Tumkur University, Karnataka

Proposed Curriculum for B.Sc. / B.Sc.(Hons.) as per NEP 2020

2021-22

and onwards

SUBJECT: ELECTRONICS

Contents

Proceedings of multiple meetings BoS – Electronics (UG) held on Online/Offline platforms.

The following members were present.

Sl No.	Name	Designation	Signature
1.	Prof. Vinod Phadke Associate Professor, Kalpataru First Grade Science College, Tiptur 572201	Chairman	
2.	Dr. Chitharanjan Rai Associate Professor and Principal, Kalpataru First Grade Science College, Tiptur 572201	Member	
3.	Dr. Manjunath D Assistant Professor, University College of Science, Tumkur 570001	Member	
4.	Dr. Shwetha D, Assistant Professor, University College of Science, Tumkur 570001.	Member	

Preamble

This model curriculum content for B.Sc (Honours) Electronics as per NEP-2020, is 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 framework encourages innovation in teaching-learning process and appropriate assessment of student learning levels.

Introduction

B.Sc (Honours) Electronics is a program which needs to develop a specialized skill set among the graduates to cater to the need of industries.

The curriculum is designed to help learners to analyze, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the graduates. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the graduates with competencies like problem solving and analytical reasoning which provide them high professional competence.

The Department/Institute/University is expected to encourage its faculty concerned tomake suitable pedagogical innovations, in addition to teaching/learning processes suggested in the model curriculum, so that the Course/Programme learning outcomes can be achieved.

Significance of Electronics

In recent years, Electronics has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries thatwork in this frontier area are in need of highly skilled and scientifically oriented manpower. This manpower can be ma de available only with flexible, adaptive an d progressive training programs and a cohesive interaction among the institutions, universities and industries. The key areas of study within subject area of Electronics comprise: Semiconductor Devices, analog and digital circuit design, microprocessors & Microcontroller systems, computer coding/programming in high level languages etc. and also modern applied fields such as embedded systems, data communication, robotics, control systems, etc.

Program Objectives

The overall Objectives of the B.Sc. (Honours) Electronics program are to:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of electronics and equip students with advanced scientific / technological capabilities for analyzing and tackling the issues and problems in the field of electronics.
- Develop ability in students to apply knowledge and skills they have acquiredto solve specific theoretical and applied problems in electronics.
- Develop abilities in students to design and develop innovative solutions for benefits of society.
- Provide students with skills that enable them to get employment in industries or pursue higher studies or research assignments or turn as entrepreneurs.

Program outcome

- Ability to apply knowledge of Logical thinking and basic science for solving electronics related problems
- Ability to perform electronics experiments, as well as to analyse and interpretdata.
- Ability to design and manage electronic systems or processes that conforms toa given specification within ethical and economic constraints.
- Ability to identify, formulate, solve and analyze the problems in various sub disciplines of electronics.
- Ability to use Modern Tools / Techniques.

APPENDIX-1: COURSE PATTERN AND SCHEME OF EXAMINATION for B.Sc. / B.Sc. (Hons.) as per NEP (2021-22 and onwards) SUBJECT: ELECTRONICS

Sl No	Sem	Title of the Paper	Teaching Hours	Hours /week		Examination Pattern Max.Marks /Paper				Duration of Exam (hours)		Total Marks / paper	Theory Credits	Practical Credits
				Theory	Practical	Theory		Practical		Theory	Practical			
						Exam	IA	Exam	IA					
1	I	**ELEDSC01:**Electronic Devices and Circuits	**60**	**4**	**4**	**70**	**30**	**35**	**15**	**3**	**4**	**150**	**4**	**2**
		ELEOEC01/02/03/04	**30**	**2**	**2**	**70**	**30**	**-**	**-**	**3***	**-**	**100**	**2**	**1**
2	II	**ELEDSC02:** Analog And Digital Electronics	**60**	**4**	**4**	**70**	**30**	**35**	**15**	**3**	**4**	**150**	**4**	**2**
		ELEOEC05/06/07/08/09	**30**	**2**	**2**	**70**	**30**	**-**	**-**	**3***	**-**	**100**	**2**	**1**

***Questions from practicals have to be included in theory examinations of Open Electives (Since electronics is a practical oriented subject)**

APPENDIX- 2: Syllabus

Semester- I

ELEDSC01: 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 analysis of RC 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 foroutput voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable).

