INSTITUTE OF SCIENCE, NAGPUR

(An Autonomous Institute)

MINOR/GE/VSEC COURSE CURRICULUM FOR B Sc DEGREE SUBJECT: ELECTRONICS

(According to NEP – 2020 Regulations)

(To be Implemented from 2023-2024)

Preamble

This curriculum content is for B. Sc (Degree) as per NEP – 2020, it is intended to offer graduates minor courses in electronics subject which will help them to respond to the current needs of the industry and equip them with skills relevant for national and global standards. Thiscourse emphasis on electronics fundamentals and application which has a profound impact on nearly every aspect of modern life today, and its importance will only continue to grow as technology continues to advance.

Introduction

The curriculum is designed to help the learners to analyses, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the graduates. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the graduates with competencies like problem solving and analytical reasoning which provide them high professional competence. The Department/Institute/University is expected to encourage its faculty concerned to make suitable pedagogical innovations, in addition to teaching/learning processes suggested in the model curriculum, so that the Course/Program learning outcomes can be achieved.

Significance

Electronics has become an integral part of modern society and has transformed the way we live, work, communicate, and even entertain ourselves. Electronics refers to the study and application of electrical circuits that use active components such as diodes, transistors, and integrated circuits to control the flow of electrons. Electronics has revolutionized many aspectsof our lives and continues to drive innovation and progress in various fields. Some of the key areas in electronics are Semiconductor technology, Analog and digital electronics, Power electronics, Communications and networking, Control systems, Embedded systems and Optoelectronics.

Eligibility criteria

Students who have qualified 10+2 or equivalent are eligible for opting for minor courses in Electronics in UG program provided they have physics or mathematics as major subjects.

Sanctioned Student Strength as per NEP: **18**

Program Objectives

The objective of an undergraduate minor course in electronics is to provide students with a basic understanding of the field of electronics and its applications, while allowing them to focus primarily on their major field of study. Some specific objectives of an undergraduate minor course in electronics are:

- To introduce students to the fundamental concepts of electronics, including analog and digital circuits, electronic devices, and signal processing.
- To develop students' ability to analyze and design simple electronic systems and circuits.
- To expose students to the practical applications of electronics in various fields such as telecommunications, power systems, control systems, and instrumentation.
- To provide students with the necessary skills to use laboratory equipment and measurement techniques for electronic testing and debugging.
- To encourage students to work collaboratively and effectively in multidisciplinary teams, applying their electronics knowledge to solve real-world problems.
- To provide students with a basic understanding of the ethical and professional considerations involved in the practice of electronics.

Overall, the objective of an undergraduate minor course in electronics is to provide students with a foundation in electronics that complements their major field of study and enhances their understandingof the role of electronics in their chosen profession.

Program Outcome

Here are some program outcomes that students can expect to achieve

- Understanding of basic electronic principles: Students will have a basic understanding of electronic principles, such as Ohm's law, Kirchhoff's laws, and the properties of various electronic components.
- Ability to design and analyze electronic circuits: Students will be able to design and analyze electronic circuits using techniques such as circuit simulation, bread board, andsoldering.
- Knowledge of analog and digital systems: Students will have a strong foundation in both analog and digital electronic systems, including analog and digital signals, filters, amplifiers, and logic circuits.
- Familiarity with electronic devices: Students will be familiar with a range of electronic devices such as transistors, diodes, and operational amplifiers.
- Awareness of safety and environmental issues: Students will be aware of safety issuesrelated to electronics, such as the proper handling of electronic components and the use of safety equipment. They will also be aware of environmental issues related to electronics, such as the disposal of electronic waste.
- Ability to work with teams: Students will be able to work effectively as part of a team, collaborating with others on projects and assignments.
- Effective communication: Students will be able to communicate effectively about electronics topics, both orally and in writing.

Overall, electronics minor courses aim to provide students with a strong foundation inelectronic principles and systems, preparing them for further study or careers in electronics- related fields.

INSTITUTE OF SCIENCE, NAGPUR

(An Autonomous Institute of Government of Maharashtra)

Department of Electronics

Teaching and Examination scheme

Bachelor of Science

THREE-Year (SIX Semester Degree Course)

B.Sc. Sem- I (ELECTRONICS-Minor from Basket)

Sr No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical					
				Th	Tu	P		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
1	GE	Basics of Electronics-I	BEL111T	2	--	--	2	2	40	10	20
		Basics of Electronics-II	BEL112T	2	--	--	2	2	40	10	20
2	VSEC	Practical based on power supply making and repairing	BEL113P	--	--	4	2	4 - 6	40	10	25
Total				04	--	04	06	--	120	30	--

B.Sc. Sem-II (ELECTRONICS -Minor from Basket)

Sr No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
				Th	Tu	P					
1	GE	Electronics Components - I	BEL121T	2	--	--	2	2	40	10	20
		Electronics Components - II	BEL122T	2	--	--	2	2	40	10	20
2	VSEC	Practical course of LED bulb making	BEL123P	--	--	4	2	4 - 6	40	10	25
Total				4	--	04	06	--	120	30	--

B.Sc. Sem-III (ELECTRONICS -Minor from Basket)

Sr No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical					
				Th	Tu	P		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
1	Minor	Paper 1:- BASIC CIRCUIT COMPONENTS AND NETWORK ANALYSIS	BEL231T	2	--	--	2	2	40	10	20
		Paper 2:- FUNDAMENTALS OF DIGITAL ELECTRONICS	BEL232T	2	--	--	2	2	40	10	20
		Minor Lab (Based on Paper 1 + Paper 2)	BEL233P	--	--	4	2	4 - 6	40	10	25
2	GE	Basics of Semiconductor Devices-I	BEL233T	2	--	--	2	2	40	10	20
Total				06	--	04	08	--	160	40	--

B.Sc. Sem-IV (ELECTRONICS - Minor from Basket)

Sr No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical					
				Th	Tu	P		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
1	Minor	Paper 1: SEMICONDUCTOR DEVICES ANALYSIS	BEL241T	2	--	--	2	2	40	10	20
		Paper 2: ADVANCED DIGITAL ELECTRONICS	BEL242T	2	--	--	2	2	40	10	20
		Minor Lab (Based on Paper 1 + Paper 2)	BEL243P	--	--	4	2	4 - 6	40	10	25
2	GE	Basics of Semiconductor Devices-II	BEL244T	2	--	--	2	2	40	10	20
3	VSEC	Training on Microcontroller	BEL245P	--	--	4	2	4 - 6	40	10	25
Total				06	--	08	10	--	200	50	--

B.Sc. Sem-V (ELECTRONICS - Minor from Basket)

