are a vital requirement as students will be able to appreciate state of the art technology in place. They will help students acquire knowledge, hands-on experience, technology at work and understand societal requirements and challenges. It will help in raising curiosity in them and finding answers to their queries.

h) **Invited talks and Hands-on Workshops** shall be organized on regular basis as it will help students interact with various subject experts from outside the institute domain. It will help them apprise about the latest technological as well as research developments, industrial needs and market requirements. It will assist them in developing self-confidence through the art of self-doing.

7. Assessment methods:

Electronic Science is a professional academic programme, so there is need to focus more on activity-based evaluation rather than purely written examination. A variety of assessment methods that are appropriate within the disciplinary area of electronics must be used. The assessment of learners' achievement in B.Sc. Honours in Electronics will be aligned with the following:

- Course outcomes
- Program Outcomes

Allowing for the diversity in learning and pedagogical methods adopted by different universities and institutions, Universities are expected to ensure that the assessment techniques are able to provide clear information about the attainment level of course outcomes and program outcomes for each and every student.

Assessment Priorities: Institutions will be required to prioritize formative assessments (in-semester activities including tests done at the department rather than giving heavy and final weightage to summative assessments (end-semester). Progress of learners towards achieving learning outcomes may be assessed making creative use of the following, either independently or in combination:

- Time-constrained examinations;
- Closed-book and open-book tests;
- Problem based assignments;
- Quizzes;
- Real life projects;
- Lab reports;
- Individual/Team project reports;
- Oral presentations, including seminar presentation;
- Viva voce;
- Computerized adaptive testing for MCQ;
- Peer and self-assessment etc.
- Any other pedagogic approaches

DIBRUGARH UNIVERSITY, DIBRUGARH – 786004

FYUGP Structure as per UGC Credit Framework of December, 2022

Year	Semester	Course	Title of Courses	Total Credit
Year 01	1st Semester	C - 1	Basic Circuit Theory and Network Analysis	4
		Minor 1	Basic Circuit Theory and Network Analysis	4
		GEC - 1	Circuit Theory	3
		AEC 1	Modern Indian Language	4
		VAC 1	Understanding India	2
		VAC 2	Health and Wellness	2
		SEC 1	Electrical Wiring and Maintenance	3
		Total		**22**
	2nd Semester	C - 2	Semiconductor Devices	4
		Minor 2	Semiconductor Devices	4
		GEC 2	Electronic Devices and Circuits	3
		AEC 2	Indian Languages and Communication Skills	4
		VAC 3	Environmental Science	2
		VAC 4	Yoga Education	2
		SEC 2	Design and Fabrication of Printed Circuit Boards	3
		Total		22
The students on exit shall be awarded Undergraduate Certificate (in the Field of Study/Discipline) after securing the requisite 44 Credits in Semester 1 and 2 provided they secure 4 credits in work based vocational courses offered during summer term or internship / Apprenticeship in addition to 6 credits from skill based courses earned during 1st and 2nd Semester				
Year 02	3rd Semester	C - 3	Electronic Circuits	4
		C - 4	Operational Amplifiers and Applications	4
		Minor 3	Electronics Circuits	4
		GEC 3	Digital Logic Circuits	3
		VAC 3	Digital and Technological Solution / Digital Fluency	2
		AEC 3	Communication English / Mathematical Ability	2
		SEC 3	Domestic Equipment Maintenance	3
		Total		**22**

Abbreviations Used:

- C = Major
- GEC = Generic Elective Course / Multi Disciplinary Course
- AEC = Ability Enhancement Course
- SEC = Skill Enhancement Course
- VAC = Value Added Course

SEMESTER I

Course Title : **Basic Circuit Theory and Network Analysis**
Course Code : **ELTC1**
Nature of Course : **Major**
Total Credits : **4**
Distribution of Marks : **80 (End Sem) + 20 (In Sem)**

Course Objectives:

1. To impart knowledge of basic circuit components and their responses in AC and DC signal.
2. To develop the concept of circuit analysis using different network theorems.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Voltage and Current** Charge, current and voltage, voltage and current sources, Ohm's law **1.2 Resistors:** Fixed and Variable resistors, Construction and Characteristics, Colour coding of resistors, resistors in series and parallel. Testing of resistance using multimeter. **1.3 Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, testing of inductance using multimeter. **1.4 Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter**.**	14	1	0	15
2 (16 Marks)	**2.1 Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **2.2 DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits.	11	1	0	12

3 (24 Marks)	**3.1 AC Circuit Analysis:** **S**inusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, **3.2 Power in AC Circuits:** Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. **3.3 Resonance:** Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. **3.4 Passive Filters:** Low Pass, High Pass, Band Pass and Band Stop.	17	1	0	18
4 (20 Marks)	**4.1 Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **4.2 Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.	14	1	0	15
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Understand the basic circuit concepts and devices like resistors, capacitors and inductors.
2. Perform AC and DC circuit analysis.
3. Work with different theorems of network analysis.