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) and clampers (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, LCDand solar cell – construction, operation and applications, 7-segment display, concept 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 theorems in 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 parametersof semiconductor devices.

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

Reference Books:

1. Robert L Boylestad, "Introductory circuit analysis", 5th edition., UniversalBook 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, 7thEd., 2011, Tata McGraw
8. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI LearningPvt. 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
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

ELEDSC01P: Electronic Devices and Circuits – Lab

(Hardware and Circuit Simulation Software)

Minimum of TEN Experiments to be performed excludingdemonstration 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 Superposition Theorem.
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 without and 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.
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 fixed positive and negative voltage regulators using78xx 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 basicgates.

18. Universal property of NAND and NOR gates.

19. Binary to Gray and Gray to Binary code conversion and parity checker usingXOR gates IC 7486.

ELEOEC01: Fundamentals of Electronics

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

Unit 1. Electronic Components: Resistors – Construction, types, applications, Ohm's Law, resistors in series and parallel, Kirchhoff's Laws; Capacitors – Classification (mention only, Capacitors in series and parallel, Inductors – types (mention only), Transformers, switches, relays. (10 hrs)

Unit 2: Semiconductor Devices: Intrinsic and extrinsic Semiconductors, P-N junction, diode - forward and reverse biasing of diode, diode characteristics; rectifiers – halfwave, full wave and bridge, Definition of ripple factor, LC Filters. Special diodes - LED, Zener diode, regulated power supply, IC regulators (78xx, 79xx and LM 317)

Bipolar Junction Transistor: NPN and PNP transistor, construction and working, Transistor characteristics (CE mode only), definition of α and β. Biasing a transistor. Different regions of operation and their application. Transistor biasing and Q point. Transistor as a switch. (12 hrs)

Unit 3: 555 Timer IC: Importance of IC 555. Functional block diagram of timer IC 555. Monostable and Astable operation. Application areas. IC 555 circuits. (8 hrs)

Practical :

1. Kirchhoff's Laws
2. Charging and discharging of a capacitor
3. Diode characteristics (SC diode and zener diode)
4. Power supplies using Half wave and full wave rectifiers
5. IC Voltage regulators
6. Automatic switching of street lights.
7. Fire alarm
8. Transistor characteristics
9. IC 555 experiments- Astable, monostable Multivibrators

Reference Books:

1. R.S.Sedha, "A Text book of Applied Electronics", 7th edition., S. Chand andCompany Ltd. 2011
2. A.P. Malvino, "Principles of Electronics", 7th edition .TMH, 2011.
3. Electronic devices and circuit theory by Boylestad, Robert Nashelsky
4. David A. Bell "Electronic Devices and Circuits", 5th Edition, Oxford Uni.Press, 2015
5. Bhargava, Kulashreshtha, Gupta,"Electronic devices and circuits", TTTI, Chandigarh.

ELEOEC02: 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.

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

ELEOEC03: 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.

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

ELEOEC04: 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 ofvarious 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 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 andCompany.
6. Computer fundamentals - Anita Goel, Pearson Edition.
7. Fundamentals of Computers - V Rajaram, NeeharikaAdabala - PHI.
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

ELEDSC02: 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 familiarwith 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)

UNIT-2 **15 HOURS**

Op-Amp: Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, Open and closed loop configuration, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.

Applications of op-amps: Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative Study). Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector

Filters: First and second order active low pass, high pass and bandpass Butterworth filters. **Oscillators:** Barkhausen criterion for sustained oscillations, Colpitt's oscillator and crystal oscillators using transistor, Phase Shift oscillator, Wien-bridge oscillator – (no derivation for each)

IC 555Timer: Introduction, Block diagram, Astable and Monostable multivibrator circuits. (Numerical Examples wherever applicable)

UNIT-3 **15 HOURS**

Logic Families: Pulse characteristics, Logic Families-classification of digital ICs. Characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector. TTL IC terminology. CMOS NAND, comparison of TTL and CMOS families.

Combinational Logic Circuits: Minimization techniques using K-maps - SOP and POS, Minterm, Maxterm, SSOP, SPOS, Simplification of Boolean expressions, K- Map for 3 and 4 variable.

Digital to Analog converter- DAC with binary weighted resistor and R-2R resistor ladder network. Analog to Digital converter: Successive approximation method- performance characteristics.