Sr. No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
				Th	Tu	P					
1	Minor	Paper 1: ANALOG CIRCUITS	BEL351T	2	--	--	2	2	40	10	20
		Paper 2: LINEAR INTEGRATED CIRCUITS	BEL352T	2	--	--	2	2	40	10	20
		Minor Lab (Based on Paper 1 + Paper 2)	BEL353P	--	--	4	2	4 - 6	40	10	25
				04	--	04	06		120	30	--

B.Sc. Sem-VI (ELECTRONICS - Minor from Basket)

Sr No	Course Category	Name of the course (Title of the Paper)	Course code	Teaching Scheme (hrs)			Total Credit	Evaluation Scheme			
				Theory	Tutorial	Practical		Duration of Examination (Hrs)	End Semester Evaluation (ESE)	Continuous Internal Evaluation (CIE)	Minimum Passing Marks
				Th	Tu	P					
1	Minor	Paper 1: BASIC COMMUNICATION ELECTRONICS	BEL351T	2	--	--	2	2	40	10	20
		Minor Lab (Based on Paper 1)	BEL352P	--	--	2	1	2	20	5	13
				02	--	02	03		60	15	--

Table showing total marks in theory and Practical semester wise

Semester	Theory	Practical	Total Marks
I	100	50	150
II	100	50	150
III	150	50	200
IV	150	100	250
V	100	50	150
VI	50	25	75
Total	650	325	975

Total Credits:

1. Three Year UG Degree Program: 39

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

Basket of Minor Courses Offered
By
Electronics Department

Institute of Science, Nagpur

Department of Electronics

Minor Courses

Semester	Title	Code
III	Paper 1:- BASIC CIRCUIT COMPONENTS AND NETWORK ANALYSIS	**BEL231T**
III	Paper 2:- FUNDAMENTALS OF DIGITAL ELECTRONICS	**BEL232T**
III	Minor Lab (Based on Paper 1 + Paper 2)	**BEL233P**
IV	Paper 1: SEMICONDUCTORDEVICES ANALYSIS	**BEL241T**
IV	Paper 2: ADVANCED DIGITAL ELECTRONICS	**BEL242T**
IV	Minor Lab (Based on Paper 1 + Paper 2)	**BEL243P**
V	Paper 1: ANALOG CIRCUITS	**BEL351T**
V	Paper 2: LINEAR INTEGRATED CIRCUITS	**BEL352T**
V	Minor Lab (Based on Paper 1 + Paper 2)	**BEL353P**
VI	Paper 1: BASIC COMMUNICATIONELECTRONICS	**BEL351T**

Basket of
Open Elective/Generic courses Offered
By
Electronics Department

Institute of Science, Nagpur

Department of Electronics

Open Elective/Generic Courses

Semester	Title	Code
I	Basics of Electronics-I	BEL111T
I	Basics of Electronics-II	BEL112T
II	Electronics Components - I	BEL121T
II	Electronics Components - II	BEL122T
III	Basics of Semiconductor Devices-I	BEL233T
IV	Basics of Semiconductor Devices-II	BEL244T

Detailed Syllabus

B.Sc. I- ELECTRONICS (Sem-I)

Course category: GE

Basics of Electronics – I (BEL111T)

Marks 40] [Time 2 hrs

OBJECTIVES:

1. To provide a comprehensive understanding of atom electron and charge
2. To understand the concepts of current, potential difference and resistance.
3. To study basic circuits using resistors.

Course OUTCOMES:

1. Ability to design and conduct basic electronics experiments, as well as to analyze and compare the circuits
2. Utilize the basic knowledge of science Electronics and Communication

Basics of Electronics – I (BEL111T)

Unit 1: The Structure of Matter, Elements, Compounds and Molecules, Atomic Structure, Electronic configuration, Valence Electrons, Valence of an atom, Conductors, Insulators and Semiconductors, Numerical Problems. (7.5 Hrs)

Unit 2: Electric Charge, Electric Current, Potential and Potential Difference, Resistance and Resistivity, Conductance and Conductivity. Numerical Problems. (7.5 Hrs)

Unit 3: Circuit Fundamentals, what is a circuit? Ohms law, Linear and Non-linear resistor, Work and Power, Series and Parallel arrangement of cells, Numerical Problems. (7.5 Hrs)

Unit 4: Switches and their types, fuses, Series and Parallel arrangement of resistors, IR drops, Numerical Problems. (7.5 Hrs)

Reference Books:

1. Basic Electronics by B L Theraja, S Chand Publication (2006).
2. Integrated Electronics by Millman and Halkies, McGraw Hill Education (2017)
3. Basic Electronics and linear circuits: Bhargava and Gupta, TMH
4. Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
5. Network analysis by G. K. Mittal
6. Basic Electronics :Dr. S R Bhagyashree , Guruprasad K N , Pradeep Kumar Y , Shalini V S , Harini R

B.Sc. I- ELECTRONICS (Sem-I)
Course category: GE
Basics of Electronics – II (BEL112T)

Marks 40] **[Time 2 hrs**

OBJECTIVES:

1. To enrich the students with the basic requirement of Networks theorems.
2. Coupled circuits and their characteristics
3. Electric network models and parameters
4. Synthesis a network from its equation

Course Outcomes:

At the end of the course student will be able

1. Derive network parameters for two-port networks
2. Synthesize one-port and two-port networks

Basics of Electronics – II (BEL112T)

Unit 1: Series adding and opposing voltages, proportional voltage formula in a series circuit, Series voltage dividers, Opens in a series circuit, Numerical Problems. (7.5 Hrs)

Unit 2: Shorts in a series circuit, Parallel Circuits, laws of parallel circuits, proportional current formula, opens and shorts in a parallel circuit, Numerical Problems. (7.5 Hrs)

Unit 3: Series-Parallel circuits: Analysis opens and shorts in a Series-Parallel circuit, Voltage division in a complex series parallel circuit, Kirchhoff's (Current and Voltage) Laws, Numerical Problems.(7.5 Hrs)

Unit 4: Network graphs & matrices; Solutions methods: nodal and mesh analysis, Numerical Problems. (7.5 Hrs)

Reference Books:

1. Basic Electronics by B L Theraja, S Chand Publication (2006).
2. Integrated Electronics by Millman and Halkies, McGraw Hill Education (2017)
3. Basic Electronics and linear circuits: Bhargava and Gupta, TMH
4. Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
5. Network analysis by G. K. Mittal
6. Basic Electronics :Dr. S R Bhagyashree , Guruprasad K N , Pradeep Kumar Y , Shalini V S , Harini R

B.Sc. I- ELECTRONICS (Sem-II)
Course category: GE
Electronics Components - I (BEL121T)
Marks 40] [Time 2 hrs

OBJECTIVES:

1. To enrich the students with the basic electronic components.
2. Designing Basic Electric circuits.
3. Gain knowledge to solve practical problems.

