Telephone No. 2419677/2419361
Fax: 0821-2419363/2419301

e-mail : registrar@uni-mysore.ac.in
www.uni-mysore.ac.in

UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated: 26-10-2021

Notification

Sub:- Syllabus and Examination Pattern of Electronics (UG) with effective from the Academic year 2021-22 as per NEP-2020.

Ref:-
1. Decision of Board of Studies in Electronics (UG) meeting held on 26-09-2021 & 08-10-2021.
2. Decision of the Faculty of Science & Technology Meeting held on 16-10-2021.
3. Decision of the Academic Council meeting held on 22-10-2021.

*****

The Board of studies in Electronics (UG) which met on 26-09-2021 & 08-10-2021has recommended & approved the syllabus and pattern of Examination of Electronics Programme with effective from the Academic year 2021-22 as per NEP - 2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 16-10-2021 and 22-10-2021 respectively have also approved the above said proposal and it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in

Registrar

Registrar
University of Mysore
Mysore

To:-

1. All the Principal of affiliated Colleges of University of Mysore, Mysore. Those who are running B.Sc Courses.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Electronics, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Psychology, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy

University of Mysore

Curriculum for I and II Semester BSc/BSc (Honours) Degree with Electronics based on NEP-2020 Regulations from the academic year 2021-22

Subject: Electronics

Contents

1. Preamble

The proposed curriculum content for BSc/BSc (Honours) Degree in 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.

2. Introduction

BSc/BSc (Honours) Degree in 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 analyse, 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 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.

3. 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 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 Institutions, Universities, and Industries. The key areas of study and good hands on training within the subject area of Electronics comprise: Semiconductor Devices, Circuit Analysis, Analog and Digital Circuit Design, Microprocessors and Microcontrollers, Embedded Systems, Knowledge on Coding/Programming in High Level Languages, Basic and Advanced Communication Systems like IoT, 4G, 5G, Satellite and Optical communication, Signal Processing, VLSI Technology, Basics of Control Systems and Robotics, etc.

4. Eligibility Criteria

A candidate who has passed the two year Pre-University Examination with Science Subjects conducted by the Pre-University Board of Education, Government of Karnataka or any other examination considered equivalent by the University is eligible for admission to the first Semester of the UG program.

5. Programme Objectives

The main objectives of the BSc/ BSc (Honours) Degree in Electronics program are:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of Electronics and equip students with advanced Scientific and Technological capabilities for analysing and tackling the issues and problems in the field of Electronics.

- Develop ability in students to apply knowledge and skills they have acquired to solve specific theoretical and applied problems in Electronics.
- Develop abilities in students to design and develop innovative solutions for benefit of the society.
- Provide students with skills that enable them to get employment in Industries or pursue higher studies or research assignments or turn as entrepreneurs.

6. Programme Outcomes

- Acquire the knowledge of Basic and Advanced topics related to the field of Electronics.
- Apply the knowledge of Logic thinking and basic Science for solving Electronics related problems
- Ability to perform Electronics Experiments and 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 sub disciplines of Electronics.
- Ability to use Modern Tools/Techniques in solving problems in the field of Electronics.

7. Exit Option

The conditions for the exit option, award of Certificate/Diploma/Degree/Honours Degree, etc., are as per the Regulations of NEP-2020 and University of Mysore.

8. Eligibility Criteria for Open Elective (OE) Courses

- Candidates who have not opted Electronics as one of the Core/Elective Courses are eligible to take any OE Courses offered by the Department.
- Except the OE Courses, Fundamentals of Electronics and Domestic Wiring and Fundamentals of Semiconductor Devices, candidates who have opted Electronics as one of the Core Courses are eligible to take other OE Courses offered by the Department.
- In a semester, the Department has to offer one OE course for students who have opted Electronics as Core/Elective Course and one OE course for students who have not opted Electronics as Core/Elective Course.

9. Scheme of Evaluation

The Scheme of Examination, Evaluation, Passing Criteria, etc., are as per the Regulations of University of Mysore. The performance of the candidate in Theory, Practical, and Project Work Courses are assessed based on three discrete components identified as C1, C2 and C3. The components C1 and C2 are the continuous assessment and C3 is the semester end Examination. The continuous assessment C1 and C2 are to be conducted during 8^{th} and 15^{th} weeks of the semester. The Final Examination for C3 is conducted during 18^{th} to 20^{th} week based on University notification.