Recommended readings:

- S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
- M. Nahvi and J. Edminister, Electrical Circuits, Schaum's Outline Series, Tata McGraw-Hill. (2005)

- Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
- W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill. (2005)
- Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

SEMESTER II

Course Title : **Semiconductor Devices**
Course Code : **ELTC2**
Nature of Course : **Major**
Total Credits : **4**
Distribution of Marks : **80 (End Sem) + 20 (In Sem)**

Course Objective:

1. To understand the fundamentals concept, types, current and voltage characteristics of semiconductors.
2. Learn the fundamental and characteristics of semiconductor diode, BJT, FET and Power electronics devices.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Semiconductor Basics:** Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **1.2 Carrier Transport Phenomena:** Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Continuity Equation.	**14**	**1**	**0**	**15**
2 (16 Marks)	**2.1 P-N Junction Diode:** Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction	11	1	0	12

	Breakdown Mechanism, Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications.				
3 (16 Marks)	**3.1 Bipolar Junction Transistors (BJT):** PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. **3.2 Metal Semiconductor Junctions:** Ohmic and Rectifying Contacts.	11	1	0	12
4 (28 Marks)	**4.1 Field Effect Transistors:** JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). **4.2 Power Devices:** **U**JT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.	20	1	0	21
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Learn the fundamental physics of the semiconductor materials and devices.
2. Identify and characterize the semiconductor devices.
3. Apply the semiconductor devices in various circuits.

Recommended readings:

- S. M. Sze, Semiconductor Devices: Physics and Technology, 2nd Edition, Wiley India edition (2002).
- Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
- Dennis Le Croissette, Transistors, Pearson Education (1989)
- Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
- Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
- Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

SEMESTER III

Course Title : Electronics Circuits
Course Code : ELTC3
Nature of Course : Major
Total Credits : 4
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course Objectives:

1. To teach the students the uses of junction diode and transistor. Understand the various uses and applications of diodes and bipolar junction transistors.
2. To learn basic function of single stage amplifier, multistage amplifier and power Amplifier and their working principle.
3. To understand basic construction of feedback circuits and their application.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Diode Circuits**: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point, Clipping and clamping circuits. **1.2 Rectifiers:** HWR, FWR (center tapped and bridge), Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. **1.3 Filters:** Types, circuit diagram and explanation of shunt capacitor filter with waveforms. **1.4 Voltage regulation:** Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.	14	1	0	15
2 (20 Marks)	**2.1 Bipolar Junction Transistor**: Review of CE, CB Characteristics and regions of operation. Hybrid parameters. Transistor	14	1	0	15

	biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with RE, collector to base bias, voltage divider bias and emitter, circuit diagrams and their working, Transistor as a switch, circuit and working**,** Darlington pair and its applications. BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).				
3 (18 Marks)	**3.1 Feedback Amplifiers:** Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.	11	1	0	12
4 (22 Marks)	**4.1 MOSFET Circuits**: Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits. **4.2 Power Amplifiers:** Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks. **4.3 Single tuned amplifiers**: Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits	17	1	0	18
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation

b) Group discussion
c) Assignment
d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Understand the various uses and applications of diodes and bipolar junction transistors.
2. Utilise the necessary skill needed to analyse electronic circuits.
3. Comprehend the designing and study of different types of amplifiers.

Recommended readings:

- Robert Boylstead and Louis Nashelsky, Electronic Devices and circuit theory, 9th Edition, 2013, PHI
- David A Bell, Electronic devices, Reston Publishing Company
- D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
- Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
- J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
- Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation.

