M S RAMAIAH COLLEGE OF ARTS, SCIENCE AND COMMERCE

ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾಲಯ BENGALURU CITY UNIVERSITY
ಆಗು ನೀ ಅಪರಿಮಿತ
BE BOUNDLESS

Curriculum for B.Sc. Basic / Honours (ELECTRONICS)

(*According to NEP – 2020 Regulations*)

Subject: ELECTRONICS

(2021 – 22 *Onwards*)

CONTENTS

28	ELE-OE 3.4: Basics of Power Electronics, and e-Vehicles
29	ELE-OE 3.5: Microprocessors
30	ELE-OE 3.6: Robotics
31	ELE-OE 3.7: Medical Electronics
32	ELE-CT 4: Electronic Communication - I
33	ELE-CP 4: Electronic Communication - I Lab
34	ELE-OE 4.1: Application of Electronics-2
35	ELE-OE 4.2: Electronics For Everyone
36	ELE-OE 4.3: PCB DESIGN AND FABRICATION
37	ELE-OE 4.4: Mobile Communication
38	ELE-OE 4.5: Augumented and Virtual Reality
39	ELE-OE 4.6: Microcontrollers
40	ELE-OE 4.7: IOT and Applications

Preamble

This model curriculum content for B.Sc. (Basic/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. (Basic/Honours) Electronics is a program which needs to develop a specialized skill set among the stake holders to cater to the need of industries. The curriculum is designed to help students to analyse, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the stake holders. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the students with competencies like problem solving and analytical reasoning which provide them high professional competence. The University is expected to encourage its faculty concerned to make suitable pedagogical innovations, in addition to teaching learning processes suggested in the model curriculum, so that the Course/Programme learning outcomes can be achieved.

Significance of Electronics

Nowadays, 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 knowledgeable, 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 within Electronics subject comprise: Semiconductor devices and its application, 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, IoTs, etc,.

Eligibility criteria

Students who have passed PUC/ 10+2 / ITI / Diploma (Electronics / Electrical / Information Science / Medical Electronics/ Computer Science/ Telecommunications) or equivalent are eligible for opting Electronics in UG program.

Program Objectives

The overall Objectives of the B.Sc. (Basic / 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 acquired to solve specific problems in Electronics.
- Develop abilities in students to design and develop innovative solutions for the benefit of society.
- Provide students with skills that enable them to get employment in various organizations, industries, pursue higher studies, research assignments and turn as entrepreneurs.

Program outcomes

- 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 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, analyses and solve the problems in various subdisciplines of Electronics.

- Ability to use Modern Tools / Techniques.

Tentative Program Structure
(Major Discipline: ELECTRONICS) - Semesters 1 – 10

SEMESTER	Discipline Core (DSC)	Title of the Paper	Open Elective (OE)
1	DSC 1	Electronic Devices and Circuits	OE 1.1: Domestic Equipment Maintenance OE 1.2: Renewable Energy and Energy Harvesting OE 1.3: Basics of Power Electronics and E-Vehicles OE 1.4: PCB Design and Fabrication OE 1.5: Digital Fundamentals
2	DSC 2	Analog and Digital Electronics	OE 2.1: Consumer Electronics OE 2.2: Industrial Electronics OE 2.3: C Programming and interfacing with Arduino OE 2.4: Mobile communication OE 2.5: Mobile Application Programming OE 2.6: Digital Sysytems
3	DSC 3	Digital Design Using Verilog and Programming in C	OE 3.1: Robotics OE 3.2: Introduction to Nano Science & Nano ElectronicsOE 3.3: Medical Electronics OE 3.4: Solar Energy, Devices and Applications OE 3.5: IC Fabrication Techniques
4	DSC 4	Electronic Communications – I	OE 4.1:App Developments OE 4.2: MEMS and Sensors OE 4.3: IoT and Applications OE 4.4: Virtual Reality & Real Time Applications
			Discipline Specific Elective (DSE)
5	DSC 5 DSC 6	Microcontroller 8051 and PIC Electronic Communications - II	DSE 1: Computer Organization DSE 2: RFID Technology DSE 3: Photonics
6	DSC 7 DSC 8	Power Electronics, PLCs, Sensors, Transducers, andInstrumentation IOT and 5G communications	DSE 4: Cryptography DSE 5: Control Systems DSE 6: Project work (0+1+2)
7	DSC 9 DSC 10 DSC 11	Signals and Systems Embedded Systems Microwave Communications	DSE 7: Wireless communication DSE 8: Python Programming DSE 9: Mechatronics
8	DSC 12 DSC 13 DSC14	Digital Signal Processing VLSI Designing Image Processing	DSE 10: ARM Processor DSE 11: Computer Network DSE 12: AI, ML and Python Research Project

Proposed Curriculum Framework for Multidisciplinary Four - Year Undergraduate Programme/ Five-year Integrated Master's Degree Programme

YEAR	OBJECTIVES	NATURE OF COURSES	OUTCOME	NO. OF COURSES
1st year – **(1st & 2nd Semesters)**	Understanding the basic concepts	1. Major Core Courses 2. Minor/Related Discipline 3. Languages 4. Ability Enhancement Compulsory Courses 5. Skill Enhancement/Development Courses	 Understanding of Disciplines Language Competency Gaining perspective of context/Generic skills Basic skills sets to pursue any certificate level jobs	1+1 1+1 2+2 1+1 1+1
EXIT OPTION WITH CERTIFICATE				
2nd Year **(3rd & 4th Semesters)**	Focus and Immersion	1. Major Core Courses 2. Minor/ Related Discipline 3. Ability Enhancement 4. Skill based Vocational 5. Extra-curricular Activities	Understanding of disciplines Gaining perspective of context Skill sets to pursue vocation Development of various Domains of mind & Personality	2+2 1+1 1+1 1+1 1+1
EXIT OPTION WITH DIPLOMA				
3rd Year - **(5th & 6th Semesters)**	Real time Learning	1. Major Discipline Core and Elective Courses 2. Minor Discipline / Generic or Vocational Electives / Field based Learning/ Research Project	In depth learning of major and minor disciplines, Skill sets for employability. Exposure to discipline beyond the chosen Subject Experiential learning/Research.	2+2 1+1 1+1
EXIT OPTION WITH BACHELOR DEGREE				
4thYear - **(7th & 8th Semesters)**	Deeper Concentration	Major Discipline Core and Elective Courses Research / Project Work with Dissertation	Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies	4+4 4+4
EXIT OPTION WITH HONOURS DEGREE				
5th Year - **(9th & 10th Semesters)**	Master of the subject	Major Discipline Core and Elective courses/ Research/ Project Work with Dissertation	Deeper and Advanced Learning of the Major Discipline towards gaining proficiency over the subject	 4+4 /6+6
MASTERS DEGREE				

PROGRAM PATTERN AND SCHEME OF EXAMINATION FOR B.SC. (Basic /Honours) IN ELECTRONICS

Sl. No.	Semester	Title of the Paper	Teaching Hours	Hours / week		Examination Pattern Max. & Min. Marks /Paper						Duration of Exam (Hours)		Total Marks / paper	Credits	
				Theory	Practical	Theory			Practical			Theory	Practical		Theory	Practical
						Max.	Min.	IA	Max.	Min.	IA					
1	I	**ELE-CT1:** *Electronic Devices and Circuits*	56	4	4	60	21	40	25	09	25	3	4	150	4	2
		ELE-OE 1.1 / 1.2 / 1.3 / 1.4 / 1.5	45	3	-	60	21	40	-	-	-	3	-	100	3	-
2	II	**ELE-CT2:** *Analog and Digital Electronics*	56	4	4	60	21	40	25	09	25	3	4	150	4	2
		ELE-OE 2.1 / 2.2 / 2.3 / 2.4 / 2.5 / 2.6	45	3	-	60	21	40	-	-	-	3	-	100	3	-

Scheme of Internal Assessment Marks: **THEORY**

Sl. No.	Particulars	IA Marks
1	Attendance / Specified Activity in the syllabus	**05***
2	Internal Tests (Minimum of Two)	**15**
3	Assignments /Seminar / Case Study / Project work / Reports on - visits to industries/exhibitions/science centre's / active participation in Electronics competitions, etc.	**20**
	TOTAL Theory IA Marks	**40**

* Criteria for awarding the marks: 75-85% - 2 marks; 85-95% - 4 marks and > 95% - 5 marks

Scheme of Internal Assessment Marks: **PRACTICALS**

Sl. No.	Particulars	IA Marks
1	Practical Test	**05**
2	Report on datasheet of electronic devices / Seminar on electronics experiments, etc.	**10**
3	Active participation in practical classes	**10**
	TOTAL Practical IA Marks	**25**

Course Content: First Semester B Sc Electronics

Syllabus for Core Subjects   **Appendix   -2**

Course Title: Electronics	Course Credits: 4
Total Contact Hours: 56 Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks :60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research.
2. Acquire experimental skills, analysing the results and interpret data.
3. Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.
5. Capability to understand the working principles of the electronic devices and their applications.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	x					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to understand the working principles of the electronic devices and their applications.	x					

Course Content: First Semester B Sc Electronics

ELE - CT1: ELECTRONIC DEVICES AND CIRCUITS   56 Hrs

Content

UNIT – 1   14 Hrs

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: Review of KCL & KVL, 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 (centre tap and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter.