Course Outcomes:

At the end of the course student will be able to

1. Understand the characteristics and applications of passive circuit elements such as resistors, inductors, and capacitors, including their types, power ratings, color codes, value tolerances, and voltage ratings.
2. Analyze and design circuits involving resistors, inductors, and capacitors, considering their properties, calculations of inductance, capacitance, impedance, reactance, and energy storage.
3. Evaluate the behavior of resistors, inductors, and capacitors in series and parallel configurations, as well as their impact on circuit performance, including stray capacitance and inductance.
4. Apply knowledge of passive circuit elements to solve practical circuit problems, including circuit design, calculations, and understanding the differences between capacitors and batteries.

Electronics Components - I

Unit 1

Passive Circuit Elements, Resistors, Resistors Types, Power Rating, Color Code, Value Tolerance, Variable Resistors, Inductor, Types and comparison,

Unit 2:

Inductance, Mutual Inductance, Coefficient of coupling, Variable Inductors, Inductors in series / parallel, stray inductance.

Unit 3:

Energy stored in magnetic field, DC resistance of a coil, reactance offered by a coil, impedance offered by a coil, Q-factor of a coil,

Unit4:

Capacitors, Charging of Capacitor, Capacitance, types of capacitors, voltage ratings of capacitors, stray capacitance, capacitor in series and parallel, energy stored in a capacitor, difference between capacitor and battery.

Reference Books:

1. Basic Electronics by B L Theraja, S Chand Publication (2006).
2. Integrated Electronics by Millman and Halkies, McGraw Hill Education (2017)
3. Basic Electronics and linear circuits: Bhargava and Gupta, TMH
4. Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
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B.Sc. I- ELECTRONICS (Sem-II)
Course category: GE
Electronics Components - II (BEL122T)

Marks 40] **[Time 2 hrs**

OBJECTIVES:

1. To enrich the students with the basic of Energy sources.
2. To understand the concept of basic electronic components.

Course Outcomes:

At the end of the course student will be able to

1. Understand the fundamental principles and working mechanisms of active circuit elements such as cells, batteries, diodes, transistors, and optoelectronic devices.
2. Analyze and evaluate different types of energy sources, dry cells, and batteries, including their ratings and lifespans.
3. Comprehend the relationship between voltage and current in cells and batteries, and apply this knowledge to practical circuit designs and calculations.
4. Recognize the significance of integrated circuits and semiconductor chips in modern electronics, and explain their functionalities and applications in various electronic systems.

Electronics Components - II (BEL122T)

Unit 1: Active Circuit Elements: Energy Sources, Cell and Battery, Different type of dry cells, Cell life
Unit 2: Voltage and Current of a cell, Battery rating, Photovoltaic Cell, Solar Cell.
Unit 3: Concept of a Diode, P-N Junction Diode, Concept of transistor, Concept of integrated circuit,
Unit 4: Optoelectronic devices examples, LED, Photodiode, Phototransistors, concept of semiconductor chip.

Reference Books:

1. Basic Electronics by B L Theraja, S Chand Publication (2006).
2. Integrated Electronics by Millman and Halkies, McGraw Hill Education (2017)
3. Basic Electronics and linear circuits: Bhargava and Gupta, TMH
4. Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
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Skill Enhancement Courses (SEC) BASKET

Offered by

Electronics Department

No	SEC course no	Title	Semester	Course Code
1	SEC 1	Practical based on power supply making and repairing	SEM I	BEL113P
2	SEC 2	Practical course of LED bulb making	SEM II	BEL123P
3	SEC 3	Training on Microcontroller	SEM IV	BEL245P

SEM I: SEC 1: BEL113P: Practical based on power supply making and repairing

Practical activities related to power supply making and repairing can help students gain hands-on experience with electrical circuits, components, and troubleshooting techniques. Following are recommended steps

No	Recommended Steps	Goal	Duration (Hrs.)
Building a basic linear power supply			
1	Provide students with a circuit diagram and component list for a simple linear power supply.	**To learn how to build a power supply with a given circuit diagram with all the given specifications**	12
2	Instruct them to assemble the circuit on a breadboard /PCB.		
3	Guide them through the process of selecting the appropriate transformer, rectifier, filter capacitor, and voltage regulator.		
4	Once the circuit is built, check the output voltage using a multimeter and verify it is as per the desired one.		
5	Encourage students to experiment with different component values to observe the effect on the output voltage and its stability.		
Circuit analysis and troubleshooting			
6	Present students with a faulty power supply circuit and challenge them to identify and resolvethe issue.	**To learn in-depth analysis of the circuit and ability to identify possible faults and learn repairing**	12
7	Encourage them to use circuit analysis techniques, such as voltage and current measurements, to pinpoint the problem area.		
8	Guide them in systematically checking components, connections, and signals to isolate the fault.		
9	Assist students in using schematics and datasheets to understand the circuit operation andidentify potential causes of failure.		
10	Once the issue is identified, instruct them on the appropriate repair or replacement procedure.		
Safety precautions and best practices			
11	Prioritize safety during power supply practicals. Educate students on electrical safety measures, such as proper grounding, insulation, and safe handling of live circuits.	**To learn about safety protocols and the reasoning behind it**	12
12	Emphasize the importance of turning off the power supply and discharging capacitors beforeworking on circuits.		
13	Demonstrate safe practices for soldering, desoldering, and using tools such as multimeters and oscilloscopes.		
14	Discuss the significance of datasheets, manufacturer guidelines, and industry		

	standards for power supply design and repair.		
Designing a customized power supply			
15	Assign students the task of designing a power supply to meet specific requirements, such as a specific output voltage and current.	**To learn how to build a customizable power supply from scratch**	12
16	Instruct them to research and select suitable components, including transformers, rectifiers, filters, and voltage regulators.		
17	Guide them through the process of calculating component values based on load requirementsand safety factors.		
18	Encourage students to simulate the circuit using software tools or breadboard prototypes before proceeding to the final implementation.		
19	Assess their designs based on performance, efficiency, stability, and adherence tospecifications.		
20	Throughout these practical exercises, provide guidance, explanations, and feedback to help students develop their skills in power supply making and repairing		
21	Encourage them to document their work, record measurements, and maintain a troubleshooting log to enhance their understanding and progress.		

Sem II: SEC 2: BEL123P: Practical course of LED bulb making

A practical course on LED bulb making can provide students with hands-on experience in small device fabrication. Following are recommended steps.

