INSTITUTE OF SCIENCE, NAGPUR

(An Autonomous Institute of Government of Maharashtra)

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 1 OF 2024 ISSUED BY THE INSTITUTE OF SCIENCE,

NAGPUR AS PER NEP 2020

(TO BE IMPLEMENTED FROM ACADEMIC YEAR 2024-2025)

ELECTRONICS-MAJOR

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.

Programme Outcomes

Program outcomes specifically tailored for a Bachelor of Science (B.Sc) major in Electronics:

Foundational Knowledge: Students will demonstrate a strong understanding of foundational concepts in electronics, including circuit theory, semiconductor physics, digital electronics, and analog electronics.

Design and Analysis Skills: Graduates will be proficient in designing and analyzing electronic circuits and systems, employing both theoretical knowledge and practical techniques to meet specific design objectives.

Hands-on Experience: Students will gain hands-on experience through laboratory work, projects, and internships, developing practical skills in circuit prototyping, troubleshooting, and testing using industry-standard equipment and software tools.

Programming Proficiency: Graduates will have a solid foundation in programming languages relevant to electronics, enabling them to program microcontrollers, develop embedded systems, and interface with electronic devices.

Integration of Hardware and Software: Students will learn how to integrate hardware and software components to create functional electronic systems, understanding the interactions between hardware design, firmware development, and software applications.

Specialization and Electives: The program will offer opportunities for students to pursue specialization areas within electronics, such as communications, control systems, power electronics, or biomedical electronics, through elective courses or concentrations.

Project Management Skills: Graduates will develop project management skills, including project planning, scheduling, budgeting, and team coordination, through hands-on projects and collaborative assignments.

Communication and Presentation Skills: Students will enhance their communication and presentation skills, both written and oral, to effectively convey technical concepts, project findings, and design solutions to diverse audiences.

Ethical and Professional Values: The program will instill ethical and professional values in students, emphasizing integrity, accountability, and responsibility in their work as future electronics professionals.

Preparation for Career and Further Study: Graduates will be well-prepared for entry-level positions in industries such as telecommunications, consumer electronics, automotive electronics, and IoT, as well as for advanced study in graduate programs or professional certifications.

These program outcomes aim to equip graduates with a solid foundation in electronics and the skills necessary to succeed in both industry and further academic pursuits.

Conclusion

In conclusion, the program outcomes of a Bachelor of Science major in Electronics are designed to equip students with a comprehensive understanding of electronics principles, hands-on skills in design and implementation, and the ability to adapt to emerging technologies and industry trends. Through a blend of theoretical coursework, practical laboratory experiences, and collaborative projects, graduates are prepared to tackle real-world challenges in fields such as telecommunications, healthcare, manufacturing, and beyond. By emphasizing critical thinking, communication, ethical responsibility, and lifelong learning, the program cultivates well-rounded professionals capable of driving innovation, contributing to global connectivity, and shaping the future of technology. With a solid foundation in electronics and a commitment to excellence, graduates are poised to thrive in diverse career paths, pursue advanced studies, and make meaningful contributions to society as electronics engineers and leaders in their respective fields.

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 Major (Core) Subject and any other subject 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	DSC	B-EL111T	Paper 1:- Basic circuit components and network analysis	4.5	2
		B-EL112P	DSC Lab		1
2	GE	B-EL113T	Basics of Electronics-I		2
		B-EL114T	Basics of Electronics-II		2
3	VSEC	B-EL115P	Introduction to basic electronics components and their working		2
4	IKS	B-EL116T	Ancient Indian Metal Working and Engineering		2
Total					11

Table 2: B.Sc. Semester II

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-EL121T	Paper 1:- Fundamental of Digital Electronics	4.5	2
		B-EL122P	DSC Lab		1
2	GE	B-EL123T	Electronics Components – I		2
		B-EL124T	Electronics Components – II		2
3	VSEC	B-EL125P	Practical based on power supply making and repairing		2
4	IKS	B-EL126T	Indian Knowledge System		2
Total					11