C1 & C2 for Theory:

The evaluation weightage for DSC, DSE and OE courses is, C1 = C2 = 20 marks and C3= 60 marks. The duration of C3 Examination is 3 Hours. The continuous assessment C1 and C2 is assessed as given in Table 1.

Table 1 Scheme for C1 and C2 Evaluation for Theory component of DSC/DSE/OE

Activity	C1	C2
Test	10 marks	10 marks
Seminar/Book Review/Report on Data Sheets of Electronic Components, etc.		10 marks
Assignment/Mini Project Work/Case Study/ Report on Industry Visit, etc.,	10 marks	
Total	20 marks	20 marks

10. Scheme of Evaluation for Practicals

The student will be evaluated on the basis of skill, comprehension, and recording the results. The student has to compulsorily submit the practical record for evaluation during C1, C2, and C3. For C3, the record has to be certified by the Head of the Department. The evaluation weightage for Practical part associated with DSC and DSE courses is, C1 = C2 = 10 marks and C3= 30 marks. The duration of the Examination for C3 is 3 hours. The student is continuously evaluated for 10 marks for C1 and C2 with the weightage of 8 marks for the preparedness and conduct of experiments by the candidate during the Practical Sessions and 2 marks for Practical Record. For the C3 evaluation, the student is evaluated for 30 marks as given in Table 2. The experiment Part evaluation for 22 marks which is mentioned in Table 2 is carried out as given in Table 3.

Table 2 Scheme for C3 component assessment in Practical Examination

Division	Marks
Experiment Part	22
Viva	04
Record	04
Total	30

Table 3 Scheme for Experiment Part assessment in Practical Examination

Division	Marks
Formula, Circuit, Tabular column, Nature of Graph	6
Arrangement, Circuit connections	5
Taking and Recording Readings	5
Plotting of Graph and Calculations	4
Accuracy of Result	2
Total	22

11. Theory Question Paper Pattern for DSC, DSE, and OE Courses

Time: 3 Hours Max. Marks: 60

1. Answer any **TEN** of the following. 10 x 2 = 20

Short Answer Type questions. Three questions from each unit.

Unit – 1 6 + 4 = 10

2. a) Long answer type question for 6 marks
   b) Short answer type question or numerical problem for 4 marks

OR

c) Long answer type question for 6 marks
d) Short answer type question or numerical problem for 4 marks

Unit – 2 6 + 4 = 10

3. a) Long answer type question for 6 marks
   b) Short answer type question or numerical problem for 4 marks

OR

c) Long answer type question for 6 marks
d) Short answer type question or numerical problem for 4 marks

Unit – 3 6 + 4 = 10

4. a) Long answer type question for 6 marks
   b) Short answer type question or numerical problem for 4 marks

OR

c) Long answer type question for 6 marks
d) Short answer type question or numerical problem for 4 marks

Unit – 4 6 + 4 = 10

5. a) Long answer type question for 6 marks
   b) Short answer type question or numerical problem for 4 marks

OR

c) Long answer type question for 6 marks
d) Short answer type question or numerical problem for 4 marks

12. Programme Structure for I year BSc/BSc(Honours) with Electronics as one of the Core Courses under NEP-2020

Semester	Course Code	Title of the Course	Credits L:T:P=Total
I	DSC-EleI	Electronic Devices and Circuits	4:0:0=4
	DSC-EleILab	Electronic Devices and Circuits Lab	0:0:2=2
	OE-EleI-1	Fundamentals of Electronics and Domestic Wiring	3:0:0=3
	OE-EleI-2	Domestic Equipment Maintenance	3:0:0=3
II	DSC-EleII	Analog and Digital Electronics	4:0:0=4
	DSC-EleIILab	Analog and Digital Electronics Lab	0:0:2=2
	OE-EleII-1	Fundamentals of Semiconductor Devices	3:0:0=3
	OE-EleII-2	Renewable Energy and Energy Harvesting	3:0:0=3
	OE-EleII-3	PCB Design and Fabrication	3:0:0=3

Curriculum Contents

Semester- I

Course Code: DSC-ELEI	Course Tittle: Electronic Devices and Circuits
Course Credits: L:T:P = 4:0:0	Teaching Hours/Week: 4 Hours/Week
Total Teaching Hours: 64	Continuous Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Course Objectives