Course Title : **Operational Amplifiers and Applications**
Course Code : **ELTC4**
Nature of Course : **Major**
Total Credits : **4**
Distribution of Marks : **80 (End Sem) + 20 (In Sem)**

Course Objectives:

1. To study the characteristics and applications of operational amplifiers.
2. To study op-amp amplifiers, comparators, voltage and current regulators, summers, integrators, and differentiators as well as signal generator.
3. To study multivibrators, oscillator and filter circuits.

UNITS	CONTENTS	L	T	P	Total Hours
1 (24 Marks)	**1.1 Basic Operational Amplifier:** Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of	17	1	0	18

	level translator, block diagram of an operational amplifier (IC 741) **1.2 Op-Amp parameters**: Input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio				
2 (24 Marks)	**2.1 Op-Amp Circuits:** Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. **2.2 Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. **2.3 Signal generators:** Phase shift oscillator, Wein bridge oscillator, square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator (IC 566).	17	1	0	18
3 (16 Marks)	**3.1 Multivibrators (IC 555):** Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565. **3.2 Fixed and variable IC regulators:** IC 78xx and IC 79xx - concepts only, IC LM317- output voltage equation.	11	1	0	12
4 (16 Marks)	**4.1 Signal Conditioning circuits:** Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers.	11	1	0	12
	Total	**56**	**4**	**0**	**60**

*Where, **L**: Lectures, **T**: Tutorials, **P**: Practicals*

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Understand the fundamentals of Operational Amplifier (OP-AMP).
2. To develop analytic and synthesis skills in circuits using OP-AMPS.

Recommended readings:

- R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
- R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw-Hill, (2001)
- A. P. Malvino, Electronic Principals,6th Edition, Tata McGraw-Hill, (2003)
- K. L. Kishore, OP-AMP and Linear Integrated Circuits, Pearson (2011)

Generic Elective Course (GEC)

Course Title : Circuit Theory
Course Code : GECELT1
Nature of Course : Generic Elective Course
Total Credits : 3
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course Objectives:

1. To introduce electric circuits and its analysis
2. To impart knowledge on solving circuit equations using network theorems
3. To introduce the phenomenon of resonance in coupled circuits.
4. To educate on obtaining the transient response of circuits.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Voltage and Current** Charge, current and voltage, voltage and current sources, Ohm's law. **1.2 Resistors:** Fixed and Variable resistors, Construction and Characteristics, Colour coding of resistors, resistors in series and parallel. Testing of resistance using multimeter. **1.3 Inductors:** Fixed and Variable inductors, Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel, testing of inductance using multimeter. **1.4 Capacitors:** Principles of capacitance, Parallel plate capacitor, Energy stored in a capacitor, different types of capacitors, Construction and application, capacitors in series and parallel, testing of capacitors using multimeter**.**	10	1	0	11

2 (20 Marks)	**2.1 Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **2.2 DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits.	10	1	0	11
3 (20 Marks)	**3.1 Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **3.2 Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters, relations between parameters.	10	2	0	12
4 (20 Marks)	**4.1 Resonance and Coupled Circuits:** Series and parallel resonance: their frequency response, Quality factor and Bandwidth, Self and mutual inductance, Coefficient of coupling, Tuned circuits, Single tuned circuits. **4.2 Transient Response Analysis:** L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for D. C. input and A. C. sinusoidal input.	10	1	0	11
	Total	**40**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome:

1. Ability to analyse electrical circuits
2. Ability to apply circuit theorems
3. Ability to analyse transients

Recommended readings:

- William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, New Delhi, 2013.

- Charles K. Alexander, Mathew N. O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.

Course Title : Electronic Devices and Circuits
Course Code : GECELT2
Nature of Course : Generic Elective Course
Total Credits : 3
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course objectives: The student should be made to:

1. Understand the structure of basic electronic devices.
2. Be exposed to active and passive circuit elements.
3. Familiarize the operation and applications of transistor like BJT and FET.
4. Explore the characteristics of amplifier gain and frequency response.
5. Learn the required functionality of positive and negative feedback systems.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Diode Circuits**: PN junction diode, structure, operation and V-I characteristics, diffusion and transition capacitance, Ideal diode, dc load line analysis, Quiescent (Q) point, Clipping and clamping circuits, **1.2 Rectifiers:** HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, Types, circuit diagram and explanation of shunt capacitor filter with waveforms. Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.	10	1	0	11
2 (20 Marks)	**2.1 Bipolar Junction Transistor**: Review of the characteristics of transistor in CE and CB configurations, Regions of operation (active, cut off and saturation), Current gains α and β. Relations between α and β. dc load line and Q point. Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two-port network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains.	10	2	0	12
3	**3.1 Feedback Amplifiers:**	10	1	0	11