Table 3: B.Sc. Semester III

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-EL231T	Paper 1:- Semiconductor Device Analysis	5.0	2
		B-EL232T	Paper 2:- Advanced digital electronics		2
		B-EL233P	DSC Lab		2
2	Minor	B-EL234T	Paper 1:-Basics of Semiconductor Devices		2
		B-EL235T	Paper 2:-Basics of Digital Electronics		2
		B-EL236P	Minor Lab		2
3	GE	B-EL237P	Basics of Semiconductor Devices-I		2
4	VSEC	B-EL238P	Introduction to C Programming		2
6	FP	B-EL239P	Field Project		2
Total					18

Table 4: B.Sc. Semester IV

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-EL241T	Paper 1:- Analogue Circuits	5.0	2
		B-EL242T	Paper 2:- Linear integrated circuits		2
		B-EL243P	DSC Lab		2
2	Minor	B-EL244T	Paper 1:- Introduction to Analogue Circuits		2
		B-EL245T	Paper 2:-Introduction to Linear Integrated Circuits		2
		B-EL246P	Minor Lab		2
3	GE	B-EL247P	Basics of Semiconductor Devices-II		2
4	VSEC	B-EL248P	Analysis and design of analogue integrated circuits such as voltage regulators, oscillators		2

			and active filters		
6	CEP	B-EL248P	Community Service		2
Total					18

Table 5: B.Sc. Semester V

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-EL351T	Paper 1:- Basic communication Electronics	5.5	3
		B-EL252T	Paper 2:- Analogue and Digital Circuits		3
		B-EL353P	DSC Lab based on Paper 1 and Paper 2		3
		B-EL354T	Paper 3:- Digital Communication systems		2
		B-EL356P	DSC Lab based on Paper 3		1
2	DSE	B-EL356T	Elective 1:- Renewable Energy Systems OR		2
		B-EL136(1)T	Elective 2:- Digital Signal Processing (DSP)		
		B-EL357P	DSE Lab based on B-ST156T		2
		B-EL357(1)P	DSE Lab based on B-ST156(1)T		
3	Minor	B-EL358T	Paper 1:-Foundation of Communication Electronics		2
		B-EL359P	Minor Lab		2
4	VSEC	B-EL3510P	Hands-On Introduction to Wireless Communication Systems		2
5	CEP	B-EL3511P	Community Service		1
Total					23

Table 6: B.Sc. Semester VI

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-EL361T	Paper 1:- Microprocessor Programming and interfacing	5.5	3
		B-EL362T	Paper 2:- Microcontroller 8051 and its applications		3
		B-EL363P	DSC Lab		3
		B-EL364T	Paper 3:- Python Programming		2
		B-EL365P	DSC Lab based on Paper 3		1
2	DSE	B-EL366T	Elective 3:- Internet of Things (IoT) OR		2
		B-EL366(1)T	Elective 4:- Advanced Semiconductor Fabrication Techniques		
		B-EL367P	DSE Lab based on B-ST166T		2
		B-EL367(1)P	DSE Lab based on B-ST166(1)T		
4	VSEC	B-EL358P	Hands-on experience in building IoT prototypes using sensors, actuators and microcontrollers		2
5	OJT	B-EL369P	Internship / Apprenticeship (Related to DSC)		4
Total					22

Table 7: B.Sc. Semester-VII (Honors)

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-ELH471T	Paper 1:- Fuzzy logic and Artificial Neural Network	6.0	4
		B-ELH472T	Paper 2:- Microwave and Optical Communication		4
2	DSE	B-ELH473T	Elective 5:- Introduction to artificial intelligence and machine learning OR		4
		B-ELH473(1)T	Elective 6:- Electromagnetic fields and antennas		
3	DSC /DSE	B-ELH474P	Lab based on B-ELH471T, B-ELH472T and (B-ELH473T or B-ELH473(1)T)		6
4	RM	B-ELH475T	Research Methodology		4
Total					22

Table 8: B.Sc. Semester-VIII (Honors)