The objectives of the Course are to enable the student to understand

- Principle of operation of passive components
- Basics principles of network theorems
- Analysis of Electronic circuits
- Construction, operation and applications of semiconductor diode, BJT and special purpose devices
- Number systems, Boolean laws and methods of simplifications of Boolean expressions

Course Outcomes

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

- Explain the principles and behaviour of basic semiconductor devices.
- Analyse basic networks using network theorems.
- Apply the concepts to realize the circuits. As per the requirement
- Build simple electronic circuits used in various applications.
- Evaluate the critical internal parameters of semiconductor devices for the given standard device models.
- Demonstrate the working of analog and digital circuits as per the specifications

Course Content

Unit - 1

Electronic Components: Passive components – R, L, and C, and their properties, V-I relation, mutual and self-inductance, Transformer and its working, Definition and list of Active components, Concept of Voltage and Current Sources, Electric Energy and Power. (Qualitative only)

Network Theorems: KCL, KVL and node analysis of circuits, Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity Theorems, inter-conversion between Thevenin and Norton equivalent circuits, (For Circuits with DC Source)

Network Analysis: 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, mention of diode equation, I-V characteristics, DC load line, Static and Dynamic resistance, Zener diode and its I-V Characteristics, Reverse saturation current, Zener and avalanche breakdown.

Rectifiers: Half-wave and Full-wave centre-tap and bridge rectifiers, expressions for output voltage, PIV, ripple factor and efficiency, Operation with and without shunt capacitor filter. (Numerical examples wherever applicable). **16 Hours**

Unit - 2

Applications of Diode: Clippers, Clampers and Voltage Multipliers (Qualitative analysis only)
Voltage Regulator: Block diagram of regulated power supply, Zener diode as voltage regulator – circuit diagram, load and line regulation, Fixed and Variable IC Voltage Regulators (78xx, 79xx, LM317).
Special Semiconductor Devices: Construction, working principles, characteristics, symbol, and applications of Varactor diode, Schottky diode, and Tunnel diode, Solar Cell.
Display Devices: Construction, working principles, characteristics, symbol, and applications of LED and LCD, operation of 7-segment display, common anode and common cathode type 7-segment display.
(Numerical problems, wherever applicable) **16 Hours**

Unit - 3

Bipolar Junction Transistor: Construction and working of NPN transistor, CE, CB and CC configurations (mention only), Input and Output characteristics of a transistor in CE mode, Regions of operation of BJT (active, cut off and saturation), leakage currents (mention only), Current gains α , β and γ and their inter-relations, dc load line and Q point.
Applications of Transistor: Circuit and working principles of Transistor as an amplifier and switch.
Transistor Biasing: Fixed and Voltage Divider Bias. Thermal runaway, mention of stability and stability factor, Transistor as a two-port network, h-parameter equivalent circuit for CE configuration.
Amplifier: Small signal analysis of single-stage CE amplifier using h-parameters, Frequency Response, Input and Output impedances, Current and Voltage gain.
Multi-stage Amplifiers: Types of coupling of amplifiers, Two-stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product.
Power Amplifiers: Class A, B and C Power Amplifiers (qualitative).
(Numerical examples wherever applicable). **16 Hours**

Unit - 4

Number System: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned binary numbers, Binary arithmetic - addition, subtraction by 1's and 2's complement method, BCD code (8421, 2421, Excess-3), Gray code, Gray to binary interconversion, parity error checking, single-bit error correction codes.
Boolean Algebra: Constants, variables, operators, SOP and POS form, canonical form, conversion form SOP to POS and Vice-versa, Boolean laws, Duality Theorem, De Morgan's Theorem.
Logic gates: AND, OR, NOT, Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. Simplification and realization of Boolean expressions using gates.
(Numerical examples wherever applicable). **16 Hours**

Reference Books:

1. Robert L Boylestad, and Louis Nashelsky, "Electronic Devices & Circuit Theory," 11th Edition, Pearson Education India, 2018.
2. Ravish R Singh, "Network Analysis and Synthesis," 1st Edition, MGH, 2018.