Numerical examples wherever applicable.

UNIT – 2   14 Hrs

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), I-V characteristics of a transistor in CE mode, Regions of operation (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 as switch - circuit and working.

Numerical examples wherever applicable.

UNIT – 3   14 Hrs

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 for CE.

Amplifier: Small signal analysis of single stage CE amplifier using r_e- model. Input and Output impedances, Current and Voltage gains. Advantages of CC amplifier. Types of coupling, two stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product, Darlington transistor, Current gain.

Special semiconductor devices: LED, LCD and solar cell – construction, operation and applications, 7-segment display, conceptof common anode and common cathode types

Numerical problems, wherever applicable.

UNIT – 4   14 Hrs

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), Self

complementing property of Excess-3 and 2421 codes, Gray code, error checking and correction codes (Only parity check). ASCII and EBCDIC codes.

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

Numerical examples wherever applicable.

Suggested References

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, 11th edn., Pearson, 2013
5. David A. Bell "Electronic Devices and Circuits", 5th edition, Oxford University 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 Edn., TMH, 2011.
8. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, PHI Learning Pvt. Ltd. 2009
9. Digital Circuits and Systems, K R Venugopal and K Shyla, Tata McGraw Hill, 2011
10. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer,PHI Learning, 2001
11. M. Nahvi & J. Edminister, "Electrical Circuits", Schaum's Outline Series, TMH, 2005
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, TMG, 1991

Course Content: First Semester B Sc Electronics

Course Title: ELE-CP1: ELECTRONIC DEVICES AND CIRCUITS – Lab	Course Credits: 2
Total Contact Hours: 56 Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 25 marks	Summative Assessment Marks: 25 marks

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

Course Content: First Semester B Sc Electronics

ELE-CP1: ELECTRONIC DEVICES AND CIRCUITS – Lab

(Hardware implementation and Analysis of Circuit using Simulation Software)

Content
1. Demonstration Experiments: Hands on Experimental Skills and 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
Part – A (Any Six)
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 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).
Part – B (Any Six experiments including compulsory experiment No 14)

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.

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Active participation	05
Assignment	10
Attendance	10
Total	**25**

Course Content: First Semester B Sc Electronics

Course Title: ELE-OE 1.1: **DOMESTIC EQUIPMENT MAINTENANCE**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative AssessmentMarks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 1.1: DOMESTIC EQUIPMENT MAINTENANCE　　　　**45 Hrs**

Content

UNIT – 1　　　　　　　　　　　　　　　　　　　　　　**15 Hrs**

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, 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.

UNIT – 2　　　　　　　　　　　　　　　　　　　　　　**15 Hrs**

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.

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.

Demonstration Experiments: 1. Working of Geyser. 2. Working of Microwave Oven. 3. Working of Induction Cooker.

UNIT – 3　　　　　　　　　　　　　　　　　　　　　　**15 Hrs**

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: 1. Working of Air Conditioner. 2. Working of Refrigerator.

Suggested References

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

Course Content: First Semester B Sc Electronics

Course Title: ELE-OE 1.2: **RENEWABLE ENERGY AND ENERGY HARVESTING**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

Pedagogy : ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 1.2: RENEWABLE ENERGY AND ENERGY HARVESTING   **45 Hrs**

Content

UNIT – 1   **15 Hrs**

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.

UNIT – 2   **15 Hrs**

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

Demonstration Experiments: 1. Demonstration of training modules on solar energy, wind energy etc.

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

Geothermal Energy: Geothermal Resources, Geothermal Technologies.

UNIT – 3   **15 Hrs**

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: 1. Conversion of vibration to voltage using piezoelectric voltages. 2. Conversion of thermal energy into voltage using thermoelectric module.

Suggested References

1. Non-conventional energy sources, B.H. Khan, McGraw Hill., 3rd Edition, 2017
2. Solar energy- Principles of Thermal collection and Storage. Suhas P Sukhatme, 15th Edition, TMH., 2006
3. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press. 3rd edition, 2012
4. Renewable Energy Sources and Emerging Technologies, Kothari D P, Singhal K C, Ranjan Rakesh, 2nd Edition, PHI Learning, New Delhi, 2011
5. Solar Energy: Resource Assessment Handbook, P. Jayakumar, e-book., 2009.

Course Content: First Semester B Sc Electronics

Course Title: ELE-OE 1.3: **BASICS OF POWER ELECTRONICS AND E-VEHICLES**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

1. Acquire the knowledge of generation and electricity distribution systems
2. Understand working of Electric Vehicles and recent trends
3. Analyse different power converter topology used for electric vehicle application
4. Develop the electric propulsion UNIT and its control for application of electric vehicles

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4		6
Acquire the knowledge of generation and electricity distribution systems	x					
Understand working of Electric Vehicles and recent trends	x					
Analyse different power converter topology used for electric vehicle application	x					
Develop the electric propulsion UNIT and its control for application of electric vehicles	x					

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 1.3: BASICS OF POWER ELECTRONICS AND E-VEHICLES   45 Hrs

Content

UNIT – 1   **20 Hrs**

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. Inverter, Uninterrupted Power supply (UPS) – online and off line UPS, SMPS.

Demonstration Experiments: SMPS: Block diagram and working of Inverter

UNIT – 2   **25 Hrs**

E-Vehicles: Electric and Hybrid Electric Vehicles Configuration of Electric Vehicles, Performance of Electric Energy storage for EV and HEV Energy storagerequirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Super Capacitors. Power Electronic Converter for Battery Charging, charging methods for battery, Termination methods, charging from grid.

Demonstration Experiments: 1. Types of motors and transformers used in household appliances. 2. SMPS: Block diagram and working Inverter.

Simulation and analysis of electrical systems using MATLAB.

Suggested References

1. Electrical Circuits, K.A. Smith and R.E. Alley, Cambridge University Press, 2012.
2. A Text Book in Electrical Technology - B L Theraja - S Chand & Co., 2005
3. Performance and design of AC machines - M G Say, CBS Publishers and Distributers Pvt Ltd., 3rdEdition, 2002, e-book edition 2017.
4. Basic Electrical Engineering - V K Mehta and Rohit Mehta, 6th Edition, S Chand and Company,2006
5. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:Fundamentals, Theory, and Design, 1st edition, CRC Press, 2004
6. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021
7. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid ElectricVehicles, Springer, 2013.
8. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001
9. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Wiley Publication, 2011.

Course Content: First Semester B Sc Electronics

Course Title: ELE-OE 1.4 **PCB DESIGN AND FABRICATION**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

1. Understand basics of PCB designing.
2. Apply advanced techniques, skills and modern tools for designing and fabrication of PCBs.
3. Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
4. Understand concepts of Packaging.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	x					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.	x					
Understand the theory and experimental skills in the design and fabrication of the PCB	x					

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 1.4 - PCB DESIGN AND FABRICATION   45 Hrs

Content

UNIT – 1   **15 Hrs**
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.

UNIT – 2   **15 Hrs**
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.
Introduction 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. Demonstration.

UNIT -3   **15 Hrs**

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.
Demonstration : Demonstration on the PCB designing and etching experiments.

Suggested References
1. Printed Circuit Board Design, Fabrication Assembly and Resting. R. S. Khandpur, TMH, 2006
2. Printed circuit Board Design and technology, Walter C. Bosshart, TMH, 1983
3. Printed Circuits Handbook. Clyde F. Coombs, Jr, Happy T. Holden, 6th Edn., TMH Education, 2016.
4. Complete PCB Design Using OrCAD Capture and PCB. Kraig Mitzner Bob Doe Alexander AkulinAnton Suponin Dirk Müller, 2nd Edition., 2019.
5. Introduction to System-on-Package – miniaturization of entire system, Rao R Tummala & Madhavan Swaminathan, TMH, 2008.
6. EMC and Printed Circuit Board Design - Theory and Layout, Mark I Montrose., IEEE Press., 2010

ELE-OE 1.5: Digital Fundamentals

Course Title: ELE-OE 1.5: Digital Fundamentals	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	X					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to develop mobile app.	X					

ELE-OE 1.5: Digital Fundamentals   **45 Hrs**

Unit 1   20Hrs

Number Systems: Introduction to number systems – positional and non-positional, Base /Radix. Decimal number system-Definition, digits, radix/base, Binary number system – Bit Byte, Conversions: Binary to Decimal and Decimal to Binary. Octal number systemConversion from Octal to Decimal to Octal, Octal to Binary and binary to Octal. Hexadecimal number system –Conversion : Decimal to Hex, Hex to decimal, Hex to Binary, Binary to Hex, Octal to Hex, Hex to Octal, Binary, arithmetic – addition, subtraction, multiplication and division (only Integer part- for binary and Hexdecimal). 1's and 2's compliment: 2's complement subtraction. Binary code: BCD numbers, 8421 code, 2421 code- examples and applications. Gray code –Conversions- Gray to binary and Binary to Gray, application of gray code (Mention only). Excess-3 code – self complimenting property and applications. Definition and nature of ASCII code. Introduction to error detection and correction code, parity check.