(20 Marks)	Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.				
4 (20 Marks)	**4.1 Power Amplifiers:** Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks.	10	1	0	11
	Total	**45**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome: At the completion of the course, the students will able to:

1. Explain the structure and working operation of basic electronic devices.
2. Able to identify and differentiate both active and passive elements
3. Analyze the characteristics of different electronic devices such as diodes and transistors
4. Choose and adapt the required components to construct an amplifier circuit.
5. Employ the acquired knowledge in design and analysis of oscillators

Recommended readings:

- David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
- Sedra and Smith, "Microelectronic circuits", 7th Ed., Oxford University Press
- Balbir Kumar, Shail. B. Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
- Thomas L. Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
- Donald A. Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
- Robert L. Boylestad, "Electronic devices and circuit theory", 2002.

- Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

Course Title : Digital Logic Circuits
Course Code : GECELT3
Nature of Course : Generic Elective Course
Total Credits : 3
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course Objectives:

1. To study various number systems and simplify the logical expressions using Boolean Functions
2. To study combinational circuits
3. To design various synchronous and asynchronous circuits.
4. To introduce asynchronous sequential circuits and PLDs
5. To introduce digital simulation for development of application-oriented logic circuits.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Number System:** Decimal-Binary conversion, Octal and Hexadecimal number system and their conversion to Decimal, BCD number, compliment Technique, Floating point number. **1.2 Boolean Algebra:** Boolean postulates from basic gates, properties of Boolean algebra, De Morgans theorems, simplification of compound expressions, sum of product and products of sum form, Minimisation by the use of Karnaugh's map for 2, 3, 4, 5 and 6 variables. **1.3 Codes:** Need of Coding, Weighted codes (BCD), Exess-3 code, Gray code and conversion, Alpha numeric code- ASCII and EBCDIC, Decimal to binary encoder, octal to binary encoder.	10	1	0	11
2 (20 Marks)	**2.1 Logic gates:** Basic Logic operation, AND, OR, NOT, NAND, NOR, XOR gates, Universal gates, Truth tables, Bipolar logic families, DTL families, RTL families, TTL families, Schottky TTL, Emitter coupled logic (ECL), NAND and NOR gates, voltage transfer function, Fanout, Fanin, Noise-immunity and propagation delay of logic families. **2.2 Flip-flops:**	10	1	0	11

	Combinational and sequential circuits, flip-flops, NAND flip-flop, SR flip-flop, Clocked SR flip-flop, D-latch, JK flip-flop. Master-slave flip-flop.				
3 (20 Marks)	**3.1 Counters:** Asynchronous counter. Asynchronous decade counter. Synchronous counters, Up/down counters. Self stopping counter, Sequential counter design procedure and applications. **3.2 Shift Registers:** Serial in shift registers, parallel-in shift register, universal shift register, 3-bits CMOS shift register.	10	1	0	11
4 (20 Marks)	**4.1 Arithmetic circuits:** Half adder, Full adder, parallel binary adder. Half subtractor. Full subtractor, parallel subtractor, subtraction using full adder. **4.2 Memory:** Introduction, primary and secondary memory, RAM, ROM, PROM, EPROM, EAPROM, floppy, Hard disk, Magnetic storage. **4.3 DAC and DAC:** Digital to analog converter, Weighted Register DAC, R-2R ladder DAC, Analog todigital converter, Successive approximation ADC, parallel ADC, Dual slope ADC.	10	2	0	12
	Total	**40**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome:

1. Ability to design combinational and sequential Circuits. Ability to simulate using software package.
2. Ability to study various number systems and simplify the logical expressions using Boolean functions
3. Ability to design various synchronous and asynchronous circuits.
4. Ability to introduce asynchronous sequential circuits and PLDs
5. Ability to introduce digital simulation for development of application-oriented logic circuits.

Recommended readings:

- James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
- Donald P. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
- Thomas L. Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
- Charles H. Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
- Comer "Digital Logic & State Machine Design, Oxford, 2012.
- Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
- William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
- D. P. Kothari, J. S. Dhillon, 'Digital circuits and Design', Pearson Education, 2016.