3. Robert L Boylestad, "Introductory Circuit Analysis," 15th edition, Pearson, 2015.
4. R. S. Sedha, "A Text book of Applied Electronics," 7th edition., S. Chand and Company Ltd., 2011.
5. A. P. Malvino, and, David J Bates, "Electronics Principles," 7th Edition, TMH, 2011.
6. David A. Bell, "Electronic Devices and Circuits," 5th Edition, Oxford Uni. Press, 2015.
7. Thomas L. Floyd, "Digital Fundamentals," 11th Edition, Pearson Education, 2015.
8. A.P. Malvino, D. P. Leach, and Saha, "Digital Principles and Applications," 8th Edition, TMH, 2014.
9. K. R. Venugopal, K. Shaila, "Digital Circuits and Systems," 1st Edition, TMH, 2011.

Course Code: DSC-ELEILab	Course Tittle: Electronic Devices and Circuits Lab
Course Credits: L:T:P = 0:0:2	Teaching Hours/Week: 4 Hours/Week
Total Teaching Hours: 64	Continuous Assessment Marks: 20
Examination Marks: 30	Exam Duration: 3 Hours

Course Objectives

The objectives of the Course are to enable the student get the hands on training on the

- Working principles of Electronics Instruments and components
- Analyse Electronic circuits by applying Network theorems
- Understand the I-V characteristics of Diode, BJT, and other semiconductor devices
- Design and construct the biasing, amplifier, resonant circuits and to understand their behaviour
- Simplify Boolean Expressions and construct the circuits to verify the truth table.

Part – A

1. Verification of Thevenin's, Norton's, and Maximum Power Transfer Theorems
2. Study the I-V Characteristics of p-n junction and Zener diodes.
3. Study of Half and full wave rectifiers without and with shunt capacitor filter and find the ripple factor for different values of filter capacitors.
4. Study of Zener diode as a voltage regulator using bridge rectifier with shunt capacitor filter and find the Load and line regulation.
5. Study of clipping and clamping circuits.

Part – B

6. Study of Transistor characteristics in CE configuration – determination of h-parameters.
7. Study of Voltage divider bias circuits.
8. Study of single stage CE amplifier and obtain its frequency response, input and output impedances in mid-band.
9. Study of Series and Parallel Resonance circuits.
10. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using respective ICs and Realization of basic gates using universal gates.
11. Binary to Gray and Gray to Binary code conversion and parity checker using XOR gates IC 7486.

Curriculum of Open Electives Courses

Course Code: OE-ELEI-1	Course Tittle: Fundamentals of Electronics and Domestic Wiring
Course Credits: L:T:P = 3:0:0	Teaching Hours/Week: 3 Hours/Week
Total Teaching Hours: 48	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Note: ***This Courses is for candidates who have not opted Electronics as one of the Core Courses***.

Course Objectives

The objectives of the Course are to enable the student to understand

- Ability to gain the knowledge of basic electronics and electronic components.
- Ability to analyse various components behaviour in AC and DC circuits.
- Ability to get the knowledge of electrical wiring and safety precautions.
- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of electrical and electronics.
- Provide students with skills that enable them to get employment in various organisations, industries, and turn as entrepreneurs.

Course Contents

Unit – 1

Introduction to Electronics: Evolution of Electronics, Definition and expression for of Charge, Current, Voltage, Potential Difference, Power, Energy. Coulombs Law, Ohm's Law.
Electronic Components: Definition and list of passive and active components. **Resistors:** Definition, application, and mention of types of resistors, color coding of resistors, series and parallel combinations. **Capacitors:** Definition, application and mention of types capacitors, series and parallel combinations, factors affecting capacitance, color coding of capacitors. **Inductors:** Definition, application, and mention of types of inductors, series and parallel combinations. Self and mutual inductance, factors affecting inductance. **12 Hours**

Unit - 2

Kirchhoff's laws: KCL and KVL, voltage divider rule and current divider rule, open and short circuits.
Network Theorems (DC analysis only): Thevenin's theorem, Norton's theorem and maximum power transfer theorem, Superposition Theorem (Qualitative Approach with statements and steps involved in solving) as applied to simple T-network.
DC power supplies: Block diagram and working, Applications.
Cells and Batteries: Primary and Secondary cells, Mention of types of batteries, series and parallel combination of batteries. **Lead Acid Battery:** Construction, Internal resistance, Efficiency and capacity of a battery, condition of a fully charged and discharged lead acid battery. **12 Hours**

Unit - 3

A. C. Fundamentals: Definition and waveform of ac signal. Definition of Amplitude, Frequency, Time period, RMS value, average value, Phase and phase angle difference of sinusoidal signal. Sinusoidal signal applied to resistor, capacitor and Inductor, waveforms and phasor diagram for each. Expression for capacitive and inductive reactance. Circuit diagram and working of series and parallel resonance circuits, expression for resonance frequency.