Unit 2   25 Hrs

Boolean algebra: Laws and theorems. AND, OR, NOT Laws, Commutative law, associative law, distributive law, Duality theorem. Demorgan's theorems-Statements, proof using truth tables; Simplification of Boolean expressions using Boolean laws. Logic Gates: AND Gate: Definition, symbol truth table, timing diagram, Pin diagram of IC 7408. OR Gate: Definition, symbol, truth table, timing diagram of IC 7432. NOT Gate: Definition symbol, truth table, timing diagram, Pin diagram of IC 7404. NAND Gate: Definition, symbol, truth table, Pin diagram of IC 7400, NOR Gate: Definition, symbol, truth table, timing diagram, Pin diagram of IC 7402. Exclusive OR Gate: Definition, symbol, truth table, timing diagram. Definition of product term, sum term, minterm, maxterm, SOP, standard POS and Standard POS. Conversion of Boolean expression to Standard SOP and Standard POS forms. Karnaugh maps-Definition of Karnaugh map, K- map for 2, 3 and 4 variables. Conversion of truth tables into k-map grouping of cells, redundant groups and don't care conditions Karnaugh map technique to solve 3 variable and 4 variable expressions. Simplification of 3 and 4 variable Boolean expression using K-maps (SOP only).

Text Books:
1) Thomas L.Floyd ,''Digital Fundamentals'', Peason Education Inc, New Delhi, 2003
Reference Books:
1) Morris Mano, "Digital Design", 5 Th Edition, Prentice Hall, 2013
2) R.P.Jain, "Modern Digital Electronics", 3rd Edition, Tata Mc Graw Hill, 2003.
3) Bignell and Donovan, "Digital Electronics", 5th Edition, Thomson Publication, 2007.

Pedagogy : ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

SECOND SEMESTER

Course Content: First Semester B Sc Electronics

Course Title: ELE - CT2: **ANALOG AND DIGITAL ELECTRONICS**	Course Credits: 4
Total Contact Hours: 56 Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

1. Understand and study the behaviour of the semiconductor devices ie., I-V characteristics of various MOSFET devices the knowledge can be extended for understanding the behaviour /characteristics/ response of unknown / novel devices.
2. Applying the standard device models to explain/calculate critical internal parameters of semiconductor devices.
3. Understanding and characterizing the behaviour of known/unknown/novel power electronic devices such as UJT, SCR, Diac, Triac etc.
4. Acquainting and familiarization of the experimental skills to determine the behaviour of semiconductor devices.
5. Capable of analyzing the device characteristics and responses.
6. Understanding the working of basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions and their applications.
7. Synthesizing and Analyzing combinatorial and sequential circuits and their applications in electronics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Understand and study the behaviour of the semiconductor devices ie., I-V characteristics of various MOSFET devices the knowledge can be extended for understanding the behaviour /characteristics/ response of unknown / novel devices.	x					
Applying the standard device models to explain/calculate critical internal parameters of semiconductor devices.	x					
Understanding and characterizing the behaviour of known/unknown/novel power electronic devices such as UJT, SCR, Diac, Triac etc.	x					
Acquainting and familiarization of the experimental skills to determine the behaviour of semiconductor devices.	x					
Capable of analyzing the device characteristics and responses.	x					
Understanding the working of basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions and their applications.	x					
Synthesizing and Analyzing combinatorial and sequential circuits and their applications in electronics	x					

ELE - CT2: ANALOG AND DIGITAL ELECTRONICS   **56 Hrs**

Content

UNIT – 1   **14 Hrs**

Varactor diode, Schottky diode, Tunnel diode - construction, characteristics, working, symbol, and applications for each.

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: 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   **14 Hrs**

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 Band passButterworth filters.

Oscillators: Barkhausen criterion for sustained oscillations, Colpitt's oscillator and crystal oscillators using transistor, Phase Shift oscillator, Wien-bridgeoscillator – (no derivation for each)
IC 555Timer: Introduction, Block diagram, Astable and Monostablemultivibrator circuits. (Numerical Examples wherever applicable).

UNIT – 3   **14 Hrs**

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: SOP and POS, Minterm, Maxterm, SSOP, SPOS, Simplification of Boolean expressions,K-Map for 3 and 4 variables. Half Adder, Full Adder, Half Subtractor, Full Subtractor. 4-bit parallel binary adder, 2-bit and 4-bit magnitude 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.
Digital to Analog Converter: DAC with binary weighted resistor and R-2R resistor ladder

network. Analog to Digital converter: Successive approximation method-performance characteristics.

UNIT – 4   **14 Hrs**

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

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

Suggested References:

1.   Robert L Boylestad, "Introductory circuit analysis", 5th edition., Universal Book 2003.
2.   Electronic Devices Conventional Current Version by Thomas L. Floyd, 10th edition, Pearson, 2018
3.   David A. Bell "Electronic Devices and Circuits", 5th Edition, Oxford Univesity Press, 2015
4.   OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., Prentice Hall., 2000
5.   Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, Oxford University Press. 2011,
6.   R S Sedha, "A Text book of Applied Electronics", 7th edn., S Chand and Company Ltd., 2011
7.   Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia, 1994
8.   Digital Principles and Applications, A.P. Malvino, D P Leach and Saha, 7th Edition, TMH, 2011.
9.   Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, PHI Learning Pvt. Ltd. 2009
10. Digital Circuits and Systems, K R Venugopal and K Shyla, Tata McGraw Hill, 2011
11. Digital Circuits and systems, Venugopal, Tata McGraw Hill. 2011
12. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, PHI Learning. 2001
13. Digital Principles, Schaum's Outline Series, R. L. Tokheim, TMH., 1994
14. Digital Electronics, S.K. Mandal, 1st Edition, McGraw Hill., 2010.

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

Course Content: Second Semester B Sc Electronics

Course Title: ELE-CP2: **ANALOG AND DIGITAL ELECTRONICS - Lab**	Course Credits: 2
Total Contact Hours: 56 Hrs	Duration of ESA: 4 Hrs
Formative Assessment Marks: 25 marks	Summative AssessmentMarks: 25 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

ELE-CP2: ANALOG AND DIGITAL ELECTRONICS – Lab

(Hardware and Circuit Simulation Software)

Content
Minimum Six Experiments to be performed in each Part
PART - A (Any SIX)
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 different input 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. Astable multivibrator using IC - 555 timer.   13. Monostable multivibrator using IC-555 timer.
PART – B (Any SIX)
1. Half Adder and Full Adder using (a) logic gates (b) using only NAND gates.   2. Half Subtractor and Full Subtractor (a) logic gates (b) using only NAND gates.   3. 4 bit parallel binary adder and Subtractor using IC7485.   4. Study of BCD to decimal decoder using IC7447   5. Study of the Encoders and priority encoders.   6. Study of Multiplexer and Demultiplexer using ICs.   7. Study of 2-bit and 4-bit magnitude comparators.   8. Study of Clocked RS, D and JK Flip-Flops using NAND gates.   9. Study of 4-bit asynchronous counter using JK Flip-Flop IC7476, modify to decadecounter and study their timing diagrams.   10. Study of 4-bit Shift Register – SISO, modification to ring counter using IC 7495.   11. Digital to Analog converter using binary weighted resistor method, determination of resolution, accuracy and linearity error.

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Active participation	10
Assignment	10
Attendance	05
Total	**25**

Course Content: Second Semester B Sc Electronics

Course Title: ELE-OE 2.1: **CONSUMER ELECTRONICS**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative AssessmentMarks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

ELE-OE 2.1: CONSUMER ELECTRONICS   45 Hrs

Content
UNIT – 1   12 Hrs
Audio Systems: PA system, Microphones, Amplifier, Loudspeakers, Radio Receivers, AM/FM, Audio Recording, and reproduction, Installation of Audio/Video systems – site preparation, electrical requirements, cables and connectors. Study of PA systems for various situations – Public gathering, Closed theatre / Auditorium,Conference room, Prepare bill of material (Costing)
UNIT – 2   10 Hrs
TV and Displays: set top box, CATV and Dish TV, LCD, Plasma, LED,OLED, QDLED and LED TV, Projectors: DLP, Home Theatres, Remote controls.
UNIT – 3   10 Hrs
Landline and Mobile Telephony: Mobile Phones, Smart Phone, Smart Watch, GPRS and Bluetooth, GPS Navigation system. Office Equipment: Scanners,Barcode / flat bed, printers, Xerox, Multifunction UNITs (Print, Scan, and copy)
UNIT – 4   13Hrs
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.   Market survey of products (at least one from each module).   Identification of block and tracing the system, Assembly and Disassembly of system using toolkit.