MINOR COURSES

Course Title : Basic Circuit Theory and Network Analysis
Course Code : MINELT1
Nature of Course : Minor
Total Credits : 4
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course Objectives:

1. To impart knowledge of basic circuit components and their responses in AC and DC signal.
2. To develop the concept of circuit analysis using different network theorems.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Voltage and Current** Charge, current and voltage, voltage and current sources, Ohm's law **1.2 Resistors:** Fixed and Variable resistors, Construction and Characteristics, Colour coding of resistors, resistors in series and parallel. Testing of resistance using multimeter. **1.3 Inductors** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of inductance using multimeter. 1.4 **Capacitors**: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction	14	1	0	15

	and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter**.**				
2 (20 Marks)	**2.1 Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **2.2 DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits.	11	1	0	12
3 (20 Marks)	**3.1 AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. **3.2 Resonance**: Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive **3.3 Filters:** Filters: Low Pass, High Pass, Band Pass and Band Stop.	17	1	0	18
4 (20 Marks)	**4.1 Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. **4.2 Two-port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. Relation between the parameters.	14	1	0	15
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment

d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Understand the basic circuit concepts and devices like resistors, capacitors and inductors.
2. Perform AC and DC circuit analysis.
3. Work with different theorems of network analysis.

Recommended readings:

- S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
- Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill. (2005)
- Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
- W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill. (2005)
- Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Course Title **: Semiconductor Devices**
Course Code **: MINELT2**
Nature of Course **: Minor**
Total Credits **: 4**
Distribution of Marks **: 80 (End Sem) + 20 (In Sem)**

Course Objective:

1. To understand the fundamentals concept, types, current and voltage characteristics of semiconductors.
2. Learn the fundamental and characteristics of semiconductor diode, BJT, FET and Power electronics devices.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Semiconductor Basics:** Introduction to Semiconductor Materials, Crystal Structure, Planes and Miller Indices, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **1.2 Carrier Transport Phenomena:** Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation	14	1	0	15

	and Recombination Processes, Continuity Equation.				
2 (20 Marks)	**2.1 P-N Junction Diode:** Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Tunnel diode, varactor diode, solar cell: circuit symbol, characteristics, applications.	11	1	0	12
3 (20 Marks)	**3.1 Bipolar Junction Transistors (BJT):** PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. Metal Semiconductor Junctions: Ohmic and Rectifying Contacts.	11	1	0	12
4 (20 Marks)	**4.1 Field Effect Transistors:** JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). **4.2 Power Devices:** UJT, Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. SCR, Construction, Working and Characteristics, Triac, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications.	20	1	0	21
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks

a) Seminar presentation
b) Group discussion
c) Assignment
d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Learn the fundamental physics of the semiconductor materials and devices.
2. Identify and characterize the semiconductor devices.
3. Apply the semiconductor devices in various circuits.

Recommended readings:

- S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
- Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
- Dennis Le Croissette, Transistors, Pearson Education (1989)
- Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
- Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
- Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)

Course Title : **Electronics Circuits**
Course Code : **MINELT3**
Nature of Course : **Minor**
Total Credits : **4**
Distribution of Marks : **80 (End Sem) + 20 (In Sem)**

Course Objectives:

1. To teach the students the uses of junction diode and transistor. Understand the various uses and applications of diodes and bipolar junction transistors.
2. To learn basic function of single stage amplifier, multistage amplifier and power Amplifier and their working principle.
3. To understand basic construction of feedback circuits and their application.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Diode Circuits**: Ideal diode, piecewise linear equivalent circuit, dc load line analysis, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, comparison. Filters: types, circuit diagram and explanation of shunt capacitor filter with waveforms. **1.2 Voltage Regulator:**	14	1	0	15