Transformers: Definition, construction, working principle and application, step-up and step-down transformers. **12 Hours**

Unit - 4

Domestic Wiring: Introduction, Types of Domestic Wiring, Cleat Wiring, Wooden/PVC Casing and Capping Wiring, Toughened Rubber Sheath (TRS or CTS) or Batten Wiring, Conduit Wiring, Specifications of Wires, Size of Conductor, Distribution Board, Types of Cables, Lighting Control Circuits, Earthing System, Fuses and HRC Fuses, Calculation of Fuse Rating.

Switches: Definition and application of switch, Brief note on SPST, SPDT, DPST and DPDT, electromagnetic relay, MCB, ELCB, RCCB, Toggle switch, push button, joystick, selector, limit, proximity switches. **12 Hours**

Reference Books:

1. C L Wadhwa, "Basic Electrical Engineering," 4th Edition, New Age International Publisher, 2007.
2. Robert Boylstead, "Introductory circuit analysis," 5th edition, PHI, 2010.
3. Robert Boylstead and Louis Nashelsky, "Electronic Devices and circuit theory," 9th Edition, PHI, 2013.
4. B. L. Theraja and A. K. Theraja, "ABC of Electrical Engineering," S Chand Publishers, New Delhi, 2014.
5. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering," Pearson Education India, 2012.
6. I. J. Nagrath, "Electronic Devices and Circuits," PHI Learning Pvt. Ltd., 2007.
7. V. Mittle and Arvind Mittle, "Basic Electrical Engineering," McGraw Hill Companies, 2005.
8. Mitchel E. Schultz, "Basic Electronics," 10th Edition, TMH, 2010.

Course Code: OE-ELEI-2	Course Tittle: Domestic Equipment Maintenance
Course Credits: L:T:P = 3:0:0	Teaching Hours/Week: 3 Hours/Week
Total Teaching Hours: 48	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Course Objectives

The objectives of the course are

- To enable the students to understand the working principle of domestic equipments.
- Identify the common faults that occurs in the domestic equipment.
- Able to carry out minor repairs in the equipments.
- Understand the technical specifications of the equipments.

Course Content

Unit-1

Microwave Oven: Working, parts, 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. Demonstrate the working of microwave oven.

Geyser: Construction and working, parts and 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. Demonstrate the working of Geyer. **12 Hours**

Unit – 2

Induction Cooker: Construction and working, parts and types. Common faults and their troubleshooting: Cooker fuse blown, cooker buttons not working, cook top 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. Demonstrate the working of induction cooker. **12 Hours**

Unit – 3

Refrigerator: Working, 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. Demonstrate the working of refrigerator.

12 Hours

Unit – 4

Air Conditioner: Working, 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. Demonstrate the working of air conditioner. **12 Hours**

Reference Books:

1. R. G. Gupta, "Electronic instruments and systems: Principles, maintenance and troubleshooting," TMH, 2001.
2. R. S. Khandpur, "Troubleshooting Electronic Equipment: Includes Repair & Maintenance," TMH, 2013.
3. G. C. Loveday, "Electronic fault diagnosis," Pearson Education, 1994

Semester- II

Course Code: DSC-ELEII	Course Tittle: Analog and Digital Electronics
Course Credits: L:T:P = 4:0:0	Teaching Hours/Week: 4 Hours/Week
Total Teaching Hours: 64	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Course Objectives

The objectives of the Course are to enable the student to understand

- Principle of operation active devices like, BJT, FET, Op-Amp, UTJ, SCR, etc.,
- Understand different applications of op-amp.
- Analysis of Electronic circuits.
- Construction, operation and applications oscillators.
- Digital Logic Families and their comparison.
- Understand, analyse and simply combinational and sequential digital logic circuits.