No	Recommended Steps	Goal	Duration (Hrs.)
Introduction to LED technology			
1	Explain the basics of Light Emitting Diodes (LEDs), their working principles, and advantages over traditional lighting sources.	To understand fundamentals of LED technology.	4
2	Discuss different types of LEDs, such as through-hole and surface mount devices, and theirapplications.		
Component selection and sourcing			
3	Introduce students to the components needed for LED bulb assembly, including LEDs, resistors, capacitors, and connectors.	To learn proper selection of components for fabrication of LED bulb.	4
4	Discuss the importance of selecting components with appropriate specifications, such as voltage ratings and current ratings.		
5	Guide students in sourcing components from reputable suppliers.		
Circuit design			
6	Provide a basic LED bulb circuit diagram and explain its various components and theirfunctions.	To learn circuit designing, assembling and testing	24
7	Teach students how to calculate the resistor value for current limiting based on LED forward voltage and desired operating current.		
8	Guide them in understanding the circuit layout and connections.		
9	Soldering and assembly		
10	Teach students how to solder components onto a Printed Circuit Board (PCB) or a custom circuit layout.		
11	Demonstrate how to verify the correct operation of the LED bulb by connecting it to a power source and ensuring proper illumination.		
Safety precautions, Customization and aesthetics			
12	Discuss safety measures specific to LED bulbs, such as handling high voltages in AC-powered bulbs or ensuring proper heat dissipation in high-power applications.	To learn device specific precautions to take and able to relate aesthetic issue with other factors.	4
13	Encourage students to explore customization options, such as adding diffusers, using colored LEDs, or designing unique bulb shapes.		
14	Discuss aesthetic considerations, such as housing materials, heat dissipation, and thermal management.		
Documentation, Project showcase and evaluation			
15	Encourage students to document their LED bulb assembly process, including circuit diagrams, component lists, and troubleshooting steps.	To learn how to do project documentation and effective presentation	12
16	Provide an opportunity for students to present their completed LED bulbs and explain the concepts, techniques, and challenges encountered during the course.		

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Department of Electronics

CREDIT STRUCTURE, EVALUATION SCHEME, AND SYLLABUS
OF
FOUR-YEAR BACHELOR OF SCIENCE (HONORS/RESEARCH) DEGREE WITH A SEMESTER PATTERN IN ELECTRONICS (FACULTY OF SCIENCE & TECHNOLOGY)
BASED ON

DIRECTION 3 OF 2023 ISSUED BY THE INSTITUTE OF SCIENCE,

NAGPUR AS PER NEP 2020

(TO BE IMPLEMENTED FROM ACADEMIC YEAR 2023-2024)

ELECTRONICS

Importance of Electronics

Electronics stands as the cornerstone of modern civilization, permeating nearly every facet of contemporary life with its transformative influence. Its paramount significance lies in its pivotal role in communication, underpinning the infrastructure of global connectivity through smartphones, computers, and the internet. Beyond communication, electronics fuels innovation and progress across industries, driving automation in manufacturing, revolutionizing healthcare with medical devices and diagnostic equipment, and enhancing transportation through navigation systems and autonomous vehicles. It powers the entertainment industry, offering immersive experiences through gaming, virtual reality, and streaming platforms. Moreover, electronics promotes energy efficiency and conservation, facilitates research and collaboration, and stimulates economic growth by generating employment opportunities and driving technological advancements. As a catalyst for innovation and a catalyst for societal advancement, electronics continues to shape the trajectory of human development, promising a future marked by unprecedented possibilities and opportunities.

Programe outcome

Including electronics as a minor subject in an undergraduate degree program can offer students a well-rounded education with a broader understanding of technology and its applications. Here are some potential program outcomes and objectives for such a minor:

Fundamental Understanding: Develop a foundational understanding of electronic principles, including circuit analysis, semiconductor devices, and digital electronics.

Problem-Solving Skills: Cultivate the ability to analyze and solve problems related to electronic circuits and systems, applying theoretical knowledge to practical scenarios.

Design Proficiency: Gain proficiency in designing basic electronic circuits and systems, including analog and digital circuits, considering factors such as functionality, efficiency, and reliability.

Laboratory Skills: Acquire hands-on experience in laboratory settings, conducting experiments to reinforce theoretical concepts and develop practical skills in electronics measurement and instrumentation.

Interdisciplinary Perspective: Appreciate the interdisciplinary nature of electronics by

exploring its connections with other fields such as computer science, telecommunications, and control systems.

Technological Innovation: Stimulate creativity and innovation by exploring emerging trends and technologies in electronics, such as embedded systems, IoT (Internet of Things), and renewable energy systems.

Critical Thinking: Develop critical thinking skills to evaluate and critique electronic systems, considering factors such as cost-effectiveness, sustainability, and ethical implications.

Communication Skills: Enhance communication skills through the presentation and documentation of electronic projects and research findings, effectively conveying technical information to diverse audiences.

Teamwork and Collaboration: Foster teamwork and collaboration through group projects and activities, encouraging students to work effectively in multidisciplinary teams to solve complex electronic engineering problems.

Professional Ethics: Understand the ethical responsibilities associated with the practice of electronics engineering, including issues related to safety, environmental impact, and intellectual property rights.

By achieving these outcomes and objectives, students completing a minor in electronics can supplement their primary field of study with valuable knowledge and skills that are increasingly relevant in today's technology-driven world.

The structure of the course for four years, the pattern of examination, and the question papers are as specified below:

Structure of Four Year-degree Program

Electronics as Minor Table 1: B.Sc. Semester I

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	GE	B-EL111T	Basics of Electronics-I	4.5	2
		B-EL112T	Basics of Electronics-II		2
2	SEC	B-EL113P	Practical based on power supply making and repairing		2
Total					06

Table 2: B.Sc. Semester II

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	GE	B-EL121T	Electronics Components - I	4.5	2
		B-EL122T	Electronics Components – II		2
2	SEC	B-EL123P	Practical course of LED bulb making		2
Total					06

Table 3: B.Sc. Semester III

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	Minor	B-EL231T	Paper 1:- Basic circuit components and network analysis	5.0	2
		B-EL232T	Paper 2:- Fundamentalsof digital electronics		2
		B-EL233P	Minor Lab		2
2	GE	B-EL234T	Basics of Semiconductor Devices-I		2
3	VSEC	B-EL235P	Introduction to C Programming		2
Total					10

Table 4: B.Sc. Semester IV

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	Minor	B-EL241T	Paper 1:- Semiconductor devices analysis		2
		B-EL242T	Paper 2:- Advanced digital electronics	5.0	2
		B-EL243P	Minor Lab		2
2	GE	B-EL244T	Basics of Semiconductor Devices-II		2
3	SEC	B-EL245P	Raspberry Pi Projects for Electronics		2
Total					10

Table 5: B.Sc. Semester V

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	Minor	B-EL351T	Paper 1:- Analog circuits	5.5	2
		B-EL352T	Paper 2:- Linear integrated circuits		2
		B-EL353P	Minor Lab		2
2	VSEC	B-EL354P	Hands-On Introduction to Wireless Communication Systems		2
Total					08