Suggested References:

1. Consumer Electronics, R.P.Bali, Pearson Education, 2008
2. R Audio and Video systems, G. Gupta, Tata McGraw Hill, 2004
3. 3D Flat Panel – Practical tool for self-assessment., TVs and Displays, Gerardus Blokdyk., edition, 2018
4. Basic TV Technology – Digital and Analog, Robert L Harwing., 4th Edition, Routhledge, 2012.
5. The TVs of Tomorrow: How RCA's Flat-Screen Dreams Led to the First LCDs (Synthesis), Benjamin Gross., Illustrated edition, University of Chicago Press; 2018
6. OLED Display – Fundamentals and Applications., Takatoshi Tsujimura., Willey, 2012

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

Course Content: Second Semester B Sc Electronics

Course Title: ELE-OE 2.2: **INDUSTRIAL ELECTRONICS**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

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

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 2.2: INDUSTRIAL ELECTRONICS   **45 Hrs**

Content
UNIT – 1   15 Hrs
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   15 Hrs
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:** Construction, working and applications of Lowpass, High pass, Band pass, Band reject and all pass filters. Phase-shift and Wein bridge oscillator using op-amp (Circuit diagram and formula only).
UNIT – 3   15 Hrs
Transducers: Transducers, types, working of transducers., Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge), Capacitive (diaphragm), Hall effect sensors, Magnetostrictive 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: 4bit 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).

Suggested References

1. Analog Electronics: Devices and Circuits., B. C. Sarkar and S. Sarkar, 1st Edition, Damodar Group publisher., 2016
2. Measurement Systems, Doeblin., 4th edition, TMH, New York, 1992.
3. Electrical Measurements & Electronic Measurements., A.K. Sawhney., Dhanpat Rai & Co. (P) Limited., 2015
4. Digital Electronics: Circuits and Systems, B. C. Sarkar and S. Sarkar, S U T Prakashani Burdwan, 2018
5. Instrumentation- Devices and Systems., Rangan, Sarma, and Mani, 2nd Edition., Tata-McGrawHill., 2008
6. Electronic Instrumentation., H.S Kalsi, 3rd Edition., McGraw Hill., 2017
7. Instrumentation measurements and analysis., Nakra & Choudhary., 3rd Edition., TMH., 2017
8. Op-Amps and Linear IC's, R. A. Gayakwad, 4th Edition., Pearson Education., 2000
9. Electronic Sensor Circuits and Projects, III Volume, Forrest M Mims, Master Publishing Inc., 2006.
10. Timer, Op Amp, and Optoelectronic Circuits & Projects, Forrest M Mims, 1st Edition., Master Publishing Inc., 2004.

Course Content: Second Semester B Sc Electronics

Course Title: ELE-OE 2.3: **C PROGRAMMING AND INTERFACING WITH ARDUINO**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research						
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.	**x**					
Capability to understand the programming techniques and computer skills	**x**					

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 2.3: C PROGRAMMING AND INTERFACING WITH ARDUINO   45 Hrs

Content
UNIT – 1   12 Hrs
Basics of C programming: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditionaloperators, bit wise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators. Arrays-concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays. Input output statement–sprintf(), scanf() & getch()) and library functions (math and string related functions).
UNIT – 2   13 Hrs
Decision making, branching & looping Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions, exampleprograms.   Structures and unions defining and declaring structure variables, accessing structure members, initializing a structure, copying and comparing structure variables, array of structures, arrays within structures, structures within structures, structures and functions. Unions-size of structures, bit fields, example programs.
UNIT – 3   20 Hrs
Introduction to Microcontrollers: Common features of Microcontroller, Different types of microcontroller, Introduction to Arduino, Pin configuration and architecture, Device and platform features, Concept of digital and Analog ports, Familiarizing with Arduino Interfacing Board. Introduction to Embedded C and Arduino platform, Arduino i/o Functions, Pins Configured as INPUT, Pull-up Resistors, Pins Configured as OUTPUT, pin Mode() Function, digital Write() Function, Analog Read() function , Arduino Interrupts, Arduino Time - Incorporating Arduino time. delay() function, delay Micro-seconds() function, Millis() function, Micros()   **Arduino Displays:** Working with Serial Monitor, Line graph via serial monitor, Interfacing a 8 bit LCD to Arduino, Fixed one line static message display, Runningmessage display, Using the LCD Library of Arduino.   **Arduino Sensors:** Arduino – Humidity Sensor, Arduino – Temperature Sensor, Arduino – Water Detector / Sensor**,** Arduino – PIR Sensor**,** Arduino – Ultrasonic Sensor**,** Arduino – Connecting Switch (Magnetic relay switches)

Suggested References
1. Programming in ANSI C, Balagurusamy, 2nd Edition, TMH, 1992
2. Exploring Arduino, Jeremy Blum, 2nd Edition., Wiley,2019
3. Beginning Arduino, Technology in Action, Michael McRobetrs, APress., 2nd Edition., 2013
4. Beginning Arduino Programming, Brian Evans, Technology in Action
5. Practical Arduino Engineering, Harold Timmis, Technology in Action, 2011.
6. Practical Arduino : Cool Projects for open source hardware, Jonathan Oxer, Hugh Blemings, Technology in Action., 1st edition, apress., 2009

Course Content: Second Semester B Sc Electronics

Course Title: ELE-OE 2.4: **MOBILE COMMUNICATION**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	x					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to understand the modern communication devices and technology.	x					

ELE-OE 2.4: MOBILE COMMUNICATION   **45 Hrs**

Content
UNIT – 1   10 Hrs
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   20Hrs
Frequencies for radio transmission- Basics of multiplexing and multiple access techniques- CDMA-Cellular system concepts- Frequency reuse- Channel assignment and handoff strategies- Improving capacity in cellular system: cell splitting, sectoring, repeaters for range extension, a microcell zone concept. Wireless LAN, Infrared vs radio transmission, Bluetooth: user scenarios and architecture. Basic concepts of 2G,3G, 4G/ LTE, 5G.
UNIT – 3   15 Hrs
Introduction to telecommunicating system- GSM: mobile services (Bearer services, tele-services, supplementary services), system architecture (radio subsystem, network and switching subsystem, operation sub system) Satellite system: history, application, basics, routing, localization and handover- Broadcast system: digital audio broadcasting, digital video broadcasting (basic concepts).

Suggested References;

1. Rapapport T. S, 'Wireless Communication Principles and Practices',3rd Edition., Pearson Education Asia, New Delhi 2003.
2. Mobile Communication, Jochen Schiller, 'Pearson Education, Asia. 2nd Edition, Pearson, 2008
3. Principles and Applications of GSM'Vijay K Garg, Joseph E Wilkes, 1st Edn, Pearson Edu.1999

Pedagogy: ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

Course Title: ELE-OE 2.5: **MOBILE App DEVELOPMENT**	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

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

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	X					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to develop mobile app.	X					

ELE-OE 2.5: MOBILE App DEVELOPMENT   **45 Hrs**

Content
UNIT – 1   15 Hrs
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 First AndroidApplication.
UNIT – 2   15 Hrs
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, Event call back methods, Handling Click Events, Touch screen Events, Keyboard Events,Context Menus, Controlling the Focus.
UNIT – 3   15 Hrs
Content Providers: An Overview of Android Content Providers, defininga 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 **.** **Compulsory activity:** *Development of mobile App*

Suggested References

1. Beginning Android 4, Onur Cinar, Apress Publication, 2012
2. Professional Android 4 Application Development, Reto Meier, 2nd Edition, Wrox Publisher, 2012
3. Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, 1st Edition, Apress, 2013
4. Beginning Windows 8 Application Development, IstvánNovák, ZoltanArvai, György Balássy and David Fulop, Wiley, 2012.
5. Professional Windows 8 Programming: Application Development with C# and XML, Allen Sanders and Kevin Ashley, John Wiley & Sons, 2012

Pedagogy : ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

ELE-OE 2.6: Digital Systems   **45 Hrs**

Course Title: ELE-OE 2.6: Digital Systems	Course Credits: 3
Total Contact Hours: 45 Hrs	Duration of ESA: 3 Hrs
Formative Assessment Marks: 40 marks	Summative Assessment Marks: 60 marks
Model Syllabus Authors:	BCU-BoS in Electronics

