APPENDIX- 2: Syllabus

Semester- I

ELE-CT1: ELECTRONIC DEVICES AND CIRCUITS

(Credits: Theory – 04, Practical – 02) Total Teaching hours: 60

Course Objectives

Upon completing the course, ELE-CT1, the student will be able to understand various fundamental principles of network analysis, number systems and Boolean algebra and become familiar with the basic operation of electronic devices and circuits which are the building blocks of all electronic circuits, devices and gadgets.

UNIT-1 **15 HOURS**

Electronic Components: Electronic passive and active components, types and their properties, Concept of Voltage and Current Sources, electric energy and power.(Qualitative only)

Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity Theorems.DC and AC analysisofRC and RL circuits,RLC series and parallel Resonant Circuits.

PN junction diode: Ideal and practical diodes, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, Zener diode, Reverse saturation current, Zener and avalanche breakdown.

Rectifiers-Half wave and Full wave (center tap and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable).

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UNIT-2 **15 HOURS**

Voltage regulator: Block diagram of regulated power supply, Line and Load regulation, Zener diode as voltage regulator – circuit diagram, load and line regulation, disadvantages.Fixed and Variable IC Voltage Regulators (78xx, 79xx, LM317), Clippers (shunt type) andclampers(Qualitative analysis only), Voltage Multipliers.

Bipolar Junction Transistor: Construction, types, CE,CB and CC configurations (mention only), VI characteristics of a transistor in CE mode, Regions of operation (active, cut off and saturation), leakage currents (mention only), Current gains α , β and y and their inter-relations, dc load line and Q point. Applications of transistor as amplifier and switch - circuit and working. (Numerical examples wherever applicable).

UNIT-3 **15 HOURS**

Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor.Transistor as a two-port network, h-parameter equivalent circuit.

Amplifier: Small signal analysis of single stage CE amplifier using h-parameters. Input and Output impedances, Current and Voltage gains. Advantages of CC amplifier. Class A, B and C Amplifiers (qualitative).Types of coupling, Two stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product, Darlington transistor, Current gain.

Special semiconductor diodes: Varactor diode, Schottky diode, Tunnel diode, - construction, characteristics, working, symbol, and applications for each.LED, LCD and solar cell – construction, operation and applications, 7-segment display, concept

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of common anode and common cathode types.(Numerical problems, wherever applicable)

UNIT-4 **15 HOURS**

Number System: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, Binary arithmetic; addition, subtraction by 1's and 2's complement method, BCD code (8421, 2421, Excess-3), Gray code, error checking and correction codes (Only parity check).

Boolean Algebra: Constants, variables, operators, basic logic gates-AND, OR, NOT, Positive and negative logic, Boolean laws, Duality Theorem, De Morgan's Theorem, simplification of Boolean expressions-SOP and POS. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. (Numerical examples wherever applicable).

Course Outcomes

At the end of this course, students will be able to

- Study and analyze basic networks using network theoremsin a systematic manner.
- Build simple electronic circuits used in various applications.
- Describe the behaviour of basic semiconductor devices
- Reproduce the I-V characteristics of diode/BJT devices
- Describe the frequency response of BJT amplifiers.
- Explain the behaviour, characteristics and applications of Varactor diode, Schottky diode, Tunnel diode, LED, LCD and solar cells.
- Apply standard device models to explain/calculate critical internal parameters of semiconductor devices.

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- Understand and represent numbers in powers of base and converting one from the other, carry out simple arithmetic operations.
- Understand the basic knowledge of Digital system building blocks, effectively can construct simple digital designs with the knowledge of Boolean algebra.

Reference Books:

1. Robert L Boylestad, "Introductory circuit analysis", 5th edition., Universal Book 2003.
2. R.S.Sedha, "A Text book of Applied Electronics", 7th edition., S. Chand and Company Ltd. 2011
3. A.P. Malvino, "Principles of Electronics", 7th edition .TMH, 2011.
4. Electronic devices and circuit theory by Boylestad, Robert Nashelsky
5. David A. Bell " Electronic Devices and Circuits", 5th Edition, Oxford Uni. Press, 2015
6. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)
7. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
8. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
9. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
10. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
11. M. Nahvi& J. Edminister, "Electrical Circuits", Schaum's Outline SeriesTMGH2005
12. S. A. Nasar," Electrical Circuits", Schaum's outline series, Tata McGraw Hill, 2004

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13.J. Millman and C. C. Halkias, "Integrated Electronics", Tata McGraw Hill, 2001

14.A.S. Sedra, K.C. Smith, A.N. Chandorkar "Microelectronic circuits", 6th Edn., Oxford University Press, 2014

15.J. J. Cathey, "2000 Solved Problems in Electronics", Schaum's outline Series, TMG1991

ELE-CP1: Electronic Devices and Circuits – Lab

(Hardware and Circuit Simulation Software)