Table 6: B.Sc. Semester VI

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	Minor	B-EL361T	Paper 1:- Basic communication electronics		2
		B-EL362P	Minor Lab		1
2	VSEC	B-EL363P	Hands-on experience in building IoT prototypes using sensors, actuators and microcontrollers		2
Total					05

Total	**45**

Vocational Skill Enhancement Courses (VSEC) available with any subject (other than Electronics) as Major or Minor (Offered by the Department of Electronics):

S.No.	Year	Semester	Course Code	Name of the paper	Credits	Practical Hrs
1	II	III	B-EL235P	Introduction to C Programming	2	4
2	III	V	B- EL354P	Hands-On Introduction to Wireless Communication Systems	2	4
3	III	VI	B- EL363P	Hands-on experience in building IoT prototypes using sensors, actuators and microcontrollers	2	4

Skill Enhancement Courses (SEC) available with any subject (other than Electronics) as Major or Minor (Offered by the Department of Electronics):

S.No.	Year	Semester	Course Code	Name of the paper	Credits	Practical Hrs
1	I	I	B-EL113P	Practical based on power supply making and repairing	2	4
2	I	II	B-EL123P	Practical course of LED bulb making	2	4
3	II	IV	B-EL245P	Raspberry Pi Projects for Electronics	2	4

Electronics as a Minor Subject and any other subject as a Major (Offered by the Department of Electronics):

S.No.	Year	Semester	Course Code	Name of the paper (Theory / Practical)	Credits	Theory / Practical Hrs
1	II	III	B-EL231T	Paper 1:- Basic circuit components and network analysis	2	2
2			B-EL232T	Paper 2:- Fundamentalsof digital electronics	2	2
3			B-EL233P	Minor Lab based on Paper I and II	2	4
4	II	IV	B-EL241T	Paper 1:- Semiconductor devices analysis	2	2
5			B-EL242T	Paper 2:- Advanced digital electronics	2	2
6			B-EL243P	Minor Lab	2	4
7	III	V	B-EL241T	Paper 1:- :- Analog circuits	2	2
8			B-EL242T	Paper 2:- Linear integrated circuits	2	2
9			B-EL243P	Minor Lab	2	4
10	III	VI	B-EL361T	Paper 1:- Basic communication electronics	2	2

11			B-EL362P	Minor Lab	1	2

List of Generic / Open Electives (OE) available with any Major subject other than faculty Science and Technology (Offered by the Department of Electronics):

S.No.	Year	Semester	Course Code	Name of the paper	Credits	Practical Hrs
1	I	I	B-EL111T	Basics of Electronics-I	2	2
2	I	I	B-EL112T	Basics of Electronics-II	2	2
3	I	II	B-EL121T	Electronics Components - I	2	2
4	I	II	B-EL122T	Electronics Components – II	2	2
5	II	III	B-EL234T	Basics of Semiconductor Devices-I	2	2
6	II	IV	B-EL244T	Basics of Semiconductor Devices-II	2	2

Credit Specifications:

a. Theory/Tutorial Courses: One hour/credit/week (a minimum of 15 hours of teaching per credit is required in a semester.

b. Laboratory/Performance-Based Courses: A minimum of 30 hours in laboratory or Performance-based activities is required in a semester. Performance-based activities include Workshop-based activities, internships, Apprenticeships, Field-based learning, community engagement learning, etc.

c. Each semester will consist of at least 15 weeks of Academic Work equivalent to 90 actual teaching days.

Assessment

The assessment Plan will consist of Continuous Internal Evaluation (CIE) and End Semester Evaluation (ESE) for each course/subject taken together.

(A) Continuous Internal Evaluation (CIE) will be based

(a) Attendance of the student during a particular semester

(b) An assignment (min. two) based on curriculum to be assessed by the teacher concerned

(c) Subject-wise class test (min. two) or activities conducted by the teacher concerned with proper rubrics.

(d) Expected classroom activities shall consist of Group Discussions, Seminars, PowerPoint Presentations, Elocution, Debate, Role Play, Case Studies, Educational Games, etc. The teacher is expected to undertake a minimum of four of the aforesaid activities.

(e) The CIE marks will be communicated to the examination cell at the end of each semester, but before the semester end examinations / as instructed by the Examination Cell. These marks will be considered for the declaration of the results.

(f) The record of internal marks, evaluation & results should be maintained for a minimum period of three years by the respective department for verification by the competent authority.

End Semester Evaluation (ESE)

(a) Pattern of Theory Question Paper of 80 marks

1. There will be four units in each paper.
2. Maximum marks for each theory paper will be 80.
3. The question paper will consist of five questions, each of 16.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

(b) Pattern of Theory Question Paper of 60 marks

1. There will be four units in each paper.
2. Maximum marks for each theory paper will be 60.
3. The question paper will consist of five questions, each of 12 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

(b) Pattern of Theory Question Paper of 40 marks

1. There will be four units in each paper.
2. Maximum marks for each theory paper will be 40.
3. The question paper will consist of five questions, each of 08 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

Standard of Passing

The scope of the course, percentage of passing in Theory and Project, and Internal Assessment will be governed as per the following rules:

(i) To pass the Bachelor of Science (B.Sc.) 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, and 8th Semester Examinations, an examinee shall obtain not less than 40 % (Grade 4) marks in each theory course/paper, taking CIE & SEE together. Whereas, for practical/performance-based examinations an examinee shall obtain not less than 50 % marks in each practical, taking CIE & SEE together.

(ii) An examinee who is unsuccessful at the examination shall be eligible for admission to the subsequent examinations on payment of a fee prescribed for the examination together with the conditions of the ordinance in force from time to time.

Abbreviations Used

Continuous Internal Evaluation: (CIE) End Semester Evaluation: (ESE) Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

INSTITUTE OF SCIENCE, NAGPUR

(An Autonomous Institute of Government of Maharashtra)

SYLLABUS

SEMESTER III

MINOR I FOR ELECTRONICS		
Paper Code: B-EL231T	**Title:: Basic circuit components and network analysis**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

The objectives of basic circuit components and network analysis encompass understanding, analysing, designing, and troubleshooting electronic circuits to prepare individuals for practical application and further studies in this field.

OUTCOMES

The outcome involves proficiency in analyzing, designing, and troubleshooting electronic circuits, facilitating practical applications and further studies.