Course Outcomes

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

- Explain the working principles of semiconductor devices like JFET, MOSFET, UJT, SCR, Diac and Triac.
- Design and build the circuits to understand the applications of op-amp.
- Demonstrate and understand the working of combinational and sequential logic circuits.

Course Content

Unit - 1

JFET: Construction, working, Symbol, and I-V characteristics of p-channel and n-channel JFET, mention of different parameters and their relation related to JFET, Comparison of BJT and JFET.

MOSFET: Construction, working, Symbol, drain and transfer characteristics of E-MOSFET, D-MOSFET, VMOS, UMOS. MOS Logic and its switching action, NMOS Inverter, CMOS and its characteristics, CMOS logic, Circuit and working of CMOS inverter, Construction and working of IGBT. Comparison of MOSFET, CMOS, and IGBT.

UJT: Construction, working, Symbol, I-V characteristics, equivalent circuit and parameters of UJT. Mention of equivalent circuit and I-V characteristics, working principles of UJT based Relaxation Oscillator.

SCR: Construction, working, Symbol, I-V characteristics, and two-transistor equivalent circuit of SCR, working principles of half-wave and full-wave controlled rectifiers.

Diac and Triac: Construction, working, Symbol, I-V characteristics and applications of Diac and Triac. Working principle of Triac as an AC-voltage controller.

(Numerical examples wherever applicable) **16 Hours**

Unit - 2

Op-Amp: Basics of Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, Open and closed loop inverting and non-inverting amplifiers,

Derivation for voltage gain, definition and expression for op-amp parameters – I/O impedance, offset voltage, CMRR, Slew Rate, concept of virtual ground, Frequency Response.

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: Definition and types of filter, active verses passive filters, First and Second order active low pass, high pass and band pass Butterworth filters.

Oscillators: Definition and working principle of oscillator, concept of negative feedback, Barkhausen criterion for sustained oscillations, Colpitt's and crystal oscillators, RC-Phase Shift and Wien-bridge oscillator (no derivation for each)

IC 555 Timer: Introduction, Block diagram, Circuit diagram and working of Astable and Monostable multivibrator circuits.

(Numerical Examples wherever applicable) **16 Hours**

Unit - 3

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 Logic, comparison of TTL and CMOS families.

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

Arithmetic Logic Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor, 4 - bit parallel binary adder, 2 – bit and 4 – bit magnitude comparator.

Encoder and Decoder: Decimal to BCD priority encoder, 2:4 decoder using AND gates, 3:8 decoder using NAND gates, BCD to decimal decoder, BCD to 7-Segment decoder.

Multiplexer and Demultiplexer: 4:1 and 8:1 multiplexer, 1:4 and 1:8 demultiplexer, Realization of Full adder and Full Subtractor using Multiplexer and Decoder.

DAC and ADC: DAC with binary weighted resistor and R-2R resistor ladder network, Successive approximation based ADC and the mention of their performance characteristics. (Numerical Examples wherever applicable) **16 Hours**

Unit - 4

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

Shift 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 (4-bits only), Synchronous verses asynchronous counters, Ring and Johnson counters, 4-bit ripple counter, modulo-n counters, 4-bit Up-Down counter, 4-bit Synchronous counter, design of Mod 3, Mod 5 and decade Counters using K-maps. **16 Hours**

Reference Books:

1. Robert L Boylestad, and Louis Nashelsky, "Electronic Devices & Circuit Theory," 11th Edition, Pearson Education India, 2018.
2. R. S. Sedha, "A Text book of Applied Electronics," 7th edition., S. Chand and Company Ltd., 2011.
3. David A. Bell, "Electronic Devices and Circuits," 5th Edition, Oxford Uni. Press, 2015.
4. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuit," 4th Edition, Pearson Education, 2000.
5. David A. Bell, "Operational Amplifiers and Linear ICs," 3rd Edition, Oxford University Press, 2011.
6. Thomas L. Floyd, "Digital Fundamentals," 11th Edition, Pearson Education, 2015.
7. A.P. Malvino, D. P. Leach, and Saha, "Digital Principles and Applications," 8th Edition, TMH, 2014.
8. K. R. Venugopal, K. Shaila, "Digital Circuits and Systems," 1st Edition, TMH, 2011.