Minimum of TEN Experiments to be performed excluding demonstration experiments

1. **Demonstration Experiment:** Familiarization with
   a) Electronic components
   b) Resistance in series, parallel and series-parallel
   c) Capacitors and inductors in series and parallel
   d) Multimeter and LCR meter – checking of components / measurements.
   e) Voltage sources in series, parallel and series-parallel
   f) Voltage and current dividers
   g) Measurement of Amplitude, Frequency & Phase difference using Oscilloscope
2. Verification of Thevenin's and Maximum Power Transfer Theorem.
3. Verification of SuperpositionTheorem.
4. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.
5. Study of the I-V Characteristics of LEDs of two different colours and 7-segment display.
6. Study of Half wave rectifier withoutand with shunt capacitor filter– ripple factor for different values of filter capacitors.
7. Study of full wave bridge rectifier without and with shunt capacitor filter – ripple factor for different values of filter capacitors.

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8. Study of Zener diode as a Voltage Regulator using bridge rectifier with shunt capacitor filter [Load and line regulation].
9. Study of Clipping, Clamping and Voltage Multiplier circuits.
10. Designing and testing of fixedpositive and negative voltage regulators using 78xx and 79xx series ICs (Using bridge rectifier and shunt capacitor filter).
11. Designing and testing of variable voltage regulator using IC LM317 (Using bridge rectifier and shunt capacitor filter).
12. Study of Transistor characteristics in CE configuration – determination of h-parameters.
13. Study of Fixed Bias and Voltage divider bias circuits – comparison for different β values.
14. Study of single stage CE amplifier (frequency response, input and output impedances in mid-band)
15. Study of two-stage RC-coupled CE amplifier (A_{V1}, A_{V2}, A_V) at mid-band frequency.
16. Study of Series and Parallel Resonance circuits – determination of its
    (a) Resonant frequency
    (b) Impedance at resonance
    (c) Bandwidth
    (d) Quality Factor
17. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using respective ICs. Realization of XOR and XNOR using basic gates.
18. Universal property of NAND and NOR gates.
19. Binary to Gray and Gray to Binary code conversion and parity checker using XOR gates IC 7486.

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ELE-OE1.1: Domestic Equipment Maintenance

(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 60

Unit-1 **15 Hours**

Geyser: Construction and working, parts and manufacturing process, types. Common faults and their troubleshooting: Dripping geyser overflow, overheating, steam or hot water escaping from overflow, water leaking through the ceiling, no hot water, water not hot enough, poor hot water pressure. Induction cooker: Construction and working, parts and manufacturing process, types.

Common faults and their troubleshooting: Cooker fuse blown, cooker buttons not working, cooktop shuts off while cooking, food not get cooked or heated properly, overheating and uneven heating, display keep flashing, weird noises–crackling, fan noise, humming sound, clicking.

Microwave Oven: Working, raw material and manufacturing process, types, Common faults and their troubleshooting: Microwave does not heat, runs then stops, buttons do not work, plate do not spin, bulb does not turn ON during operation, sparking inside, shuts OFF after few seconds

Unit – 2 **15 Hours**

Refrigerator: Working, raw material and manufacturing process, electrical wiring diagram, types of refrigerator. 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.

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.

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Demonstration Experiments: **30 Hours**

1. Working of Air Conditioner
2. Working of Refrigerator
3. Working of Geyser
4. Working of Microwave Oven
5. Working of Induction Cooker

References:

1. Electronic instruments and systems: Principles, maintenance and troubleshooting by R. G. Gupta Tata McGraw Hill
2. Modern electronic equipment: Troubleshooting, repair and maintenance by Khandpur, Tata McGraw Hill
3. Electronic fault diagnosis by G. C. Loveday, A. H. Wheeler publishing

ELE-OE1.2: Renewable Energy and Energy Harvesting

(Credits: Theory – 02, Demonstration Lab – 01) **Total Teaching hours: 60**

Unit-1 **15 Hours**

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models, equivalent circuits, and sun tracking systems.

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***Wind Energy harvesting*:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Unit – 2 **15 Hours**

***Ocean Energy*:** Ocean Energy Potential against Wind and Solar, Wave Characteristics, and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

***Hydro Energy*:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources. *Piezoelectric Energy harvesting*: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. *Electromagnetic Energy Harvesting*: Linear generators, physics mathematical models, recent applications,; Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

Demonstration Experiments: 30 Hours

1. Demonstration of training modules on solar energy, wind energy etc.
2. Conversion of vibration to voltage using piezoelectric voltages
3. Conversion of thermal energy into voltage using thermoelectric module.

Reference Books:

1. Non-conventional energy sources, B.H. Khan, McGraw Hill.
2. Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, Oxford University Press.
4. Renewable Energy Sources and Emerging Technologies, Kothari et.al., PHI Learning.
5. Solar Energy: Resource Assessment Handbook, P Jayakumar.