Unit No.	Content	No. of Hours
Unit - I	**Passive Elements** Resistors, capacitors and inductors; their symbol, unit, types, construction and characteristics, Colour code system, Series and parallel combination. Voltage and Current divider circuits. Transformer: classification, construction, working and applications. Relays and Switches, Introduction to Surface mounting devices.	**(7.5Hrs)**
Unit -II	**Circuit Analysis** Energy sources AC & DC, Kirchhoff's Current & Voltage Laws, Node and loop analysis method, Network Theorems: Statements with explanation and problems (Dc only): Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Millman's Theorem and Maximum Power Transfer Theorem.	**(7.5Hrs)**
Unit - III	**Transient Behavior of circuit elements under initial and final conditions in RL, RC and RLC circuits for AC and DC excitations** AC Circuit Analysis: Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values Resonant Circuits: Series and parallel resonance, frequency-response of series and Parallel circuits, Q–Factor, Bandwidth.	**(7.5Hrs)**
Unit - IV	**Transducer** Definition, Classification, characteristics of transducers, Construction and working of Resistive transducer- Potentiometer,	**(7.5Hrs)**

	Capacitive transducer-by changing dielectrics & changing distance between the plates, piezoelectric transducer, LVDT, strain gauges, temperature transducers- thermistors, RTDS and thermocouples.	

REFERENCES:

1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.
2	Electronics Instrumentation: A. K. Sawney, Dhanpat Rai Publications.
3	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications.
4	Basic Electronics and linear circuits: Bhargava and Gupta, TMH.
5	Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
6	Electrical Circuit Analysis: Mahadevan and Chitra, PHI.
7	Electronic instruments and measurement techniques: W. D. Cooper and A. D. Helfrick (PHI).
8	Network analysis by G. K. Mittal
9	Analogue and Digital Techniques: G. N. Navneet.
10	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill.
11	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
12	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.
13	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.
14	Digital Fundamentals: Thomas L. Flyod, Pearson Education Asia (1994).
15	Digital Principles: R. L. Tokheim, Schaum's Outline Series, Tata McGraw- Hill (1994).

MINOR II FOR ELECTRONICS		
Paper Code: B-EL232T	**Title:: :- Fundamentals of digital electronics**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

1. To enrich the students with the basic requirement of digital electronics.
2. To describe the use of Boolean Algebra for circuit operations.
3. To elaborate the use of flip flops as memory in data processing system.
4. To explore the use of binary circuits in digital system.
5. To familiarize about the basic building blocks required for digital system

OUTCOMES

1. Ability to design and conduct electronics experiments, as well as to analyse and interpret data
2. Utilize the basic knowledge of science Electronics and Communication

Unit No.	Content	No. of Hours
Unit - I	**Number Systems**: Decimal, Binary, Octal and Hexadecimal number systems, inter conversions. Representation of signed and unsigned numbers. Binary, octal and hexadecimal arithmetic; addition, subtraction by 1's and 2's complement method. **Binary Codes:** BCD, Grey, XS3, parity and Alphanumeric codes.	**(7.5Hrs)**
Unit -II	**Logic Gates:** Study of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates. **Boolean algebra:** Boolean laws, simplification of equation, De'Morgan's Theorems, logic structures.	**(7.5Hrs)**
Unit - III	**Logic functions:** Standard logic functions, SOP and POS forms, minterms and maxterms, Minimization Techniques; Karnaugh's map minimization up to 4 variables for SOP only. **Combinational circuit:** Adder, Subtractor, 4- bit Adder/ Subtractor, Decoder, Encoder, Multiplexers De-multiplexer (Basic circuits).	**(7.5Hrs)**
Unit - IV	**Sequential Circuits:** Bi-stable multivibrator, SR, CKSR, D Flip-Flops and JK Flip-Flop; Race-around condition, Construction using Universal gates, Properties of FFS, Preset and Clear operations, Clocked FFS (Level and Edge Triggered), JK Master-Slave Flip-Flop, and T Flip-Flop.	**(7.5Hrs)**

REFERENCES:

1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.
2	Electronics Instrumentation: A. K. Sawney, Dhanpat Rai Publications.

3	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications
4	Basic Electronics and linear circuits: Bhargava and Gupta, TMH.
5	Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
6	Electrical Circuit Analysis: Mahadevan and Chitra, PHI.
7	Electronic instruments and measurement techniques: W. D. Cooper and A. D. Helfrick (PHI).
8	Network analysis by G. K. Mittal
9	Analogue and Digital Techniques: G. N. Navneet.
10	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill.
11	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
12	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.
13	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.
14	Digital Fundamentals: Thomas L. Flyod, Pearson Education Asia (1994).
15	Digital Principles: R. L. Tokheim, Schaum's Outline Series, Tata McGraw- Hill (1994).

MINOR LAB		
Paper Code: B-EL233P		**PRACTICALS Based on MINOR I & II**
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Practical No.	**Content**
Practicals on Minor I — BASIC CIRCUIT COMPONENTS AND NETWORK ANALYSIS	
1	To study components used in electronics circuits.
2	To study Transformer.
3	To Study & verify Thevenin's theorem.
4	To Study & verify Norton's theorem.
5	To Study & verify Maximum Power Transfer theorem.
6	To Study & verify Millman's theorem.
7	To study Potentiometer transducer for the measurement of displacement.
8	Study of RC and RL circuit
9	To study LVDT transducer for the measurement of displacement.
10	To study Thermistor & its properties.
Practicals on Minor II– FUNDAMENTALS OF DIGITAL ELECTRONICS	
11	To study identification of Logic gates and verification of its truth table.
12	To realize and verify the operation of basic gates from Universal gates.
13	To Study De'Morgan's Theorems.
14	To construct & verify logic structure for given Boolean expression.
15	To Study construction of Half adder And Full adder.
16	To Study 4 bit parallel binary adder operation.
17	To Study decoder and encoder circuit.
18	To study multiplexer and de-multiplexer circuit.
19	To study SR, CKRS and D FFS.
20	To study JK and JKMS Flip-Flop

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL234T	**Title:: Basics of Semiconductor Devices-I**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

Basics of Semiconductor Devices-I is a foundational course aimed at providing students with an understanding of semiconductor fundamentals and basic device operation. This course covers semiconductor materials, semiconductor junctions, diodes, and bipolar junction transistors (BJTs).

OUTCOMES

Upon completion of Basics of Semiconductor Devices-I, students will understand semiconductor fundamentals, diode operation, and bipolar junction transistor (BJT) characteristics.

Unit No.	Content	No. of Hours
Unit - I	Introduction to semiconductors and their significance in technology, Atomic structure and bonding in semiconductor materials, Semiconductor doping: N-type and P-type materials, Crystal structure of semiconductors: Silicon and germanium, Carrier generation and recombination in semiconductors	**(7.5Hrs)**
Unit -II	Introduction to semiconductor junctions: P-N junction formation Depletion region: Formation and characteristics, Forward and reverse biasing of semiconductor diodes, Diode characteristics and the diode equation, Applications of diodes: Rectification, clipping, and clamping	**(7.5Hrs)**
Unit - III	Introduction to bipolar junction transistors (BJTs), BJT structure: Construction and operation of NPN and PNP transistors, BJT configurations: Common emitter, common base, and common collector, BJT biasing techniques: Fixed bias, emitter bias, and voltage-divider bias, BJT amplifier configurations: Amplification principles and applications	**(7.5Hrs)**
Unit - IV	BJT as a switch: Operating regions and switching characteristics, BJT amplifiers: Analysis and design considerations, Frequency response of BJT amplifiers, Troubleshooting and practical applications of BJTs	**(7.5Hrs)**

REFERENCES:

1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.
2	Electronics Instrumentation: A. K. Sawney, Dhanpat Rai Publications.
3	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications.
4	Basic Electronics and linear circuits: Bhargava and Gupta, TMH.