Design of Arithmetic logic circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor. 4-bit parallel binary adder, 2-bit and 4-bitmagnitude comparator. Encoder, decimal to BCD priority encoder. Decoder, 2:4 decoder using AND gates, 3:8 decoder using NAND gates, BCD to decimal decoder, BCD to 7-Segment decoder, Multiplexer - 4:1 and 8:1 multiplexer, Demultiplexer - 1:4 and 1:8 demultiplexer - logic diagram and truth table of each, Realization of Full adder and Full subtractor using Mux and Decoder.

UNIT 4 **15 HOURS**

Sequential Logic Circuits: Flip-Flops - SR Latch, RS, D and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race- around conditions in JK Flip-Flop. Master- Slave JK and T Flip-Flops. Applicationsof Flip-Flops in semiconductor memories, RAM, ROM and types.

Registers and Counters: Types of Shift Registers, Serial-in-Serial-out, Serial-in- Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (onlyup to 4 bits), applications. Ring counter, Johnson counter applications. Asynchronous Counters: Logic diagram, Truth table and timing diagrams of 4 bit ripple counter, modulo-n counters,4bit Up-Down counter, Synchronous Counter: 4-bit counter, Design of Mod 3, Mod 5 and decade Counters using K-maps.

Course Outcomes

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

- Reproduce the I-V characteristics of various MOSFET devices,
- Apply standard device models to explain/calculate critical internal parametersof

semiconductor devices.

- Explain the behavior and characteristics of power devices such as UJT, SCR,Diac, Triac etc.
- Perform experiments for studying the behavior of semiconductor devices.
- Calculate various device parameters' values from their IV characteristics.
- Interpret the experimental data for better understanding the device behaviour.
- Understand basic logic gates, concepts of Boolean algebra and techniquesto reduce/simplify Boolean expressions
- Analyze combinatorial and sequential circuits

Reference Books:

(1) Electronic devices and circuit theory by Boylestad, Robert Nashelsky

(2) Electronic Devices Conventional Current Version by Thomas L. Floyd

(3) David A. Bell " Electronic Devices and Circuits", 5th Edition, Oxford Uni. Press, 2015

(4) OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn, 2000, Prentice Hall

(5) Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.

(6) R.S.Sedha, "A Text book of Applied Electronics", 7th edition.,S.Chand and Company Ltd. 2011

(7) Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)

(1) Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7thEd., 2011, Tata McGraw

(2) Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.

(3) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

(4) Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer,2001, PHI Learning.

(5) R.L. Tokheim, Digital Principles, Schaum's Outline Series, TataMcGraw- Hill (1994)

(6) Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

ELEDSCo2P: ANALOG AND DIGITAL ELECTRONICS - Lab

(Hardware and Circuit Simulation Software)

PART A (Any FIVE)

1. Study of JFET/MOSFET characteristics – determination of parameters.
2. Study of single stage JFET amplifier. (frequency response and band width)
3. UJT characteristics and relaxation oscillator
4. SCR characteristics – determination of I_H and firing voltage for different gate currents.
5. Design of inverting and non-inverting amplifier using Op-amp & study of frequency response.
6. Op-amp inverting and non-inverting adder, subtractor and averaging amplifier.
7. Study of the zero-crossing detector and comparator.
8. Design and study of differentiator and integrator using op-amp for differentinput waveforms.
9. Design and study of Wien bridge and RC phase shift oscillator using op-amp. 10.Design and study of first order high-pass and low-pass filters using op-amp. 11.Study of Colpitt's and crystal oscillator using transistor. 12.Astablemultivibrator using IC555 timer.
13. Monostable multivibrator using IC555 timer.

PART B (Any SEVEN)

14. Half Adder and Full Adder using (a) logic gates (b) using only NAND gates. 15.HalfSubtractor and Full Subtractor(a) logic gates (b) using only NAND gates.
16. 4-bit parallel binary adder and subtractor using IC7485.
17.Study of BCD to decimal decoder using IC7447 18.Study of the Encoders and priority encoders.
19.Study of Multiplexer and Demultiplexer using ICs.
20.Study of 2-bit and 4-bit magnitude comparators.
21. Study of Clocked RS, D and JKFlip-Flops using NAND gates.

22. Study of 4-bit asynchronous counter using JK Flip-Flop IC7476, modify to decade counter and study their timing diagrams.
23. Study of 4-bit Shift Register – SISO, modification to ring counter using IC7495.
24. Digital to Analog converter using binaryweighted resistor method, determination of resolution, accuracy and linearity error.