	Zener diode regulator circuit diagram and explanation for load and line regulation, disadvantages of Zener diode regulator.				
2 (20 Marks)	**2.1 Bipolar Junction Transistor**: Review of CE, CB Characteristics and regions of operation. Hybrid parameters. Transistor biasing, DC load line, operating point, thermal runaway, stability and stability factor, Fixed bias without and with RE, collector to base bias, voltage divider bias and emitter bias (+VCC and –VEE bias), circuit diagrams and their working. Transistor as a switch, circuit and working**,** Darlington pair and its applications. BJT amplifier (CE), dc and ac load line analysis, hybrid model of CE configuration, Quantitative study of the frequency response of a CE amplifier, Effect on gain and bandwidth for Cascaded CE amplifiers (RC coupled).	14	1	0	15
3 (20 Marks)	**3.1 Feedback Amplifiers:** Concept of feedback, negative and positive feedback, advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Hartley oscillator.	11	1	0	12
4 (20 Marks)	**4.1 MOSFET Circuits**: Review of Depletion and Enhancement MOSFET, Biasing of MOSFETs, Small Signal Parameters, Common Source amplifier circuit analysis, CMOS circuits. **4.2 Power Amplifiers:** Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks. **4.3 Single tuned amplifiers**: Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits	17	1	0	18
	Total	**56**	**4**	**0**	**60**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course Outcome: At the completion of this course, a student will be able to

1. Understand the various uses and applications of diodes and bipolar junction transistors.
2. Utilise the necessary skill needed to analyse electronic circuits.
3. Comprehend the designing and study of different types of amplifiers.

Recommended readings:

- Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky, 9th Edition, 2013, PHI
- Electronic devices, David A Bell, Reston Publishing Company
- D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
- Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
- J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
- Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation.

Skill Enhancement Course (SEC)

Course Title : Electrical Wiring and Maintenance
Course Code : SEC122
Nature of Course : Skill Enhancement Course
Total Credits : 3
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course objective: The aim of this course is to

1. Develop the skill of the students in domestic wiring and troubleshooting the electrical circuits especially electrical wiring and common household appliances through hands-on mode.
2. To prepare a working diagram of electrical wiring for a house/ building and install and commission electrical wiring and maintenance in domestic applications.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Basics of Electrical Circuits:** Introductory concepts and basic circuit elements: Concept of Electric current and its unit, Conductors, Insulators, Resistance, potential and potential difference, units, different voltage sources (AC and DC), Effects of current, Ohm's law, heating effect of current, Joule's law of heating, electric power, electric energy, Analysis of DC circuits; Kirchhoff's laws: KCL, KVL, Current and voltage drop across the DC circuit elements. Series circuit, parallel circuit, combination circuit, AC current and voltage, single-phase and three-phase alternating current sources, Transformers, transmission of AC Unit of power and energy, kWh, KVA. Different types of light sources like filament bulb, tube (fluorescent) light, CFL, LED and Neon light, Different types of switches, two-way, three-way, four-way switches, fan regulators, dimmer, different types of domestic electrical appliances and their power.	10	2	0	12
2 (20 Marks)	**2.1 Types of wiring:** Various types of tools and wiring accessories, Basics of wiring: casing-capping, PVC conduit wiring, concealed wiring (PVC/MS), comparison of different wire joint (flat and straight), types of wiring systems; selection and design of wiring schemes for particular situation (domestic),selection of wire, cables, wiring accessories and use of protective devices i.e., MCB, ELCB etc.; rating and current carrying capacity of wires, cables, fuse, switches, socket, MCBs, ELCBs and other electrical accessories.	10	1	0	11
3 (20 Marks)	**3.1 Electrical Drawing and Symbols:** Different types of electrical symbols used in domestic installation and power systems as per BIS code. Electrical Schematics. Power circuits and control circuits. Reading of circuit schematics. Understanding the connections of elements and identifying current flow and voltage drop. Wiring diagram of light, fan, bell and alarm circuit, staircase wiring, schematic diagram of lighting system of small room, hall and conference room, circuit breakers, inverter connections, Design and drawing of panels,	10	1	0	11

	distribution board using MCB, ELCB, main switches and change over switches for domestic installations, Estimation of electrical materials for domestic wiring.				
4 (20 Marks)	**4.1 Electrical Protection and Safety:** Earthing: Concept and purpose of earthing, different types and procedure of earthing, drawing of plate and pipe earthing, test material and costing and estimating. Safety precautions: Effect of electric shock on human body, first aid for electric shock-rules and standards in house wiring, Introduction to Lightning Arresters– Types- Necessity and Advantages-Layout and Installation, Electrical Hazards and its effects-Basic safety introduction- Personal protection and PPE-Basic injury prevention- Basic first aid -Hazard identification and avoidance **4.2 Demonstration and Laboratory:** 1. Safety use in electricity, shock treatment methods, safety precautions. 2. To study & find the specifications of various types of wires and cables. 3. To measure the gauge of a given wire with the help of a wire gauge. 4. Prepare a chart of wattage of different electrical items/ appliances like CFL bulb, LED bulb, Tube light, Ceiling Fan, Table Fan, Gyger, Mixer-grinder, Refrigerator, Water pump, Iron, Xerox Machine, Inverter, TV, Hanging/pendant Light, Microwave oven etc. 5. Measurements of ac voltage with multimeter. 6. To connect the wires with different electrical accessories. 8. Skinning the cable and joint practice on single and multi-strand wire. 9. To make a main switch board for house wiring 10. Installation of common electrical accessories such as switch, holder, plug on board 11. Installation and wiring connection of ceiling fan, exhaust fan, geyser, and water purifier. 12. Preparation of extension board with switches, sockets and indicator. 13. Demonstrate electrical circuit diagrams	10	1	0	11