Course Code: DSC-ELEIILab	Course Tittle: Analog and Digital Electronics Lab
Course Credits: L:T:P = 0:0:2	Teaching Hours/Week: 4 Hours/Week
Total Teaching Hours: 64	Formative Assessment Marks: 20
Examination Marks: 30	Exam Duration: 3 Hours

Course Objectives

The objectives of the Course are to enable the students to have hands on training and understanding of the following

- I-V characteristics of special devices like Principle of operation active devices like, BJT, FET, Op-Amp, UTJ, SCR, etc.,
- Understand different applications of op-amp
- Know about the working of sinusoidal and non-sinusoidal oscillators
- Working of Combinational and Sequential Digital circuits
- Understand the concept and working of ADC and DAC

PART- A

1. Study the JFET characteristics and obtain the frequency response and calculate band width of single stage JFET amplifier.
2. Study of inverting and non-inverting amplifier, adder, subtractor, and averaging amplifier using Op-amp
3. Study of differentiator and integrator using op-amp for different input waveforms.
4. Design and study Colpitt's and RC phase shift oscillator using op-amp.
5. Obtain the frequency response of first order low-pass and high-pass filters using op-amp.
6. Study of astable and monostabe multivibrators using IC 555 timer.

PART- B

1. Study of Half and Full Adder, half and full Subtractor using NAND gates.
2. Study of 4 - bit parallel binary adder and Subtractor using IC.

3. Study of Clocked RS, D and JK Flip-Flops using NAND gates.
4. Study of BCD to decimal decoder using IC, Encoders and priority encoders.
5. Study of Multiplexer and Demultiplexer using ICs.
6. Study of 4-bit asynchronous counter using JK Flip-Flop.
7. Study of 4-bit Shift Register – SISO, modification to ring counter using IC.
8. Study of Digital to Analog Converter using binary weighted resistor method

Curriculum of Open Electives Courses

Course Code: OE-ELEII-1	Course Tittle: Fundamentals of Semiconductor Devices
Course Credits: L:T:P = 3:0:0	Teaching Hours/Week: 3 Hours/Week
Total Teaching Hours: 48	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Note: ***This Courses is for candidates who have not opted Electronics as one of the Core Courses***.

Course Objectives

The objectives of the Course are to enable the student to understand

- Ability to gain the knowledge of Semiconductors devices.
- Ability to get the applications of semiconductor devices.
- Provide students with learning experiences that develop broad knowledge and understanding of semiconductor devices and its applications.

Course Contents

Unit – 1

Introduction to Semiconductors: Structure of a matter, conductors, insulators and semiconductors with examples to each, Energy band diagrams, intrinsic and extrinsic semiconductors. Definition of doping, dopant, donor, and acceptor, p-type and n-type semiconductors and their comparisons.

Diode: Construction, working, symbol, I-V characteristics and mention of application of pn-junction diode. Ideal verses practical diodes, mention of different types of diodes and their symbolic representations.

Zener Diode: Construction, working, symbol, I-V characteristics and mention of application of zener diode, Zener and avalanche breakdown.

LED: Construction, working, symbol, and mention of application of LED, seven segment display and its applications. **12 Hours**

Unit – 2

Rectifiers: Circuit diagrams, working and waveforms of half wave, full wave canter tap and bridge rectifiers. Mention of ripple factor and efficiency to each.

Filters: Definition of filter, circuit diagram and working of rectifiers with and without shunt capacitor filter. Mention of ripple factor with and without filter.

Voltage Regulator: Definition and applications, Circuit diagram and working of zener diode voltage regulator, load and line regulation. Block diagram of regulator power supply and its applications.

Wave-shaping Circuits: circuit diagram and working of positive, negative clippers and clampers. **12 Hours**

Unit - 3

BJT: Construction, working principle, symbol of NPN bipolar junction transistor, Mention of CE, CB, CC configurations, Definition of α, β and γ and their interrelations, Characteristics of a transistor in CE mode. Circuit diagram and working principle of transistor as a switch.

JFET: Construction, working principle, symbol of N channel FET, Difference between P and N channel FET, comparison of FET with BJT.

MOSFET: Construction, working and symbol of depletion type and enhancement type MOSFET. **12 Hours**

Unit - 4

Transistor Biasing: Need for biasing, DC load line, operating point. Circuit diagram and working of Voltage divider bias circuit.