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6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

ELE-OE1.3: Basics of Electronics, Computers and PCB Design

(Credits: Theory – 02, Demonstration Lab – 01) Total Teaching hours: 60

Unit-1 **15 Hours**

Generation of and distribution of electricity: Mention of hydro electric generator, diesel generator, thermal generator, wind power, solar, ocean waves. Generation of DC power – Mention of batteries. Single phase, Two phase and Three phase. Transformers.Power transmission and distribution.Domestic electrical wiring – connection from AC line to the meter, sockets, mention of phase neutral and the need of earthing. Mention of electric shock and safety. Mention of power type (ac or dc) and current ratings for home appliances. Mention of tester. Electric motor working principle.

Computer fundamentals: History of computer system, block diagram of a computer system- functions of each units (Input, Output, Memory and CPU), Mention of various input and output devices, Memories - registers, primary memory, secondary memory, cache memory, Software - system software (operating system, program language translators - assembler, interpreter and compiler), utility programs, communication software, performance monitoring software), application software, Software hierarchy and dependence between the different layers, computer languages – Machine, Assembly level and High level, Inverter, Uninterrupted Power supply (UPS) – online and off line UPS, SMPS.

Unit – 2 **15 Hours**

PCB Design: Types of PCB, Single sided board – double sided – Multilayer boards – Plated through holes technology – Benefits of Surface Mount Technology (SMT) – Limitation of SMT – Surface mount components: Resistors, Capacitor, Inductor, Diode and IC's.

LAYOUT AND ARTWORK: Layout Planning – General rules of Layout – Resistance, Capacitance and Inductance – Conductor Spacing – Supply and Ground Conductors – Component Placing and mounting–Cooling requirement and package

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density–Layout check. Basic artwork approaches– Artwork taping guideline–General artwork rules– artwork check and Inspection.

LAMINATES AND PHOTO PRINTING: Manufacture of copper clad laminates – Properties of laminates – Types of Laminates – Manual cleaning process – Basic printing process for double sided PCB's – Photo resists – wet film resists – Coating process for wet film resists – Exposure and further process for wet film resists – Dry film resists. ETCHING AND **SOLDERING:** Introduction – Etching machine – Etchant system. Soldering: Principles of Solder connection – Solder joints – Solder alloys – Soldering fluxes. Soldering Tools: Soldering, Desoldering tools and Techniques – Man Soldering – Solder mask – Safety, health and medical aspects in Soldering practice.

Demonstration Experiments: 30 Hours

1. Unboxing and assembling of desktop computers
2. Types of motors and transformers used in household appliances
3. Understanding voltage, current, frequency etc. of ac mains.
4. Upgradation of RAM, hard disk and SSD
5. SMPS: Block diagram and working
6. Inverter
7. Types of PCB and fabrication process.

Reference books:

1. Electrical Circuits, K.A. Smith and R.E. Alley, Cambridge University Press.
2. A text book in Electrical Technology - B L Theraja - S Chand & Co.
3. A text book of Electrical Technology - A K Theraja.
4. Performance and design of AC machines - M G Say ELBSEdtion.
5. Basic electrical engineering - V K Mehta and Rohit Mehta, S Chand and Company.
6. Computer fundamentals - Anita Goel, Pearson Edition.
7. Fundamentals of Computers - V Rajaram, NeeharikaAdabala - PHI.

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8. Computer Fundamentals - Peter Norton, McGraw-Hill Education
9. Walter C.Bosshart "PCB Design and Technology" Tata McGraw Hill, Publications, Delhi. 1983.
10. Clyde F.Coombs "Printed circuits Handbook" IIIEdition McGrawhill Kraig Mitzner, "Complete PCB Design Using OrCAD Capture and Layout," Elsevier, Amsterdam,
11. Walter C Bosshart, "Printed Circuit Board Design and Technology",1st ed., McGraw Hill Education

Semester II

ELE-CT2: ANALOG AND DIGITAL ELECTRONICS

(Credits: Theory – 04, Practical – 02) Total Teaching hours: 60

Course Objectives

Upon completing the syllabus contents of ELE-CT2, the student will become familiar with various working principles of widely used electronic devices, linear and digital ICs which help the students to build small projects and also be able to answer some basic questions that appear in competitive examinations.

UNIT-1 **15 HOURS**

JFET–Types - p-channel and n-channel, working and I-V characteristics - n-channel JFET, parameters and their relationships, Comparison of BJT and JFET.

MOSFET:E – MOSFET, D – MOSFET – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, VMOS, UMOS Power MOSFETs, handling, MOS logic, symbols and switching action of MOS, NMOS inverter, CMOS logic, CMOS – inverter, circuit and working, CMOS characteristics, IGBT construction and working.

UJT - basic construction, working, equivalent circuit and I-V characteristics,intrinsic stand-off ratio, relaxation oscillator.

SCR - Construction, VI characteristics, working, symbol, and applications – HWR and FWR.

Diac and Triac-construction, working, characteristics, applications, (Numerical examples wherever applicable)

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