Course Outcomes (COs):

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

6. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research.
7. To acquire experimental skills, analysing the results and interpret data.
8. Ability to design / develop / manage / operation and maintenance of sophisticated electronicgadgets / systems / processes that conforms to a given specification within ethical and economic constraints.
9. Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.
10. Capability to develop mobile app

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6
Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries and research	X					
To acquire experimental skills, analysing the results and interpret data.						
Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.						
Capacity to identify and implementation of the formulate to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.						
Capability to develop mobile app.	X					

ELE-OE 2.6: Digital Systems   **45 Hrs**

Unit 1   **20Hrs**

Combinational logic circuits: Definition, applications. Half Adder: Symbol, Logic circuits using XOR and basic gates, Truth table, Full Adder: Symbol, Logic circuits using XOR and basic gates, Truth table, Half Subtractor: Symbol, Logic circuits using XOR and basic gates, Truth table. Full Subtractor: Symbol, Logic circuits using XOR and basic gates, Truth table. Adder – Subtractor; Logic circuit, Pin diagram IC 7483, IC 7486. Parallel Adder: 4 –bit parallel binary adder, BCD adder, IC 7483 NAND – NOR implementation of Adders.

Unit 2   **25Hrs**

Sequential Circuits: Importance of clock in digital circuit and introduction to flip flop. Flip –flop-difference between latch and flip-flop. Qualitative study of level and edge triggering. RS latch /unlocked, symbol and truth table. RS flip-flop using NAND gate, symbol, truth table and timing diagram. D flip –flop – Symbol, truth table, Realization of JK flip –flop using NAND gates, working, and timing diagram. Race around condition, present and clear inputs, pin diagram of IC 74112. T flip flop-Logic symbol, JK flip flop as a T flip –flop truth table and timing diagram. Master slave flip flop; Logic circuit, truth table and timing diagram, advantage of M/S flip-flop, pin diagram of IC 7473 IC 7476. Registers: Definition, types of registers-Serial in serial out, serial in parallel out, Parallel in serial out, Parallel in parallel our shift register (Block diagram representation for each), truth table, timing diagram and speed comparison.

Text Books:
1) Thomas L.Floyd ,''Digital Fundamentals", Peason Education Inc, New Delhi, 2003
Reference Books:
1) Morris Mano, "Digital Design", 5 Th Edition, Prentice Hall, 2013
2) R.P.Jain, "Modern Digital Electronics", 3rd Edition, Tata Mc Graw Hill, 2003.
3) Bignell and Donovan, "Digital Electronics", 5th Edition, Thomson Publication,2007.

Pedagogy : ICT lecture method, group discussion, seminar etc.

Formative Assessment	
Assessment Occasion	**Weightage in Marks**
Internal test	15
Assignment	15
Attendance	10
Total	**40**

THIRD SEMESTER

ELE-CT3: PROGRAMMING IN C AND DIGITAL DESIGN USING VERILOG

(Credits: Theory – 04, Practical – 02) Total Teaching: 56 hours

Course Objectives: After the successful completion of the course, the student will be able to:
- Gain the knowledge of programming the system using C programming language.
- The ability to code and simulate any digital function in Verilog HDL.
- Know the difference between synthesizable and non-synthesizable code.
- Understand library modeling, behavioural code and the differences between simulator algorithms andlogic verification using Verilog simulation.
- Learn good coding techniques required for current industrial practices.

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Write and execute and debug C codes for solving problems.
CO2. Apply the acquired knowledge of digital circuits in different levels of modeling using Verilog HDL.
CO3. Apply the acquired knowledge of digital circuits in different levels of modeling using Verilog HDL.
CO4. Design and verify the functionality of digital circuit/system using test benches.
CO5. Develop the programs more effectively using directives, Verilog tasks and constructs.
CO6. Design and analyse algorithms for solving simple problems.

UNIT 1   14 hours
Introduction to C Programming

C Programming: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bitwise operators, expressions and evaluation of expressions, type cast operator, implicit conversions, precedence of operators.
Input output statement – sprintf(), scanf() and getch(), and math library functions.
Decision making, branching, and looping: if, if-else, else-if, switch statement, break, for loop, while loopanddo loop. string related library functions.

UNIT 2   14 hours
Arrays: Basics of arrays, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays.
Functions: Defining functions, function arguments and passing, returning values from functions, exampleprograms.
Pointers: Pointer declaration, assigning values to pointers, pointer arithmetic, array names used as pointers, pointers used as arrays, pointers and text strings, pointers as function parameters.
Structures: Structure type declarations, structure declarations, referencing structure members, referencingwhole structures, initialization of structures, structure bit fields

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Unit 3   16 hours

Introduction to Verilog

A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog Introduction toSimulation and Synthesis Tools, Test Benches.

Language Elements- Keywords, Identifiers, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters.

Verilog: Module, Delays, brief description - data flow style, behavioral style, structural style, mixed design style, simulating design.

Expressions: Operands, Operators, types of Expressions

Gate level modeling - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits).

Unit 4   12 hours

Data flow Modeling and Behavioral Modeling

Data flow Modeling: Continuous assignment, net declaration assignments, delays, net delays and examples. Behavioral Modeling: Procedural constructs, timing controls, block statement, procedural assignments, conditional statement, loop statement, procedural continuous assignment, Illustrative Examples

Suggested Learning ResourcesTEXT BOOKS:

1) E. Balaguru swamy, ‒Computing fundamentals and C programming‖, 4th,Edition, TMH,2008.
2) E. Balaguru swamy, ‒Programming in ANSI C‖, 2nd Edition.TMH, 2010.
3) Samir Palnitkar, ‒Verilog HDL: A guide to digital design and synthesis‖, Pearson, 2nd edition,2006.
4) J Bhasker, ‒A Verilog HDL Primer‖, 3rd Edition, BS Publications,2008.
5) Nazesh M Botros, ‒HDL programming VHDL and Verilog‖. Dream tech press, 2009 reprint.

REFERENCE BOOKS:

1) Yashavant Kanetkar, ‒Let us C‖, 18th edition, BPB Publications, 2021.
2) T Jayapoovan, ‒A first course in Programming with C‖ Vikas Publishing Pvt Ltd,2004
3) Michael D Ciletti, ―Advanced Digital Design with the Verilog HDL‖, person , 2nd edition.
4) Padmanabhan, Tripura Sundari, ‒Design through Verilog HDL.‖ Wieley, 2016.
5) Cyril P.R., ‒Fundamentals of HDL‖, Pearson/sanguine 2010.
6) Donald E. Thomas, Philip R. Moor by, ‒The Verilog Hardware description language‖, Springer Science, 5th edition.

ELE DSC-P3: PROGRAMMING IN C & DIGITAL DESIGN USING VERILOG - LAB

Section – A: C – Programming: (Minimum "FIVE" programs to be executed)

1) Programme to generate Fibonacci series upto n elements.
3) Programme to read three numbers and find the biggest (using nested-if).
4) Programme to calculate factorial of a given number.
5) Programme to read percentage of marks and to display appropriate message.
6) Programme to arrange the numbers in ascending order.
7) Programme to generate n-prime numbers.
8) Programme to find roots of quadratic equation (Demonstration of switch case statement).
9) Programme to find the sum & difference of two matrices of order MxN and PxQ.
10) Programme to find the product of two matrices of order MxN and PxQ.
11) Programme to find the sum of principle and secondary diagonal elements of the given MxN
12) Programme to find the transpose of given MxN matrix.

Section B: Digital Design Using Verilog with FPGA kit (Minimum Five programmes is to be written and executed)

1) Realisation of gates using Verilog code.
2) Realize Adder/Subtractor (Full/Half) circuits using Verilog data flow description.
3) Realize the following code converters using Verilog behavioral description.
a) Gray to Binary and Vice – Versa.
b) Binary to excess 3 and vice-versa.
4) To realize 4-bit ALU using Verilog programme.
5) To realize using Verilog behavioral description : 8:1 multiplexer, 8:3 encoder.
6) To realize using Verilog behavioral description: 1:8 Demultiplexer, 3:8 decoder.
7) To realize using Verilog behavioral description flip flops:
(a) D-type (b) JK - type (c) T-type.
8) To realize counters: Up/down (BCD & Binary) using Verilog behavioral description.

Note: It is suggested to carry out **One mini project** for awarding practical IA marks

ELE-OE 3.1: Renewable Energy and Energy Harvesting

Credits: 03   **Total Teaching: 45 hours**

Unit-1   25 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 inwind turbines, Power electronic interfaces, and grid interconnection topologies.

Demonstration Experiments: 1. Demonstration of training modules on solar energy, wind energy etc.