Amplifier: Circuit diagram and working of single stage CE amplifier, frequency response, definition of gain, bandwidth, lower and higher cut-off frequency, application of amplifiers. Block diagram and working of Multistage amplifier and expression for gain.

Oscillator: Definition and concept of positive and negative feedback, Barkhausen's criterion for sustained oscillation, Circuit diagram and working of RC phase shift oscillator using transistor. **12 Hours**

Reference Books:

1. Robert Boylstead, "Introductory circuit analysis," 5th edition, PHI, 2010.
2. Robert Boylstead and Louis Nashelsky, "Electronic Devices and circuit theory," 9th Edition, PHI, 2013.
3. B. L. Theraja and A. K. Theraja, "ABC of Electrical Engineering," S Chand Publishers, New Delhi, 2014.
4. R.S. Sedha, "A Text book of Electronics," S Chand and Co., Multicolour, 3rd edition, 2012.

Course Code: OE-ELEII-2	Course Tittle: Renewable Energy and Energy Harvesting
Course Credits: L:T:P = 3:0:0	Teaching Hours/Week: 3 Hours/Week
Total Teaching Hours: 48	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Course Objectives

The objectives of the course are

- To enable the students to understand the importance of non-conventional energy systems
- Understand the method of energy harvesting using solar energy, wind energy, hydro energy, etc.
- Know the principle of operation of piezoelectric effect and its use in energy harvesting
- Get the knowledge on electromagnetic energy harvesting methods

Course Content

Unit-1

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. **12 Hours**

Unit-2

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. **12 Hours**

Unit-3

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

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. **12 Hours**

Unit-4

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.

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. **12 Hours**

Reference Books:

1. B.H. Khan, "Non-conventional energy sources," 2nd Edition, TMH, 2017.
2. Suhas P Sukhative, "Solar energy," 8th Edition, TMH, 2008.
3. Godfrey Boyle, "Renewable Energy, Power for a sustainable future," 3rd Edition, Oxford University Press, 2012.
4. D.P.Kothari, "Renewable Energy Sources and Emerging Technologies," 2nd Edition, PHI, 2011.
5. Jayakumar, P., "Solar Energy Resource Assessment Handbook," Renewable Energy Corporation Network for the Asia Pacific, 2009.
6. John R. Balfour, "Introduction to Photovoltaic System Design," 1st Edition, Jones and Bartlett Publishers, 2011.
7. http://en.wikipedia.org/wiki/Renewable_energy

Course Code: OE-ELEII-3	Course Tittle: PCB Design and Fabrication
Course Credits: L:T:P = 3:0:0	Teaching Hours/Week: 3 Hours/Week
Total Teaching Hours: 48	Formative Assessment Marks: 40
Examination Marks: 60	Exam Duration: 3 Hours

Course Outcomes

Upon the completion of this course, students will demonstrate the ability to:

- Understand basics of PCB designing.
- Apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
- Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
- Understand concepts of Packaging.

Course Content

Unit -1

Introduction to Printed circuit board: Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications. **12 Hours**

Unit -2

Introduction to Electronic design automation (EDA) tools for PCB designing: Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, creating report of design, creating manufacturing data (GERBER) for design. **12 Hours**

Unit -3

Introduction to printed circuit board production techniques: Photo printing, film- master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. **12 Hours**

Unit - 4

PCB design for EMI/EMC: Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards,

PCB Technology Trends: Multilayer PCBs. Multi wire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

12 Hours

Reference Books:

1. R.S Khandpur, "Printed Circuit Boards - Design, Fabrication, Assembly and Testing," 1st Edition, TMH, 2017.
2. Walter C. Bosshart, "Printed Circuit Boards- Design and Technology," McGraw Hill Education,1983.
3. Clyde F. Coombs, "Printed Circuits Handbook," 6th Edition, McGraw Hill Education, 2007.
4. Kraig Mitzner, "Complete PCB Design Using OrCAD Capture and PCB Editor," 2nd Edition, Academic Press, 2019.
5. Rao R. Tummala, "Introduction to System-on-Package (SOP): Miniaturization of the Entire System," McGraw Hill, 2008.
6. Mark I. Montrose, "EMC and the Printed Circuit Board-Design, Theory and Layout Made simple," 1st Edition, Wiley-IEEE Press, 1998.