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-ELH481T	Paper 1:- Embedded Systems Design	6.0	4
		B-ELH482T	Paper 2:- Optoelectronics and Photonics		4
2	DSE	B-ELH483T	Elective 7:- Molecular Electronics		4
		B-ELH483(1)T	Elective 8:- Wireless Sensor Networks		
3	DSC /DSE	B-ELH484P	Lab based on B-STH481T, B-STH482T and (B-STH483T or B-STH483(1)T)		6
4	OJT	B-ELH485P	Internship / Apprenticeship (Related to DSC)		4
Total					22

Table 9: B.Sc. Semester VII (Honors with Research)

Sr No	Course Category	Course Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-ELR471T	Paper 1:- Fuzzy logic and Artificial Neural Network	6.0	4
		B-ELR472T	Paper 2:- Microwave and Optical Communication		4
2	DSE	B-ELR473T	Elective 5:- Introduction to artificial intelligence and machine learning OR		4
		B-ELR473(1)T	Elective 6:- Electromagnetic fields and antennas		
3	DSC /DSE	B-ELR474P	Lab based on B-STR471T, B-STR472T and (B-STR473T or B-STHR473(1)T)		2
4	RM	B-ELR474T	Research Methodology		4
5	RP	B-ELR475P	Research Project / Dissertation (Core)		4
Total					22

Table 10: B.Sc. Semester-VIII (Honors with Research)

Sr No	Course Category	Courses Code	Name of the course (Title of the Paper)	Level	Total Credit
1	DSC	B-ELR481T	Paper 1:- Embedded Systems Design	6.0	4
		B-ELR482T	Paper 2:- Optoelectronics and Photonics		4
2	DSE	B-ELR483T	Elective 7:- Molecular Electronics		4
		B-ELR483(1)T	Elective 8:- Wireless Sensor Networks		
3	DSC /DSE	B-ELR484P	Lab based on B-STR481T, B-STR482T and (B-STR483T or B-STR483(1)T)		2
4	RP	B-ELR485P	Research Project / Dissertation 1 (Core)		4
		B-ELR486P	Research Project / Dissertation 2 (Core)		4
					22

Total Credits:

1. Three-Year UG Degree Program: 132

2. Four-Year UG Degree Program: 176

List of Vocational Skill Courses (VSC) available with 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-EL115P	Introduction to basic electronics components and their working	2	4
2	I	II	B-EL125P	Practical based on power supply making and repairing	2	4
3	III	VI	B-EL358P	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	III	B-EL238P	Introduction to C Programming	2	4
2	I	IV	B-EL248P	Analysis and design of analogue integrated circuits such as voltage regulators, oscillators and active filters	2	4
3	II	V	B-EL3510P	Hands-On Introduction to Wireless Communication Systems	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-EL234T	Paper 1:- Basics of Semiconductor Devices	2	2
2			B-EL235T	Paper 2:- Basics of Digital Electronics	2	2
3			B-EL236P	Minor Lab based on Paper I and II	2	4
4	II	IV	B-EL244T	Paper 1:- Introduction to Analogue Circuits	2	2
5			B-EL245T	Paper 2:- Introduction to Linear Integrated Circuits	2	2
6			B-EL246P	Minor Lab based on Paper I and II	2	4
10	III	V	B-EL358T	Paper 1:- Foundation of Communication Electronics	2	2
11			B-EL359P	Minor Lab based on Paper I	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-EL113T	Basics of Electronics-I	2	2
2	I	I	B-EL114T	Basics of Electronics-II	2	2
3	I	II	B-EL123T	Electronics Components – I	2	2
4	I	II	B-EL124T	Electronics Components – II	2	2
5	II	III	B-EL237P	Basics of Semiconductor Devices-I	2	2
6	II	IV	B-EL247P	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 50 % marks in each theory course/paper, taking CIE & SEE together and also not less than 25 % marks in SEE. 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

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SYLLABUS

SEMESTER I

DSC FOR ELECTRONICS MAJOR		
Paper Code: B-EL111T	**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, Capacitive transducer-by changing dielectrics & changing distance	**(7.5Hrs)**

	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).

DSC LAB FOR ELECTRONICS MAJOR		
Paper Code: B-EL112P	**PRACTICALS Based ON DSC**	
Course type- Practical	**No. of credits – 1**	**No. of contact hours – 30**

Practical No.	**Content**
Practicals on DSC – 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.