Unit – 2   20 Hours

*Ocean Energy***:** Ocean Energy Potential against Wind and Solar, Wave Characteristics, and Statistics, WaveEnergy 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 EnergyHarvesting*: Linear generators, physics mathematical models, recent applications,; Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

Demonstration Experiments: 1. Conversion of vibration to voltage using piezoelectric voltages. 2.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.
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

ELE OE 3.2: Fundamentals of Electronics.

Credits: 03   **Total Teaching: 45 hours**

Unit–1:   **15 Hrs**

Passive Components: Overview of passive components-Fabrication, Types, colour coding, andapplications.

Transformer: Principle, construction and working, turn ratio, Types of transformers (Step up andStep down).

Semiconductors: Intrinsic and extrinsic semiconductors.

Diodes: P-N Junction theory, V-I Characteristics, Rectifiers, Clippers, and Clampers (Qualitativeanalysis only).

Special diodes: Zener diode, LED and LDR; Construction, working and applications.

Unit -2:   **15 Hrs**

Bipolar Junction Transistor (BJT): Physical structures, modes of operations, characteristics. Transistor as an amplifier, RC- Coupled amplifier, Darlington pairs, Transistor as a switch. Field Effect Transistor (FET): Physical structures and modes of operations, Characteristics.

Electronic Instruments: Ammeter, Voltmeter- design and construction, analog millimeter, Digitalmillimeter, function generator (Qualitative analysis only). Cathode Ray Tube (CRT), Cathode Ray Oscilloscope (CRO)- Block diagram.

Digital fundamentals: Binary numbers, signed binary numbers, binary to decimal and Decimal toBinary conversion, Binary additions, and Subtractions,

Logic gates: AND, OR and NOT gates.

Unit -3:   **15 Hrs**

Component and Device Applications: To design and Construct at least Ten of the following circuits.

1. V –I characteristics of semiconductor diode.
2. V –I characteristics of Zener diode. Determination of breakdown voltage.
3. V –I characteristics of LED. Determination of Cut-in voltage.
4. Characteristics of LDR.
5. Half wave rectifier; with and without filter. Determination of ripple factor.
6. Full wave rectifier (Centre tap/ Bridge); With and without filter, determination of ripplefactor.
7. Zener diode voltage regulator; determination of line and load regulation.
8. Clipping circuits; Positive clipper, Negative Clipper, Biased positive and negative clippers.Trace the input and output waveforms.
9. Clamper circuits: Positive clamper, Negative Clamper. Trace the input and outputwaveforms.
10. Input and output characteristics of a transistor in Common Emitter configuration, determineof current gain β.
11. Input and output characteristics of a transistor in common base configuration, determine thecurrent gain α.
12. Transistor as a switch.
13. Construct RC coupled amplifier. Plot the frequency response curve and determine thebandwidth.
14. V-I Characteristics of Common Source (CS) configuration of FET. Determine the current

gain.

15. Construct an ammeter to read (0-1ma) of current.
16. Construct a voltmeter to read (0-1volt).
17. Measure Vp, Vpp and Time period of Sine and Square waves using CRO.
18. Construct OR, AND and NOT gates using diodes and transistors. Verify the truth tables.
19. Verify the truth tables OR, AND and NOT gates using Integrated Chips (ICs).
20. Construct four-bit binary adder.

References

‒A Textbook of Electronics‖ R. S. Sedha; S Chand and Co, 3rd edition.
‒Principles of Electronics‖, V K Mehta and Rohit Mehta, S Chand and Co
‒Basic Electronics‖, B L Theraja, S Chand and Co, 3rd edition 2012
‒Electronic Devices‖, Devid Bell, Reston Publishing Company.
‒Electronic Devices and Circuit Theory‖, Pearson edition.
‒Digital Principles and Applications‖, Malvino and Leach
‒Electronics text lab manual‖, Paul B Zabar

ELE OE 3.3: Application of Electronics-1

Credits: 03   **Total Teaching : 45 hours**

Unit–1: Basic Electronics   **12 Hrs**

Introduction to circuit components- Resistors, capacitors, inductor, transformer, diode and transistor.Symbols, pimples.
LED and LCD display, relay, fuse, switches, wires. AC and DC applications.

Unit -2: Applied Electronics   **13 Hrs**

Electronic instruments: DMM, CRO, Biomedical instruments-ECG, EEG, EMG, pH meter, X-ray, sphygmomanometer, Glucometer, Digital thermometer. Sensor-OMR, MICR, Scanner, Barcode reader.

Unit -3: Power Supplies   **10 Hrs**

Dc power supply, Rectifiers-principle, Types
Inverter and UPS. Adopter and SMPS. Inverter and UPS. Mobile chargers.

Unit -4: Electronic calculators   **10 Hrs**

Types, Functions of Basic calculators-block diagram, Keypad using, use of calculator.

References

Basic Electronics-Solid State – B L Theraja - S Chand And Company Ltd

Electronic Devices And Circuit Theory – Robert L Boylestad And Louis Nashelsky (PHI)

<h1 style="text-align:center">ELE-OE 3.4: Basics of Power Electronics, and e-Vehicles</h1>

Credits: 03   **Total Teaching: 45 hours**

Unit-1   25 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. Inverter, Uninterrupted Power supply (UPS) – online and off line UPS, SMPS.

Demonstration Experiments: 1. Un boxing 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. Up gradation of RAM, hard disk and SSD. 5. SMPS: Block diagram and working Inverter

Unit – 2   20 Hours

Electric and Hybrid Electric Vehicles Configuration of Electric Vehicles, Performance of Electric Energy storage for EV and HEV Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Super Capacitors. Power Electronic Converter for Battery Charging, Charging methods for battery, Termination methods, charging from grid.

Demonstration Experiments: Demonstration Experiments: 1. Types of motors and transformers used in household appliances. 2. SMPS: Block diagram and working Inverter. 3.Simulation and analysis of electricalsystems using matlab.

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. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles:Fundamentals, Theory, and Design, CRC Press, 2005
7. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
8. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid ElectricVehicles, Springer, 2013.
9. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001
10.   Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles AndApplications With Practical Perspectives, Wiley Publication, 2011.

ELE OE 3.5: Microprocessors

Credits: 03   **Total Teaching : 45 hours**

UNIT 1   15 hrs
Introduction to Microprocessor
Introduction, applications, basic block diagram, speed, word size, memory capacity, classification ofmicroprocessors (mention different microprocessors being used)
Microprocessor 8085: Features, architecture -block diagram, internal registers, register pairs, flags, stack pointer, program counter, types of buses. Multiplexed address and data bus, generation of control signals, pindescription of microprocessor 8085.
8085 Instructions-Operation code, Operand & Mnemonics.
Instruction set of 8085, instruction classification, addressing modes, instruction format.
Data transfer instructions, arithmetic instructions, increment & decrement instructions, logical instructions,branch instructions and machine control instructions.

UNIT 2   15 hrs
Stack operations and Microprocessor Programming
Stack operations, subroutine calls and return operations. Delay loops, use of counters, timing diagrams- instruction cycle, machine cycle, T- states, time delay-numerical examples.
Programs for data transfer and memory operations (direct & indirect addressing), addition and subtraction of two 8-bit & 16- bit numbers, multiplication, display of smallest / largest number in a given array of numbers, sorting of numbers in descending / ascending order. Number of 1's and 0's in a given byte, testing for zero condition. 1's and 2's complements. Verification of truth tables of logic gates, program to add two N byte numbers, program to generate Fibonacci series up to the limit, program to find the factorial of a number, program to find the GCD of two integer numbers.

UNIT 3   15 hrs
I/O instructions and Interfacing
I/O instructions and, interrupts in 8085. Basic interfacing concepts, compatible ICs of □P 8085, data transfer, synchronous I/O data transfer using interrupts.
Memory interfacing – address decoding, interfacing RAM and ROM.
Interfacings I/O devices– input port, output port, IN & OUT instructions, interfacing input devices (interfacing matrix key board-block diagram), interfacing output devices (LED display interfacing-block diagram).
PPI IC 8255– features, pin diagram, functional block diagram, ports & their modes.

Text Books
1. Microprocessor Architecture, Programming and Applications with 8085
Ramesh S.Gaonkar - Wiley Eastern Limited- IV Edition.
2. Fundamentals of Microprocessor & Microcomputer: B. Ram—Danpat Rai Publications.

Reference Books
1. Microprocessor and Interfacing- Programming & Hardware, Douglas hall, 2e TMH, 1991
2. Modern Digital Electronics, R.P. Jain–Tata Mc- GRAW hill–2nd Edition.
3. Microprocessor and its Applications- R.Theagarajan, S. Dhanasekaran and S. Dhanapal-NewAge International Publishers.
4. Microprocessors and Microcontrollers-B.P singh, Galgotia publications.
5. The intel Microprocessors 8086/8088,80186,386,486, architecture, Programming and interfacing –Barry. B. Bray, PHI, New Delhi.
6. Microprocessor Lab Manual- G.T Swamy- Lakshmi Publications 2006.