5	Electric Circuits: S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
6	Electrical Circuit Analysis: Mahadevan and Chitra, PHI.
7	Electronic instruments and measurement techniques: W. D. Cooper and A. D. Helfrick (PHI).
8	Network analysis by G. K. Mittal
9	Analogue and Digital Techniques: G. N. Navneet.
10	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill.
11	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
12	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.
13	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.

VEC AVAILABLE WITH ELECTRONICS AS MAJOR OR MINOR		
Paper Code: B-EL235P	**Title:: Introduction to C Programming**	
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Objectives

The objective of the "Introduction to C Programming" course is to equip students with a solid understanding of C language fundamentals and problem-solving skills through hands-on programming practice.

Outcome

Upon completion of the "Introduction to C Programming" course, students will have a solid understanding of fundamental programming concepts, syntax, and techniques in the C programming language, enabling them to write, compile, and debug basic C programs.

Unit No.	Content
1	Introduction to C programming language.
2	Setting up the development environment (IDE or text editor, compiler).
3	Writing and running your first "Hello, World!" program.
4	Syntax rules in C: statements, variables, and comments.
5	Data types: int, float, char, double, Constants and variables.
6	Input and output functions: printf() and scanf().
7	Practice exercises: Simple arithmetic operations.
8	Decision-making in C: if, if-else, nested if.
9	Looping constructs: while, for, do-while.
10	Switch-case statements.
11	Practice exercises: Implementing basic algorithms using control flow structures.
12	Introduction to functions: definition, declaration, and invocation.
13	Function parameters and return values.
14	Function prototypes.
15	Recursion.
16	Practice exercises: Writing and using functions to solve problems.
17	Arrays: declaration, initialization, and accessing elements.
18	Multidimensional arrays.
19	Strings: declaration, initialization, and string manipulation functions.
20	Practice exercises: Implementing algorithms using arrays and strings.

INSTITUTE OF SCIENCE, NAGPUR

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SYLLABUS

SEMESTER IV

Minor I for Electronics		
Paper Code: B-EL241T	**Title:: Semiconductor devices analysis**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

1. To explain about semiconductors used for the fabrication of semiconductor devices.
2. To acquire the knowledge of transistor used in many electronic circuits.
3. To familiarize about the field effect transistor and its operation.
4. To explore the use of power devices required in electronics circuits.
5. To familiarize about the applications of diode, transistor and power devices.

OUTCOMES

1. Ability to design and conduct electronics experiments, as well as to analyse and interpret data
2. Utilize the basic knowledge of science Electronics and Communication
3. To provide opportunity to students to learn the latest trends in Electronics

Unit No.	Content	No. of Hours
Unit - I	**Semiconductors:** Classification and types, PN junction; Formation, depletion region, barrier potential, symbol, biasing modes, V-I characteristics, , diode current equation, effect of temperature on diode current, ideal diode, basic diode ratings, Zener diode, LED construction, working, characteristics & uses.	**(7.5Hrs)**
Unit -II	**Transistor Basics:** Formation of transistor; PNP and NPN, symbols, working principle, transistor current equation. Modes of operation; CB, CE and CC, input output and transfer characteristics in CB and CE configuration, definition of α, ß and relation between them, simple problems, comparison of CB, CE and CC mode Regions of operation (active, cut off and saturation), Leakage currents, load line and Q point, Transistor as an amplifier and switch in CE configuration.	**(7.5Hrs)**
Unit - III	**Field Effect Transistors:** Construction, working and characteristics of JFET, FET Parameters rd, gm, μ and their relation. MOS Field Effect Transistors: Types of MOSFETs, Circuit symbols, Construction, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Comparison between JFET and MOSFET.	**(7.5Hrs)**
Unit - IV	**Switching Devices:** Construction, Working principle, characteristic curves, symbol and Applications of UJT, SCR, DIAC and TRIAC.	**(7.5Hrs)**

REFERENCES:		
1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.	
2	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications.	
3	Electronic Devices and Circuits: Allen Mottershed.	
4	Basic Electronics and linear circuits: Bhargava- Gupta, TMH.	
5	Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).	
6	Electronic Devices and Circuits: David A. Bell, 5th Edition 2015, Oxford University Press.	
7	Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, TMH.	
8	Electrical Circuit Analysis: Mahadevan and Chitra, PHI Learning.	
9	Integrated Electronics: J. Millman and C. C. Halkias, Tata McGraw Hill (2001).	
10	Learning Microelectronic circuits: A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn, Oxford University Press.	
11	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hills.	
12	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.	
13	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.	
14	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.	
15	Digital Fundamentals: Thomas L. Flyod, Pearson Education Asia (1994).	
16	Digital Principles: R. L. Tokheim, Schaum's Outline Series, Tata McGraw- Hill (1994).	

Minor II for Electronics		
Paper Code: B-EL242T	**Title:: Advanced digital electronics**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

1. To enrich the students with the digital ICS used in electronics circuits.
2. To enhance the use of Flip-Flops in the construction of counters.
3. To familiarize the use of Counters & Registers in data processing system.
4. To explore the use of binary memory in digital system.
5. To disseminate about the building blocks required for digital system.