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL113T	**Title:: Basics of Electronics – I**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

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..

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

Unit No.	Content	No. of Hours
Unit - I	The Structure of Matter, Elements, Compounds and Molecules, Atomic Structure, Electronic configuration, Valence Electrons, Valence of an atom, Conductors, Insulators and Semiconductors, Numerical Problems.	**(7.5Hrs)**
Unit -II	Electric Charge, Electric Current, Potential and Potential Difference, Resistance and Resistivity, Conductance and Conductivity. Numerical Problems.	**(7.5Hrs)**
Unit - III	Circuit Fundamentals, what is a circuit? Ohms law, Linear and Non-linear resistor, Work and Power, Series and Parallel arrangement of cells, Numerical Problems.	**(7.5Hrs)**
Unit - IV	Switches and their types, fuses, Series and Parallel arrangement of resistors, IR drops, potential divider circuit, Numerical Problems.	**(7.5Hrs)**

REFERENCES:

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, Notion Press (2021).

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL114T	**Title:: Basics of Electronics – II**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

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

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

Unit No.	Content	No. of Hours
Unit - I	Series adding and opposing voltages, proportional voltage formula in a series circuit, Series voltage dividers, Opens in a series circuit, Numerical Problems.	**(7.5Hrs)**
Unit -II	Shorts in a series circuit, Parallel Circuits, laws of parallel circuits, proportional current formula, opens and shorts in a parallel circuit, Numerical Problems.	**(7.5Hrs)**
Unit - III	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.	**(7.5Hrs)**
Unit - IV	Network graphs & matrices; Solutions methods: nodal and mesh analysis, Numerical Problems.	**(7.5Hrs)**

REFERENCES:

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, Notion Press (2021).

VSC AVAILABLE WITH ELECTRONICS AS MAJOR OR MINOR		
Paper Code: B-EL115P		**Title:: Introduction to basic electronics components and their working**
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Practical No.	**Content**
	Introduction to Electronics:
1	Overview of electronics and its importance.
2	Historical background and key milestones in electronics.
	Electronic Components Overview:
4	**Introduction to basic electronic components**: resistors, capacitors, inductors, diodes, transistors.
5	**Resistor Fundamentals:** Understanding resistor types, values, and color codes, Resistor networks and applications.
6	**Capacitor Basics:** Capacitor types, capacitance, voltage ratings, and markings, Capacitor applications in circuits.
7	**Inductor Principles:** Types of inductors, inductance, and factors affecting inductance, Inductor applications and characteristics.
8	**Semiconductor Devices:** Introduction to diodes: PN junction, forward and reverse biasing, characteristics, Basics of bipolar junction transistors (BJTs) and field-effect transistors (FETs).
9	**Circuit Construction Techniques:** Connecting components on a breadboard, Soldering fundamentals: soldering techniques and safety precautions.
10	**Basic Circuit Analysis:** Ohm's Law and its applications, Kirchhoff's Laws: voltage and current laws, Thevenin's and Norton's theorems.
	Practical Circuit Design, troubleshooting, application and safety:
11	**Circuit Design:** Designing basic circuits using electronic components and verifying their functionality.
12	**Troubleshooting:** Techniques for identifying and rectifying common circuit errors, Using multimeters and oscilloscopes for troubleshooting.
13	**Applications:** Practical applications of basic electronic circuits, Hands-on projects to reinforce learning and creativity.
14	**Safety:** Safety precautions when working with electronic components and circuits, Proper handling of tools and equipment.
Assessment of participants' understanding through practical exercises and quizzes.	

IKS FOR ELECTRONICS MAJOR		
Paper Code: B-EL116T	**Title:: Ancient Indian Metalworking and Engineering**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

The course aims to elucidate ancient Indian metalworking practices, covering metallurgical techniques, technological advancements, tools, trade networks, and their enduring legacy.

OUTCOMES

Participants will gain a deep understanding of ancient Indian metalworking practices, including metallurgical techniques, technological advancements, tools, trade networks, and their enduring legacy, preparing them for further exploration and research in the field.