ELE OE 3.6: Robotics.

Credits: 03   **Total Teaching : 45 hours**

Unit–1:   15 Hrs
Definitions of Robots, Robotics, Motivation, A Brief History of Robotics, A Robot System, Interdisciplinary Areas in Robots, Classification of Robots, Introduction to embedded system, Understanding Embedded System, Overview of basic electronics and digital electronics. Microcontroller vs. Microprocessor, Common features of Microcontroller. Comparison between the two Different types of microcontrollers. Sensors, Classification of sensors (contact & non-contact), characteristics of sensors, Touch sensor, Position sensor, optical sensor, IR, PIR, Ultrasonic, temperature, displacement sensor.

Unit -2:   15 Hrs
Getting Started with Programming platform of Robots: Installation of IDE, Pin configuration and architecture of Microcontroller (Atmel series/arduino), Device and platform features. Concept of digital and analog ports. Familiarizing with Interfacing Board, Introduction to Embedded C platform, Review of Basic Concepts, Arduino data types, Variables and constants, Operators, Control Statements, Arrays Functions, I/o Functions, Pins Configured as INPUT, Pins Configured as OUTPUT, Incorporating time delay() function, delay Microseconds() function ,millis() function , micros() function

Unit -3:   15 Hrs
Programming different types of Robots:
1. Temperature & Humidity controlled Robot (Fan Regulation, thermostat)
2. Infra-Red signal Controlled Robot (Measuring the speed of the vehicle)
3. Ultra-sonic signal operated Robot (automatic Tap system/Hand Drier/Floor drier)
4. Obstacle Follower & avoider Robot

References
- Fundamentals of Robotics by D K Pratihar
- Robotics Simplified: An Illustrative Guide to Learn Fundamentals of Robotics,by Dr. Jisu Elsa Jacob ,
- Manjunath N
- Introduction to Robotics | Fourth Edition by John Craig
- Arduino Robotics by John-David Warren (Author), Josh Adamsduino
- Programming in 24 Hours by Richard Blum
- Getting Started with Arduino: The Open Source Electronics Prototyping Platform Book by Massimo
- Banzi and Michael Shiloh

ELE OE 3.7: Medical Electronics.

Credits: 03   **Total Teaching : 45 hours**

Unit–1:   10Hrs

Fundamental Electronics: Amplifiers, Frequency response, signal generation.
Differenttypes of transducers & their selection for biomedical applications.
Electrode theory, selection criteria of electrodes & different types of electrodes
Bio electric amplifiers

Unit -2:
                                                                                 12 Hrs

Introduction to Bio-medical instruments: Origin of bio-electric signals, active &
passivetransducer for medical application –Electrocardiography-waveform-standard
lead systems,typical ECG amplifier, EEG electrode, recording systems, EMG basic
principle-block diagram of a recorder.

Unit -3:
                                                                                 10 Hrs

Medical Imaging: Nature and production od X-rays, Improving X-ray
images, Computerised axial tomography, Using ultrasound in medicine,
Ultrasound scanning,Magnetic resonance imaging PET and SPECT Imaging

Unit -4:   13Hrs
Biomedical Signal Processing: Fundamentals of signal processing, digital image,
transforming image, image enhancement, image Segmentation, image compression,
imagerestoration and reconstruction of medical images.
Demonstration using MATLAB

References
- L Cromwell, F J Weibell, Eapfeiffer, Biomedical Instrumentation and measurements,
  PHIPublications.

Fourth Semester Syllabus

Credits: Theory - 04   Practical – 02   **Total Teaching : 56 hours**

Course Objectives:
➢ To understand the communication system, Principle and working communicationsystem, means and medium of communication.
➢ To understand the Principle and working of different modulation techniques.
➢ Will be able to differentiate between analog and digital communication.
➢ To understand the Principle and working of Satellite and optical fiber communication.

Course Outcomes (COs): After the successful completion of the course, the studentwill be able to:

CO1. Know the basic concept of Analog Communication, means and medium of communication.
CO2. Understand the principle of Analog and digital modulation.
CO3. Familiar with AM‖ and ‒FM ‒techniques.
CO4. Understand the basic concept of Pulse Modulation, Carrier Modulation for digitaltransmission andable to construct simple pulse modulation.
CO5. Understand the basic concept of Satellite Communication
CO6. Understand the basic concept of Optical Fibre Communication

UNIT 1   14 hours
Noise, T-lines and Antennas
Noise-Introduction, internal and external noises, signal to noise ratio and noise figure, numerical examples. *Transmission lines* - types and equivalent circuit of T-lines, primary and secondary constants. reflection co-efficient, VSWR and CSWR-numerical examples, losses and distortions in T-lines. Wave propagation -groundwave, sky-wave and space wave propagations, ionosphere and its effects.
Antennas: Radiation mechanism, wire radiators in space-resonant antennas-radiation pattern and current distribution for different lengths, non - resonant antenna. Antenna parameters-gain, directive gain, power gain, bandwidth, beam width, polarisation, efficiency, radiation resistance, total effective resistance, Expression for the power radiated by antenna and radiation resistance. Ungrounded and grounded antenna. Qualitative study of –folded dipole, micro strip, dish, helical, horn, and loop antennas, numerical examples wherever applicable.

UNIT 2   16 hours
Block diagram of electronic communication system. Modulation, need and types of modulation (AM, FM & PM).
Amplitude modulation – representation, modulation index, Derivation for instantaneous voltage, frequencyspectrum, power relations. Limitations of AM.

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*Frequency M*odulation- definition, modulation index, frequency spectrum, bandwidth requirements, frequency deviation and carrier swing. Block diagram of AM and FM transmitter. Comparison of AM and FM,numerical examples wherever applicable.

Introduction to pulse communication: types- PAM, PWM, PPM, PCM – quantization, advantages and applications.

Satellite Communication - Introduction, need, geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.

UNIT 3   12 hours
Radar communication systems
Introduction to Microwaves, frequency bands and applications.

RADAR Systems: RADAR– principles, maximum unambiguous range, detailed block diagram of pulsed RADAR system, RADAR range equation-derivation, factors influencing maximum range, Doppler effect, MTI RADAR-block diagram, CW RADAR-block diagram, advantages, applications and limitations, FM CW RADAR-block diagram, numerical examples wherever applicable.

UNIT 4   14 hours
Optical Fiber Communication
Introduction – need for OFC. Block diagram of OFC system. Fiber optic cables, light propagation through fiber – step index fiber, graded index fiber, Snell's law, numerical aperture (derivation). Types of optical fiber cables, light sources – requirements, LEDs and semiconductor laser diodes. Photo detectors – PN, PIN and avalanche photodiodes. Losses in optical fibers – Rayleigh scattering, absorption, leaky modes, bending, joint junction losses. Advantages and disadvantages of OFC over metallic cables, numerical examples wherever applicable.

Text Books:
1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. Electronic Communication systems, Kennedy & Davis, IVth edition-TATA McGraw Hill.
4. Introduction to RADAR systems – Skolnik- McGraw Hill.
5. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition-Pearson education

References
1. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
2. Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
3. Modern Digital and Analog Communication Systems, B.P. Lathi, 4th Edition, 2011, OxfordUniversity Press.
4. K.D Prasad, ‒Antenna and Wave Propagation‖, Satyaprakashan, New Delhi.
5. Sanjeev Gupta, ‒Electronic Communication Systems‖, Khanna Publishers, New Delhi.
6. Electronic Communication systems, G. Kennedy, 3rd Edn., 1999, Tata McGraw Hill.
7. Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill

8. Communication Systems, S. Haykin, 2006, Wiley India Electronic Communication system, Blake,Cengage, 5th edition.

9. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

10. Gerd Keiser, ‒Optical Fibre Communication ‒, McGraw Hill, 3rd Edn.

Semester IV - Practical IV

ELE-DSC4P: Electronic Communication-I Lab

1. Amplitude modulator and Demodulator
2. FM modulator using IC8038
3. Pre –emphasis and De- emphasis
4. Three way Audio cross over network.
5. IF amplifier
6. Automatic Gain Control
7. Frequency mixer
8. Frequency Multiplier
9. PWM and PPM
10. PAM modulator
11. Band Elimination Filter
12. Characteristics of OFC
13. VCO using IC 566
14. Time Division Multiplexing and de multiplexing
15. Study of Sensitivity, Selectivity and Fidelity of an AM radio receiver

Note:
1. Minimum of 7 experiments to be performed. Simulation is to be carriedout for any twoexperiments.
2. One mini project is to be carried out for awarding practical IA marks

Credits : 03   **Total Teaching : 45 hours**

Unit–1: Introduction to Advanced Communication   12 Hrs

Radio, TV- principles, block diagram & applications OFC applications and advantages,Embedded system – Smart card, SIM card, Mobiles- Bock diagram &applications

Unit -2: Advance Electronics   12 Hrs

CCTV camera, ATM- principles, block diagram & applicationsElectronic voting Machine (EVM)- CU,BU,VVPAT.,

Unit -3: Application of Satellite   11 Hrs

Types, EDUSAT, TV & Internet-modem, Wi-Fi.