ELEOEC05: Digital Electronics, Cellular and Satellite Communication

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

OPEN ELECTIVE - 2

Unit 1: Digital Principles:

Number Systems, binary and hexadecimal, interconversion between binary, decimal and hexadecimal., Boolean algebra, basic operations, basic boolean equations, Logic gates, Truth Tables and symbols of AND, OR, NOT, NOR, NAND, XOR and XNOR gates. NAND and NOR as universal gates, Half adder, Half Subtractor. Realization using NAND gates. Simple applications of Logic gates. **(10 hours)**

Unit 2: Cellular Communication: History of wireless communication, concept of cell, cell splitting, frequency reuse. Block diagram of cellular system, call set up, Mobile handset block diagram, SIM card, Hand off (hard and soft). Basics of multiple access methods – GSM and CDMA. Generations of mobile technology. **(10 hours) Unit 3: Satellite Communication**: History, applications, basics of satellite communication. Frequencies used, types of orbits, examples for each, sun synchronous and geosynchronous satellite orbits. GPS system. Advantages and disadvantages of Satcom. **(10 hours)**

Laboratory experiments:

1. Voltage divider bias
2. NAND as Universal gate
3. NOR as Universal gate
4. Half adder
5. Half Subtractor
6. Verification of Logic gates
7. Simple projects using transistor amplifiers and oscillators
8. Demonstration of mobile handset
9. Description of mobile handset

Text Books

1. Rapapport T. S, 'Wireless Communication Principles and Practices', Pearson Education Asia, New Delhi, 3rd Ed.2003.
2. JochenSchiller,'Mobile communication 'Pearson Education,Asia

Reference books:

1. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)

2 Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7thEd., 2011, Tata McGraw

3. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009,PHI Learning Pvt. Ltd.
4. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

5. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer,2001, PHI Learning.
6. Vijay K Garg, Joseph E Wilkes,' Principles and Applications of GSM', Pearson Edu.

ELEOEC06: Consumer Electronics

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

Unit – 1

Audio Systems: PA system, Microphones, Amplifier, Loudspeakers, Radio Receivers, AM/FM, Audio Recording, and reproduction, Cassettes, CD and MP3.

Unit – 2

TV and Video Systems: Television standards, BW/Colour, CRT/HDTV, video system, VCR/VCD/DVD players, MP4 players, set top box, CATV and Dish TV, LCD, Plasma and LED TV, Projectors: DLP, Home Theatres, Remote controls.

Unit – 3

Landline and Mobile Telephony: Basic landline equipment, CL1, cordless intercom/EPABX system, mobile phones: GPRS and Bluetooth, GPS Navigation system, smart phones, Office Equipment: Scanners, Barcode / flat bed, printers, Xerox, Multifunction units (Print, Scan, fax, and copy)

Unit – 4

Electronic gadgets and Domestic Appliances: Digital Clock, Digital Camera, Handicam, Home security system, CCTV, Air conditioners, Refrigerators, washing machine / Dish washer, Microwave oven, Vacuum cleaners.

Suggested Books:

1. R.P.Bali, Consumer Electronics, Pearson Education (2008)
2. R.G. Gupta, Audio and Video systems, Tata McGraw Hill (2004)

Consumer Electronics Lab:

1. Study of PA systems for various situations – Public gathering, Closed theatre / Auditorium, Conference room, Prepare bill of material (Costing)
2. Installation of Audio/Video systems – site preparation, electrical requirements, cables and connectors
3. Market survey of products (at least one from each module)
4. Identification of block and tracing the system, Assembly and Disassembly of system using toolkit.

ELEOEC07: Electronics For Everyone

(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 60 Unit-1

Timer and PLL: Functional block diagram of 555 timer, Monostable operation and its Application, Astable operation and its Applications,

Phase Locked Loop: Functional block diagram – Phase detector / Comparator, Voltage Controlled Oscillator, Low pass filter, Applications: Frequency multiplier/ Division, AM detection

Unit-2 Operational Amplifier

Inverting and non-inverting amplifier, Op-amp parameters, Summing Amplifier, Difference Amplifier, Integrator, Differentiator, Instrumentation Amplifier, Audio Amplifier(LM386), Voltage to current converter, Current to Voltage converter, Sample and Hold circuits.

