SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

Three Years- Six Semesters Bachelor's Degree Programme

3 Years B.Sc. /4 Year B.Sc. (Hons) & 4 Year B.Sc. (Hons with Research) Programme

Faculty of

Science and Technology

(Science Group)

Subject: **ELECTRONICS**

(Semesters III and IV)

Effective from Academic Year 2026-27

(As per Uniform NEP 2020)

Contents

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
FACULTY: Science and Technology
Subject: ELECTRONICS
Teaching and Learning Scheme for the Degree of Bachelor of Science (B.Sc.)
Three Years / Four Years - (Six/ Eight Semesters) Bachelor Degree Programme

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination & Evaluation Assessment	Theory					Theory (Total)		Practical					Practical (Total)	
			External			Internal				External			Internal			
			Max Marks	Min Marks	Duration (Hrs.)	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Duration (Hrs.)	Max Marks	Min Marks	Max Marks	Min Marks
A	**Major**	External & Internal	**30**	**9**	**2**	**20**	**6**	**50**	**20**	**25**	**10**	**4**	**25**	**10**	**50**	**20**
	IKS Major Specific		**30**	**9**	**2**	**20**	**6**	**50**	**20**	**--**	**--**		**--**	**--**	**--**	**--**
B	**Minor**		**30**	**9**	**2**	**20**	**6**	**50**	**20**	**25**	**10**	**4**	**25**	**10**	**50**	**20**
C	**Generic/ Open Elective**		**30**	**9**	**2**	**20**	**6**	**50**	**20**	**--**	**--**		**--**	**--**	**--**	**--**
D	**VSC**	**Internal**	**---**	**---**						**--**	**--**		**50**	**20**	**50**	**20**
	SEC	**Internal**	**---**	**---**						**--**	**--**		**50**	**20**	**50**	**20**
F	**Internship/ Apprenticeship**	**Internal**	Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process shall be prescribed separately													
	FP/CES															
	CC															

Internal Assessment for Theory/Practical/Laboratory:

All the internal assessments should be conducted on the basis of Continuous Assessment Tests (CAT).

Continuous Assessment Tests (CAT):

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under

i. Three CAT each of 10 Marks (Theory) and 10 Marks (Practical).
   - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
   - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
   - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days. .

ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.

iii. Total Performance in CAT (i.e.40 %) shall be based on the best two out of three in CAT examinations

iv. Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

External Assessment for Practical (Major/ Minor Lab):

- Practical Performance : 20 Marks
- Viva-Voce : 05 Marks
- **Total : 25 Marks**
- Duration of Examination : 04 Hrs.

Internal Assessment for Practical (Major/ Minor Lab):

- Internal Assessment based on CAT : 15 Marks
- Record Book : 10 Marks
- **Total : 25 Marks**

Internal Assessment for Practical (SEC/ VSC Lab):

- Internal Assessment based on CAT : 20 Marks
- Record Book : 10 Marks
- Attendance : 10 Marks
- 10 MCQ/short Question : 10 Marks
- **Total : 50 Marks**
- Duration of End Semester Examination: 04 Hrs.

Evaluation and Assessment for FP/CES:

- Project Report: The final report will be assessed based on its content, organization, and the quality of the research. (20 Marks)
- Oral Presentation: The presentation will be evaluated on clarity, engagement, and the ability to answer questions. (10 Marks)
- Faculty Evaluation: The faculty mentor will assess the student's performance throughout the project. (20 Marks)
- **Total 50 Marks**

Note: The external assessments of theory courses will be conducted in accordance with the guidelines issued by the SGBA University.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
FACULTY: Science and Technology
Subject: ELECTRONICS
Teaching and Learning Scheme: for the Degree of Bachelor of Electronics (B.Sc.)
Three Years / Four Years- (Six / Eight Semesters) Bachelor's Degree Programme

SECOND YEAR: Level 5.0 - SEMESTER – III (T & L Credit Scheme)

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field/ Online/ Hybrid	a.	Major	Electronics Theory 3	113212	Electronic Devices and Circuits- I	2	2	10
			Electronics Theory 4	113213	Digital Techniques- I	2	2	
			Electronics Lab/Practical-6	113215	Practical based on Theory 3 & 4	2	4	
		IKS - SS	IKS-Electronics Theory	113214	Evolution of Number System in Ancient India	2	2	
	b.	Minor	Electronics Theory 3	113216	Electronic Circuits and Digital Techniques- I	2	2	6
			Electronics Lab/Practical-7	113217	Practical based on Electronic Circuits and Digital Techniques- I	2	4	
	c.	Generic/ Open Elective	Electronics Theory 5	113218	Solar Power Plant Installation and Maintenance	2	2	2
	d.	VSC	Lab/Practical-8	113219	Advanced Practical on Major Electronics	2	4	4
	e.	FP/ CES	Project	113220	Field Project / CE Services on Electronics	2	4	8
		CC	Outdoor			2	4	
		TOTAL				**20**	**30**	**30**