	related to electrical household appliances. 14. Carry out the earthing of the installed electrical circuit as per standard practice 15. Practice on different types of House Wiring installation and testing 16. House wiring circuits using fuse, switches, sockets, ceiling fan etc. in P. V. C. casing-capping. 17. Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m^2 with given light, fan & plug points.				
	Total	**40**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

- **Course Outcome:** After successful completion of this course students will be able to identify various electrical devices, circuits and their symbols, familiar with schematic and wiring diagrams of electrical devices, understand electrical installation plan, perform and practice any type of domestic wiring and its maintenance.

Recommended readings:

- M. L. Gupta, Elementary Electrical Engineering, New Heights
- Surjit Singh, Electrical Installation and Estimating, Dhanpat rai and sons
- J. B. Gupta, A course in Electrical Installation, Estimating and costing, S K Kataria and Sons
- B. L. Theraja, A text book in Electrical Technology, S Chand & Co.
- A. K. Theraja, A text book of Electrical Technology

Course Title : **Design and Fabrication of Printed Circuit Board**
Course Code : **SEC222**
Nature of Course : **Skill Enhancement Course**
Total Credits : **3**
Distribution of Marks : **80 (End Sem) + 20 (In Sem)**

Course Objective: After the end of the course, a student will be able to

1. Understand the fundamentals of printed circuit boards and its classification.
2. Develop the knowledge about designing and fabrication of printed circuit boards.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 PCB Fundamentals:** PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD). **1.2 Classification of PCB:** single, double, multilayer and flexible boards, Manufacturing of PCB, PCB standards.	10	1	0	11
2 (20 Marks)	**2.1 Schematic & Layout Design:** Schematic diagram, General, Mechanical and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding.	10	1	0	11
3 (20 Marks)	**3.1 Technology OF PCB:** Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper clad laminates materials of copper clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing and quality controls. Recent Trends and advances, Environmental concerns in PCB industry.	10	1	0	11
4 (20 Marks)	**4.1 Hands on tutorials:** Hands on tutorials/demonstrations by using freeware version of Diptrace software/other open-source equivalents: a) Draw schematic circuit of RC band pass filter circuit and design its single sided PCB layout b) Draw schematic circuit of Regulated DC power supply and design its single sided/double sided PCB layout c) Draw schematic circuit of 741 Operational amplifier-based differentiator circuit and design its single sided/double sided PCB layout **4.2 PCB fabrication & etching**: Use screen printing / toner paper / CNC tools to convert the Diptrace PCB layout design above into actual PCB	10	2	0	12

	4.3 Drilling and soldering: Drilling should be done on the fabricated PCBs and components should be soldered during the demonstration session.				
	Total	**40**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment
  d) Attendance

Course outcome: This course will enable the students to

1. Acquire the knowledge about the importance and necessity of printed circuit boards in electronic applications.
2. Learn the techniques and processes involved in the design and fabrication of printed circuit boards.

Recommended readings:

- Printed circuit Board – Design & Technology by Walter C. Bosshart, Tata McGraw Hill.
- Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGraw Hill Publisher

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Course Title : Domestic Equipment Maintenance
Course Code : SEC322
Nature of Course : Skill Enhancement Course
Total Credits : 3
Distribution of Marks : 80 (End Sem) + 20 (In Sem)

Course Objectives:
The objective of this course is to introduce the students about working principle of different types of house hold equipment and procedure for general fault finding of the equipment.