Unit No.	Content	No. of Hours
Unit - I	**Foundations of Ancient Indian Metalworking:** Introduction to ancient Indian civilizations and their metallurgical practices. Overview of metalworking materials, including copper, bronze, iron, gold, and silver. Exploration of ancient Indian techniques of metal extraction, alloying, and shaping.	**(7.5Hrs)**
Unit -II	**Indus Valley Civilization: Technological Advancements:** In-depth study of metalworking and engineering techniques of the Indus Valley Civilization. Analysis of artifacts and archaeological evidence from Harappa and Mohenjo-Daro.Examination of urban planning, architecture, and hydraulic engineering achievements.	**(7.5Hrs)**
Unit - III	**Techniques and Tools of Ancient Indian Metalworking:** Detailed exploration of metal working techniques such as casting, forging, soldering, and engraving. Study of ancient Indian metalworking tools and equipment. Hands-on demonstrations or virtual simulations of ancient metal working processes.	**(7.5Hrs)**
Unit - IV	**Trade, Commerce, and Legacy:** Discussion on the role of metal and engineering in ancient Indian trade networks. Exploration of the economic and cultural impact of metal working. Analysis of the legacy of ancient Indian metal working and its influence on later civilizations.	**(7.5Hrs)**

REFERENCES:

1	"The Ancient Indus Valley: New Perspectives" edited by Jane McIntosh ABC-CLIO, Inc. ISBN 978-1-57607-907-2 (hard copy : alk. paper) — ISBN 978-1-57607-908-9 (ebook).
2	"The Lost River: On The Trail of the Sarasvati" by Michel Danino, Published January 1, 2010 by Penguin Books India ISBN 9780143068648 (ISBN10: 0143068644) .
3	Copper and Bronze in Art: Corrosion, Colorants, Conservation" by David A. Scott.
4	Ghosh JK, Mitra, SK and Parthasarathy KR (1992), Glimpses of India's Statistical Heritage, Wiley Eastern, New Delhi.
5	Research articles and documentaries.

INSTITUTE OF SCIENCE, NAGPUR

(An Autonomous Institute of Government of Maharashtra)

SYLLABUS

SEMESTER II

DSC FOR ELECTRONICS MAJOR		
Paper Code: B-EL121T	**Title:: Fundamental 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).

DSC LAB FOR ELECTRONICS MAJOR		
Paper Code: B-EL122P	**PRACTICALS Based ON FUNDAMENTALS OF DIGITAL ELECTRONICS**	
Course type- Practical	**No. of credits – 1**	**No. of contact hours – 30**

Practical No.	**Content**
Practicals on DSC – FUNDAMENTALS OF DIGITAL ELECTRONICS	
1	To study identification of Logic gates and verification of its truth table.
2	To realize and verify the operation of basic gates from Universal gates.
3	To Study De'Morgan's Theorems.
4	To construct & verify logic structure for given Boolean expression.
5	To Study construction of Half adder And Full adder.
6	To Study 4 bit parallel binary adder operation.
7	To Study decoder and encoder circuit.
8	To study multiplexer and de-multiplexer circuit.
9	To study SR, CKRS and D FFS.
10	To study JK and JKMS Flip-Flop

VSC AVAILABLE WITH ELECTRONICS AS MAJOR OR MINOR		
Paper Code: B-EL123P	Practical based on power supply making and repairing	
Course type- Practical	**No. of credits – 2**	**No. of contact hours – 60**

Practical No.	**Content**
	Building a basic linear power supply
1	Provide students with a circuit diagram and component list for a simple linear power supply.
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 resolve the issue.
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.
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.
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 beforeproceeding 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.

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL124T	**Title::** Electronics Components - I	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

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

OUTCOMES

By course end, students will adeptly understand and analyze passive circuit components (resistors, inductors, capacitors), design circuits utilizing their properties, evaluate their configurations' impact on performance, and apply this knowledge to solve practical circuit problems, distinguishing between capacitors and batteries.