First order active filters (Circuit diagram and formula only): low pass, high pass,band pass, band reject and all pass filters. Phase-shift and Wein bridge oscillator using op-amp.

Unit-3 Transducers (Basic Working)

Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi- conductor strain gauge) Capacitive (diaphragm), Hall effect sensors, magneto- strictive transducers, Microphone, Touch Switch, Piezoelectric sensors, light(photo- conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature(electrical and non-electrical), Pressure sensor.

A-D and D-A Conversion: D-A conversion: 4 bit binary weighted resistor type, circuit and working. Circuit of R-2R ladder- Basic concept. A-D conversion characteristics, successive approximation ADC. (Mention the relevant ICs for all).

Unit-4: Data Acquisition using Arduino:

Arduino: Birth, Open Source community, Functional Block Diagram, Functions of each Pin, Arduino Development Boards: IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Designingof 1st sketch, Programming of an Arduino (Arduino ISP) , Serial port Interfacing, Basic Interfacing and I/O Concept, Interfacing LED,Switch,7seg LED, different sensors.

Suggested Books:

1. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), Damodar Group (Publishers),Burdwan, ISBN: 978-93-85775-15-4(2019)
2. Measurement Systems, 4/e, Doeblin McGraw Hill, New York, 1992.
3. Electrical Measurements & Electronic Measurements by A.K. Sawhney
4. B. C. Sarkar and S. Sarkar, Digital Electronics: Circuits and Systems, S UT Prakashani ,Burdwan, ISBN:978-81-88391-57-8 (2018)
5. Instrumentation- Devices and Systems ByRangan, Sarma, and Mani, Tata- McGrawHill
6. Electronic Instrumentation by H.S Kalsi, McGraw Hill
7. Instrumentation measurements and analysis by Nakra&Choudhary
6. Measurement & Instrumentation- DVS Murthy
7. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
8. Electronic Sensor Circuits and Projects, III Volume, Forrest M Mims, Master Publishing Inc.

9. Timer, Op Amp, and Optoelectronic Circuits & Projects, Forrest M Mims, Master Publishing Inc.
10. Exploring Arduino, Jeremy Blum, Wiley
11. Beginning Arduino, Michael McRobetrs, Technology in Action
12. Beginning Arduino Programming, Brian Evans ,Technology in Action
13. Practical Arduino Engineering, Harold Timmis, Technology in Action
14. Practical Arduino : Cool Projects for open source hardware, Jonathan Oxer, Hugh Blemings, Technology in Action

Electronics For Everyone Demonstration Lab
(Hardware and Circuit Simulation Software) 30 hours

1. Study of basic monostable multivibrator
2. Study of basic Astable multivibrator
3. Light detection using 555 timer
4. Rain alarm using 555 timer
5. Motor control by PWM using 555 timer
6. LED flasher circuit using 555 timer
7. Analog light wave Transmitter/Receiver using 555 timer
8. Study of basic inverting and non-inverting amplifier
9. Study of basic integrator circuit
10. Study of basic differentiator circuit
11. Design of first order LPF
12. Study of first order HPF
13. Designing of fiber optic based Transmitter /Receiver using LM386
14. Temperature to voltage converter using 741.
15. Shadow sensing using 741
16. Light based PWM using 741 and V-F converter

17. Test the different Arduino Boards, Open-Source and Arduino Shields.
18. Install Arduino IDE and its development tool.
19. Develop a program to Blink LED for 1second.
20. Develop a program to interface Input Switches and output LEDs with development board (arduino).
21. Interface 7 segment display with development board (arduino)
22. Interface LM35 temperature sensor with arduino and monitor temperature onserial monitor.
23. Interface DC motor using L293D Motor Driver.
24. Interfacing of various sensors with arduino development board

ELEOEC08: Mobile Communication

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

Unit 1

Evolution of mobile radio communication-Examples of wireless communication system: paging systems, cordless telephone system, cellular telephone system-Trends in cellular radio and personal communication systems

Unit 2

Frequencies for radio transmission- Basics of multiplexing and multiple access techniques-CDMA-Cellular system concepts- Frequency reuse- Channel assignmentand handoff strategies- Improving capacity in cellular system: cell splitting, sectoring, repeaters for range extension, a microcell zone concept.

Unit 3

Introduction to telecommunicating system- GSM: mobile services (Bearer services, tele- services, supplementary services), system architecture (radio subsystem, networkand switching subsystem, operation sub system)

Unit 4

Satellite system: history, application, basics, routing, localization and handover- Broadcast system: digital audio broadcasting, digital video broadcasting (basic concepts).