UNITS	CONTENTS	L	T	P	Total Hours
1 (20 Marks)	**1.1 Safety:** Safety Practices; Fires in electrical Circuits & Precautions, Fire Extinguishers &its Types, General Safety of Tools &equipment, Rescue of person who is in contact with live wire, Treat a person for electric shock/ injury. **1.2 General idea on Various Components:**	8	1	0	9

	Different types of switches, fuse, thermostat, heating elements, conductors, insulators, capacitors, wires and cables (for up to 15 amp) symbol of various components. Different types of electrical testing instruments.				
2 (20 Marks)	**2.1 Maintenance of heating appliances**: Identification, Working, raw material and manufacturing process, electrical wiring diagram, types. Common Faults and their troubleshooting working and specification of each part. Repairing for some common problems, replacement of coil, insulators, thermostat etc. for a. Room Heater (with/ without variable thermostat) b. Electric iron (with/without variable thermostat) c. Electric stove, electric kettle, electric rice cocker, electric toaster d. Electric immersion heater e. Microwave oven f. Geyser.	10	1	0	11
3 (20 Marks)	**3.1 Maintenance of motorised appliances:** Maintenance of Ceiling and Table fan: Construction, Identification of various parts, electrical diagram, regulator. Connection Wiring of a fan with switch and regulator, maintenance of fan (overhauling), repair of some common problems like low speed, fan not starting, fan rotating in reverse direction, any other as suggested by concerned teacher. Maintenance of Domestic Pump motor: Identification of pump motor, type & specification, electrical connection, of switch, cable etc. Routine check-up of motor (e.g. meggar test, checking of winding resistance.) repairing of some common fault like starting problem, tripping of motor or any other as suggested by concerned teacher. Maintenance of domestic Mixer grinder, food processor: Identification of various parts, identification of motor used, its type and specification. Study of selector switch and its repairing, thermostat connection and its replacement and operation, repairing for some common fault (e. g. motor not starting, motor abnormal noise etc).	12	1	0	13

	Maintenance of washing machine: Identification of various parts of a semi-automatic washing machine like (a) motor, (b) water valve, (f) timer, (g) Brake arrangement, working of all parts for various mode of operation, replacement of various parts of a washing machine. Troubleshooting for various faults. Vacuum Cleaner: Identification of various constructional parts, motor specification, type, electrical connection. Common faults, repair and maintenance of vacuum cleaner.				
4 (20 Marks)	**4.1 Air Conditioner:** Working, raw material and manufacturing process, electrical wiring diagram, types. Common Faults and their troubleshooting: Faults in following parts of AC: Filter, thermostat, refrigerant leaks, breakers, capacitors, compressor, evaporator coils, condenser coils, warm contactor. General faults: AC UNIT has an odour, shuts ON and OFF repeatedly, does not blow cold air, repeatedly tripping a circuit breaker, indoor UNIT is leaking water inside the room, outdoor UNIT is making an unusually loud sound, room is not getting cold enough, AC not turning ON. **4.2 Refrigerator:** Working, raw material and manufacturing process, electrical wiring diagram, types of refrigerators. Common faults and their troubleshooting: fridge not cooling, fridge not defrosting, leaking water, freezing food light not working, freezer is cooled but fridge stays warm, dead refrigerator, not enough cooling, keeps running, leakage, makes noise. Replacement procedure for: seal (gasket), evaporator fan motor, PTC relay, thermostat, compressor, bulb.	10	2	0	12
	Total	**40**	**5**	**0**	**45**

Where, L: Lectures, T: Tutorials, P: Practicals

Modes of In-Semester Assessment: (20 Marks)

- One Internal Examination - 10 Marks
- Any one of the following - 10 Marks
  a) Seminar presentation
  b) Group discussion
  c) Assignment

d) Attendance

Course Outcome: At the end of the course the student should be able to:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research.
2. To acquire experimental skills, analysing the results and interpret data.
3. Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / Systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.
5. Capability to use the Modern Tools / Techniques for the operation and maintenance of the domestic electrical/ electronic gadgets
6. Capability to use the Modern Tools / Techniques.

Recommended readings:

- R. G. Gupta, Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting, TMH, 2001.
- R. S. Khandpur, Modern Electronic Equipment: Troubleshooting, Repair and Maintenance, TMH, 1987.
- G. C. Loveday, A. H., Longman, Electronic fault diagnosis, 4th Edition, 1994.