Unit No.	Content	No. of Hours
Unit - I	Passive Circuit Elements, Resistors, Resistors Types, Power Rating, Color Code, Value Tolerance, Variable Resistors, Inductor, Types and comparison.	**(7.5Hrs)**
Unit -II	Inductance, Mutual Inductance, Coefficient of coupling, Variable Inductors, Inductors in series /parallel, stray inductance.	**(7.5Hrs)**
Unit - III	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.	**(7.5Hrs)**
Unit - IV	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.	**(7.5Hrs)**

REFERENCES:

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, Notion Press (2021).

GE / OE AVAILABLE WITH ANY MAJOR SUBJECT OTHER THAN FACULTY SCIENCE AND TECHNOLOGY		
Paper Code: B-EL125T	**Title::** Electronics Components - II	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

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

OUTCOMES

By course end, students will proficiently grasp the fundamental principles and workings of active circuit elements; including cells, batteries, diodes, transistors, and optoelectronic devices, analyze energy sources, understand voltage-current relationships in cells and batteries, and appreciate the significance of integrated circuits and semiconductor chips in modern electronics.

Unit No.	Content	No. of Hours
Unit - I	Active Circuit Elements: Energy Sources, Cell and Battery, Different type of dry cells, Cell life	**(7.5Hrs)**
Unit -II	Voltage and Current of a cell, Battery rating, Photovoltaic Cell, Solar Cell.	**(7.5Hrs)**
Unit - III	Concept of a Diode, P-N Junction Diode, Concept of transistor, Concept of integrated circuit.	**(7.5Hrs)**
Unit - IV	Optoelectronic devices examples, LED, Photodiode, Phototransistors, concept of semiconductor chip.	**(7.5Hrs)**

REFERENCES:

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, Notion Press (2021).

IKS FOR ELECTRONICS MAJOR		
Paper Code: B-EL126T	**Title:: Ancient Indian Metalworking and Engineering**	
Course type- Theory	**No. of credits – 2**	**No. of contact hours – 30**

OBJECTIVES

The course aims to elucidate ancient Indian metalworking practices, covering metallurgical techniques, technological advancements, tools, trade networks, and their enduring legacy.

OUTCOMES

Participants will gain a deep understanding of ancient Indian metalworking practices, including metallurgical techniques, technological advancements, tools, trade networks, and their enduring legacy, preparing them for further exploration and research in the field.

Unit No.	Content	No. of Hours
Unit - I	**Foundations of Ancient Indian Metalworking:** Introduction to ancient Indian civilizations and their metallurgical practices. Overview of metalworking materials, including copper, bronze, iron, gold, and silver. Exploration of ancient Indian techniques of metal extraction, alloying, and shaping.	**(7.5Hrs)**
Unit -II	**Indus Valley Civilization: Technological Advancements:** In-depth study of metalworking and engineering techniques of the Indus Valley Civilization. Analysis of artifacts and archaeological evidence from Harappa and Mohenjo-Daro.Examination of urban planning, architecture, and hydraulic engineering achievements.	**(7.5Hrs)**
Unit - III	**Techniques and Tools of Ancient Indian Metalworking:** Detailed exploration of metal working techniques such as casting, forging, soldering, and engraving. Study of ancient Indian metalworking tools and equipment. Hands-on demonstrations or virtual simulations of ancient metal working processes.	**(7.5Hrs)**
Unit - IV	**Trade, Commerce, and Legacy:** Discussion on the role of metal and engineering in ancient Indian trade networks. Exploration of the economic and cultural impact of metal working. Analysis of the legacy of ancient Indian metal working and its influence on later civilizations.	**(7.5Hrs)**

REFERENCES:

1	"The Ancient Indus Valley: New Perspectives" edited by Jane McIntosh ABC-CLIO, Inc. ISBN 978-1-57607-907-2 (hard copy : alk. paper) — ISBN 978-1-57607-908-9 (ebook).
2	"The Lost River: On The Trail of the Sarasvati" by Michel Danino, Published January 1, 2010 by Penguin Books India ISBN 9780143068648 (ISBN10: 0143068644) .
3	Copper and Bronze in Art: Corrosion, Colorants, Conservation" by David A. Scott.
4	Ghosh JK, Mitra, SK and Parthasarathy KR (1992), Glimpses of India's Statistical Heritage, Wiley Eastern, New Delhi.
5	Research articles and documentaries.