Unit -4: E-waste management   10 Hrs

E-waste management-identification, segregation, disposal

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References

- Basic Electronics-Solid State – B L Theraja - S Chand And Company Ltd

ELE-OE 4.2: Electronics For Everyone

Credits: 03   **Total Teaching: 45 hours**

Unit-1   25 Hours

Functional block diagram of 555 timer, Monostable operation and its Application, Astable operation and itsApplications.

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-2   20 Hours

Demonstration of 555 timer and op-Amp by performing any seven of the following experiments either usingsimulation or circuit realisation

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

Suggested Books:

1. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), DamodarGroup (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. Instrumentation- Devices and Systems ByRangan, Sarma, and Mani, Tata-McGrawHill
5. Electronic Instrumentation by H.S Kalsi, McGraw Hill
6. Instrumentation measurements and analysis by Nakra&Choudhary
7. Measurement & Instrumentation- DVS Murthy
8. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
9. Electronic Sensor Circuits and Projects, III Volume, Forrest M Mims, Master Publishing Inc.
10.   Timer, Op Amp, and Optoelectronic Circuits & Projects, Forrest M Mims, Master Publishing Inc.

ELE-OE 4.3: PCB DESIGN AND FABRICATION

Total Credits: 3   **Total teaching: 45 hours**

Unit I: 10 Hours

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 fastpulse applications, Power electronic applications, Microwave applications.

Unit II: 15 Hours

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.

Unit III: 20 Hours

Introduction 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. Demonstration **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, Reflowsoldering, Introduction to High-Density Interconnection (HDI) Technology.

Text Books:

1. Printed circuit board design ,fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill2006

Reference Books:

1. Printed circuit Board Design and technology, Walter C. Bosshart
2. Printed Circuits Handbook, Sixth Edition,by Clyde F. Coombs, Jr, Happy T. Holden, Publisher:McGraw-Hill Education Year: 2016
3. Complete PCB Design Using OrCAD Capture and   PCB   Editor, Kraig Mitzner Bob Doe AlexanderAkulin Anton Suponin Dirk Müller, 2nd Edition 2009.
4. Introduction to System-on-Package, Rao R Tummala & Madhavan Swaminathan, McGraw Hill, 2008.
5. EMC and Printed circuit board **,**Design theory and layout**,** Mark I Montrose IEEE compatibility society.
6.   Flexible Printed circuit board Design and manufacturing ,By Robert torzwell
7.   Web-based Current literature.

ELE-OE 4.4: Mobile Communication
Credits: 03   **Total Teaching: 45 hours**

Unit 1   09 Hours
Evolution of mobile radio communication-Examples of wireless communication system: paging systems, cordless telephone system, cellular telephone system- Trends in cellular radio and personal communicationsystems

Unit 2   09 Hours
Frequencies for radio transmission- Basics of multiplexing and multiple access techniques-CDMA-Cellular system concepts- Frequency reuse- Channel assignment and handoff strategies-Improving capacity in cellular system: cell splitting, sectoring, repeaters for range extension, a microcell zone concept.

Unit 3   09 Hours
Introduction to telecommunicating system- GSM: mobile services (Bearer services, tele-services, supplementary services), system architecture (radio subsystem, network and switching subsystem, operationsub system)

Unit 4   09 Hours
Satellite system: history, application, basics, routing, localization and handover- Broadcast system: digitalaudio broadcasting, digital video broadcasting (basic concepts).

Unit 5   09 Hours
Wireless LAN-Infrared vs radio transmission- Bluetooth: user scenarios and architecture- LTE-3G, 4G, 5G-Wi-Fi - basic concepts.

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
1.   Vijay K Garg, Joseph E Wilkes,' Principles and Applications of GSM', Pearson Edu.

ELE OE 4.5: Augmented and Virtual Reality

Credits :03   Total Teaching : 45 hours

Unit–1: Introduction to Virtual Reality   10 Hrs

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output-Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Unit -2: Augmented Reality   10 Hrs

AR: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.

Unit -3: The Geometry of Virtual Worlds &The Physiology of Human Vision
12 Hrs

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implicationsfor VR. #Exemplar/ Case Studies Sweeping coverage of eye movements

Unit -4: Visual Perception & Rendering and Motion & Tracking   13 Hrs

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates #Exemplar/ Case Studies Automatic stitching of panoramas in Virtual Reality. Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached
Bodies.

References

1   E. Balagurusamy, - Computing Fundamentals and C Programming‖, Tata McGraw-Hill, 2008.
2   Anand R., ‒Augmented and Virtual Reality‖, Khanna Publishing House, Delhi.
3   R.G.Dromey, How to Solve by Computer, Pearson Education, Inc, Reprint 2009.
4   Yashavant P. Kanetkar, ―Let Us C, Fifth Edition, Sridhara Publication, India, 2008.

ELE OE 4.6: Microcontrollers

Credits: 03   **Total Teaching : 45 hours**

UNIT 1   10 hrs
Introduction to Microcontrollers
Basic block diagram, comparison of microcontroller with microprocessors, comparison of 8 bit, 16 bit and 32 bit microcontrollers. Overview of 8051 series–comparison of 8051, 8052, 8031.
Microcontroller 8051- architecture **-**internal block diagram, key features of 8051, pin diagram, memory organization, Internal RAM memory, Internal ROM. General purpose data memory, special purpose/function registers, external memory.
Counters and timers – 8051 oscillator and clock, program counter, TCON, TMOD, timer counter interrupts, timer modes of operation. Input / output ports and circuits/ configurations, serial data input / output – SCON, PCON, serial data transmission modes.

UNIT 2   20hrs
8051- Interrupts, Addressing modes and Instruction set
Interrupts – IE, IP, time flag interrupts, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations & software generated interrupts.
Addressing modes–immediate addressing, register addressing, direct and indirect addressing, Data transfer instructions – internal data move, external data move, code memory read-only data move, Push and Pop and data exchange instructions.
Logical Instructions – byte level logical operations, bit level logical operations, rotate and swap operations.
Arithmetic Instructions – flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic, simple programs in assembly language.
Jump and call instructions – jump and call program range, jumps, calls and subroutines, interrupts and returns, simple example programs in assembly language.

UNIT 3   15 hrs
Interfacing with 8051 and programming in C
Basic interfacing concepts and interrupts, Programming–8051 interrupts, programming Timer interrupts, programming the external hardware interrupts.
Schematic diagrams and basic concepts of Interfacing of 8051 to keyboard, seven segment display, stepper motor, DAC, ADC and traffic light controller circuits.
8051 programming using C– Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, accessing code ROM space and data serialization.
Timer / Counter Programming in 8051–Programming 8051 timers, counter, programming timers 0 and 1 in 8051 C, Example programs.

Books:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, Pearson edition.
2. The 8051 Microcontroller, Fourt Edition, Kenneth Ayala, Thomson publication.
3. 8051 Microcontroller, Architecture, Application and Programming, Mahalakshmi, ABE edition.
4. 8051 Microcontroller, Pearson edition, Subrotha Ghoshal.
5. 8051 Microcontroller based and Embedded Systems, Mc Graw Hill, Manish KPatil.

ELE OE 4.7: IOT and Applications

Credits: 03   **Total Teaching : 45 hours**

Unit–1:   12 Hrs
Fundamentals of IoT: Introduction, History of IoT, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, Components of an IoT Solution, IoT frameworks, IoT and M2M, Open Source and Commercial Examples, Competing Standards for IoT

Unit -2:   12 Hrs
Sensors Networks: Definition, Traditional Data Storage, Analog and Digital I/O Basics, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

Unit -3:   11 Hrs
Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z- Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols

Unit -4:   10 Hrs
Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage Applications of IoT: Home
Automation

References
1   Internet of Things, Vasudevan, Nagrajanand and Sundaram, Wiley India.
2   Srinivasa K G ‑Internet of Things‖, Cengage Learning, India 2017.
3   David Hanes, Gonzalo Salgueiro, Patrick Grosstete, Robert Barton, Jerome Henry, IoT fundamentals: Networking Technologies, Protocols and uses cases for the Internet of things, 1st
     Edition, Pearson Education.
4   Iot Fundamentals, David Hence et al, Cisco press.