OUTCOMES

1. Ability to design and conduct electronics experiments, as well as to analyse and interpret data
2. Utilize the basic knowledge of science Electronics and Communication
3. To provide opportunity to students to learn the latest trends in Electronics
4. To provide opportunities to the students to formulate, analyse and resolve the problems in Electronics Industry

Unit No.	Content	No. of Hours
Unit - I	**Logic Families:** Introduction to ICs Scale of Integration, Classification digital ICs, Construction and Working of TTL, NAND and NOR gates, Construction and Working of CMOS NAND and NOR gates, Tristate logic, Comparison of TTL and CMOS	**(7.5Hrs)**
Unit -II	**Binary Counters:** Types, Asynchronous; up/down, Decade, Modified and Synchronous counter, Ring Counter, Johnson counter; Construction, working, Truth tables and timing diagrams (4 bits), Uses.	**(7.5Hrs)**
Unit - III	**Shift Registers:** Introduction, Buffer Register, Controlled Buffer Register, Data Transmission in shift registers; Construction and Working of Serial-in serial-out, serial-in parallel-out, Parallel-in serial-out, Parallel-in Parallel-out, Right Shift and Left Shift, Uses.	**(7.5Hrs)**
Unit - IV	**Memory Organization:** Types of RAM and ROM, Characteristics of Memory Systems, Memory Hierarchy, Main Memory, Organization; Address & data bus, Static and dynamic RAM, Memory expansion; address and data size using address table method.	**(7.5Hrs)**

REFERENCES:	
1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.
2	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications.
3	Electronic Devices and Circuits: Allen Mottershed.
4	Basic Electronics and linear circuits: Bhargava- Gupta, TMH.
5	Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
6	Electronic Devices and Circuits: David A. Bell, 5th Edition 2015, Oxford University Press.
7	Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, TMH.
8	Electrical Circuit Analysis: Mahadevan and Chitra, PHI Learning.
9	Integrated Electronics: J. Millman and C. C. Halkias, Tata McGraw Hill (2001).
10	Learning Microelectronic circuits: A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn, Oxford University Press.
11	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hills.
12	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
13	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.
14	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.
15	Digital Fundamentals: Thomas L. Flyod, Pearson Education Asia (1994).
16	Digital Principles: R. L. Tokheim, Schaum's Outline Series, Tata McGraw- Hill (1994).

MINOR LAB FOR ELECTRONICS MAJOR		
Paper Code: B-EL243P		**PRACTICALS Based on Minor I & II**
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Practical No.	Content
Practicals on MINOR I – SEMICONDUCTOR DEVICES	
1	To study V-I characteristics of diode, Zener diode and LED.
2	To study characteristics of transistor in CB mode and calculate α
3	To study characteristics of transistor in CE mode and calculate β.
4	To study the operation of transistor as an amplifier and switch.
5	To study output characteristics of FET and calculate rd, gm and μ.
6	To study output characteristics of MOSFET.
7	To study V-I characteristics of SCR.
Practicals on MINOR II – ADVANCED DIGITAL ELECTRONICS	
8	To study CMOS NAND gate and verify its operation.
9	To study CMOS NOR gate and verify its operation.
10	To Study the working of 4-bit Asynchronous counter.
11	To Study 4-bit Asynchronous counter as UP/Down counter.
12	To Study the working of Asynchronous modified counter.
13	To Study the working of Jonson's counter.
14	To Study the working of ring counter.
15	To Study Serial-in register as serial-out and parallel-out.
16	To Study Parallel-in register as serial-out and parallel-out.
17	To study RAM and ROM Structure.

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL244T	**Title:: Basics of Semiconductor Devices-II**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

Basics of Semiconductor Devices-II builds upon the knowledge acquired in Basics of Semiconductor Devices-I. This course focuses on advanced semiconductor devices such as field-effect transistors (FETs), integrated circuits (ICs), and their applications.

OUTCOMES

Upon completion of Basics of Semiconductor Devices-II, students will comprehend field-effect transistor (FET) operation, integrated circuit (IC) fabrication, and practical applications of semiconductor devices.

Unit No.	Content	No. of Hours
Unit - I	Introduction to field-effect transistors (FETs): MOSFETs and JFETs, FET structure and operation: Enhancement and depletion modes, FET biasing techniques: Fixed bias, self-bias, and voltage-divider bias, FET amplifier configurations: Common source, common gate, and common drain	**(7.5Hrs)**
Unit -II	Introduction to integrated circuits (ICs): Basic fabrication process and types, Applications of semiconductor devices in integrated circuits: Digital and analog circuits, IC packaging and interconnection techniques Unit 3: Semiconductor Devices in Practical Applications	**(7.5Hrs)**
Unit - III	Semiconductor devices in consumer electronics, renewable energy, and other fields, Emerging trends in semiconductor technology, Ethical considerations and societal impacts of semiconductor technology	**(7.5Hrs)**
Unit - IV	Introduction to advanced semiconductor technologies: Nanoelectronics, quantum computing, Potential future applications and challenges	**(7.5Hrs)**

REFERENCES:

1	Basic Electronics (Solid State): B. L. Theraja S. Chand & Company, 2000.
2	A Textbook of Applied Electronics: R. S. Sedha, S. Chand Publications.
3	Electronic Devices and Circuits: Allen Mottershed.
4	Basic Electronics and linear circuits: Bhargava- Gupta, TMH.
5	Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004).
6	Electronic Devices and Circuits: David A. Bell, 5th Edition 2015, Oxford University Press.
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8	Electrical Circuit Analysis: Mahadevan and Chitra, PHI Learning.
9	Integrated Electronics: J. Millman and C. C. Halkias, Tata McGraw Hill (2001).
10	Learning Microelectronic circuits: A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th

	Edn, Oxford University Press.
11	Digital Principles and Applications: A. P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hills.
12	Fundamentals of Digital Circuits: Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
13	Digital Circuits and systems: Venugopal, 2011, Tata McGraw Hill.
14	Digital Systems: Principles & Applications, R. J. Tocci, N. S. Widmer, 2001, PHI.
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SEC AVAILABLE WITH ANY SUBJECT (OTHER THAN ELECTRONICS) AS MAJOR OR MINOR		
Paper Code: B-ST245P	**Title:: Raspberry Pi Projects for Electronics**	
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Objectives

The objective of this course is to equip students with the fundamental knowledge and practical skills in Python programming and its applications, enabling them to confidently apply Python for various tasks, including web development, data analysis, and machine learning

Outcome

1. Basic understanding of Python programming language
2. Ability to write Python code using the correct syntax
3. Knowledge of data types and variables in Python
4. Familiarity with control flow structures (if statements, loops)
5. Basic error handling using try-except blocks
6. Understanding of basic data structures (lists, tuples, dictionaries)
7. Proficiency in basic string manipulation and file handling in Python

No.	Content
1	**Introduction to Raspberry Pi** • What is a Raspberry Pi? (a single-board computer) • Different Raspberry Pi models and their uses • Setting up a Raspberry Pi (hardware and software) • Introduction to Raspbian operating system • Using the Raspberry Pi desktop environment • Navigating the command line interface (CLI)
2	**Raspberry Pi & Electronics Interaction** • Introduction to GPIO pins (General Purpose Input/Output) • Connecting basic electronic components to the Raspberry Pi • Blinking an LED with Python code • Reading sensor data (e.g., temperature sensor) and controlling outputs (e.g., LED) with Python
3	**Introduction to Project Building** • Brainstorming simple project ideas using Raspberry Pi and electronics • Project development process: planning, building, testing, debugging • Resources for finding project ideas and tutorials

Assessment:

- ❖ Hands-on projects utilizing Raspberry Pi and electronics
- ❖ Quizzes or assignments to test understanding of concepts