Unit 5

Wireless LAN-Infrared vs radio transmission- Bluetooth: user scenarios and architecture- Wimax: basic concepts and features- Wi-Fi - basic concepts.

Mobile Communication – Demonstration Lab **30 hours**

1. Demonstration of keypad mobile handset
2. Demonstration of smartphone handset
3. Block diagram description

Text Books

1. Rapapport T. S,'Wireless Communication Principles and Practices', Pearson Education Asia, New Delhi, 3rd Ed.2003.
2. JochenSchiller,'Mobile communication 'Pearson Education,Asia.

Reference Book

Vijay K Garg, Joseph E Wilkes,' Principles and Applications of GSM', PearsonEdu.

ELEOEC09: Mobile Application Programming

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

Introduction: What is mobile Application Programming, Different Platforms, Architecture and working of Android, iOS and Windows phone 8operating system, Comparison of Android, iOS and Windows phone 8.

Android Development Environment: What is Android, Advantages and Future of Android, Tools and about Android SDK, Installing Java, Eclipse, and Android, Android Software Development Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs: Smartphone Emulators, Image Editing.

Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, The Values Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: TheAndroidManifest.xml File, Creating Your FirstAndroid Application.

Android Framework Overview: The Foundation of OOP, The APK File, Android Application Components, Android Activities: Defining the User Interface, **Android Services:** Processing in the Background, Broadcast Receivers:

Announcements and Notifications, Content Providers: Data Management, Android Intent Objects: Messaging for Components, Android Manifest XML: Declaring Your Components.

Views and Layouts, Buttons, Menus, and Dialogs, Graphics Resources in Android: Introducing the Drawable, Implementing Images, Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android.

Handling User Interface(UI) Events: An Overview of UI Events in Android, listening for and Handling Events, Handling UI Events via the View Class, Eventcall back methods, Handling Click Events, Touch screen Events, Keyboard Events, Context Menus, Controlling the Focus.

Content Providers: An Overview of Android Content Providers, defining a Content Provider, Working with a Database.

Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers

Advanced Android: New Features in Android 4.4**.**

iOS Development Environment: Overview of iOS, iOS Layers, Introduction to iOS application development.

Windows phone Environment: Overview of windows phone and its platform, Building windows phone application.

Mobile Application Programming – Demonstration Lab

3

o hours Suggested Books:

3. Beginning Android 4, OnurCinar , Apress Publication
4. Professional Android 4 Application Development, Reto Meier, Wrox
5. Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, Apress
6. Beginning Windows 8 Application Development, IstvánNovák, ZoltanArvai, György Balássy and David Fulop
7. Professional Windows 8 Programming: Application Development with C# andXML, Allen Sanders and Kevin Ashley, Wrox Publication

Suggested syllabus for

Skill Enhancement Course: ELESEC01

Semester I : ELESEC01: Electronic Instruments

Credits: 2 (Theory – 2 hours per week) **Total teaching hours: 30 hrs**

Unit 1: Introduction to electronic instruments **(15 hours)**

Need of instruments in different fields (such as medical, industry, academic etc). PMMC, voltmeter, ammeter, conversion of galvanometer into voltmeter and ammeter. Specifications of current and voltmeter. Loading effect of voltmeter.

Cathode Ray Oscilloscope: cathode ray tube, working, block diagram of CRO, displays used in CRO and other optical electroluminescent devices.

Measurement using multimeters, digital multimeter, comparison with analog multimeter

Unit 2: Testing boards: **(15 hours)**

Tag board, Breadboard, Printed circuit board, PCB designing for simple circuits, soldering practice, Soldering with simple devices such as switches, power supplies and some simple circuits, Simple electrical wiring – Construction of a switch board (extension board) for mains supply. Switches, transformers, relays – Types and specification and applications for each.

Reference Books:

1. Bhargava, Kulashreshtha and Gupta, “Electrical and Electronic devices and circuits” TTTI, Chandigarh
2. Electronic instruments and systems: Principles, maintenance and troubleshooting by R.G. Gupta tata McGraw Hill
3. Electronic Fault Diagnosis by G.C. Loveday, A.H. Wheeler Publishing
4. Electronic Components by Dr. K Padmanabhan and Swaminathan, Laxmi Publications (P) ltd, 2006