Major Theory 3 – Electronic Devices and Circuits- I

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113212	Electronic Devices and Circuits- I	2	30	2 Hrs	30

Course Objectives:	• Read, understand, and interpret electrical/electronic circuits through verbal, mathematical and graphical methods. • To give need-based education in Electronics of the highest quality at the undergraduate level. • Use Information Communication Technology to gather knowledge. • Impart skills required to gather information from resources. • Equip students in methodology related to electronic circuits, devices and systems.
Course Outcomes:	**After completing the course, the student will** • Identify electronic components and ICs. • Design system components that meet the requirement of public safety and offer solutions to the societal and environmental concerns. • Apply research-based knowledge to design and conduct experiments. • Construct, choose and apply the techniques, resources and modern electronics tools required for Electronics applications. • Utilize the basic knowledge in Electronics science. • Apply Electronics knowledge in their day-to-day life.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Hybrid-parameters & Cascaded amplifiers**: Hybrid-parameters, Transistor equivalent circuit of CE, CB and CC, Analysis of small signal CE amplifier. Concept of cascaded amplifier, Types of coupling, RC Coupled Amplifier, Direct Coupled amplifier, Transformer Coupled amplifier and Single Tuned amplifier.	8 Hrs	8 Marks	Besides classroom teaching demonstration of components and measuring instruments (physically and/or virtually), wherever applicable.
Unit II	**Power Amplifier**: Classification of power amplifier, Class A, Class B, Class C and Class AB amplifiers. Construction, working and efficiency of Class A - transformer coupled amplifier and Class-B Push-pull amplifier, Crossover Distortion, Complementary symmetry Class-B Push-pull amplifier.	7 Hrs	7 Marks	
Unit III	**Feedback Amplifiers and Oscillators**: Concept of feedback, Feedback theory, Positive and Negative feedback, Advantage of negative feedback,	8 Hrs	8 Marks	

	Physical idea of feedback amplifier: Block diagram only, Concept of oscillator, Basic elements of oscillator, Barkhausen Criteria of oscillation, Concept of tank circuit. RC oscillator: Phase shift and Wein bridge oscillator, LC oscillator: Colpitts and Hartley oscillator and Crystal oscillator.			
Unit IV	**Timer and Phase Locked Loop:** Functional block diagram of IC-555, Applications of IC 555: Astable, Bistable and Monostable multivibrators, Construction, working and time period of each. Functional block diagram of PLL IC-565, Concept of Capture range and Lock range, Pull in time, Electrical Characteristics.	7 Hrs	7 Marks	
References:	1. Integrated Electronics by Millman Halkias 2. Principles of Electronics by V. K. Mehta 3. Elements of Electronics by Bagde and Singh 4. Linear Integrated Circuits by Ramakant Gaikwad 5. Basic Electronics by B. L. Theraja (S. Chand and Company)			
Model questions for theory external examination.				
MCQs for Internal Assessment:	1.Hybrid means ……. a) Mixed b) Combination c) Added d) None 2. For a transistor number of h-parameters are: a) 2 b) 3 c) 4 d)1 3. The maximum overall efficiency of transformer coupled Class A power amplifier is. a) 78% b) 50% c) 60% d) 90% 4. Phase shift oscillator use_____circuits. (a) Tuned (b) LC (c) RC (d) All above 5. One of the following is not an oscillator a) Colpitts b) Wein-bridge c) Push pull d) Hartley 6. IC555 is called as _____ a) Timer b) amplifier c) counter d) None			
Short answer questions	1. Name Various types of Power Amplifier. 2. Classify the types of Coupling. 3. Write concept of Cascaded Amplifier. 4. Write Concept of Tank Circuit. 5. Write Barkhausen Criteria of Oscillation. 6. State applications of IC 555. 7. What is PLL? 8. Explain Lock in range.			
Long answer questions	1. Draw Hybrid equivalent circuit diagram of CE amplifier and explain. 2. Explain Class-A amplifier with its efficiency. 3. Explain construction and working of Hartley Oscillator 4. Explain construction and working of IC 555 as Astable Multivibrator.			

Major Theory 4 – Digital Techniques- I

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113213	Digital Techniques- I	2	30	2 Hrs	30

Course Objectives:	• To provide understanding about number systems. • To provide knowledge about Logic Gates & Boolean Laws. • To provide knowledge about digital ICs and its applications in the circuits. • To provide knowledge of Logic families.
Course Outcomes:	**After completing the course, the student will** • Student will be able to understand about number systems. • Design various circuits using Logic Gates & Boolean Laws. • Able to make various applications of digital ICs. • Will acquire the knowledge about Logic families and its characteristics.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Binary Arithmetic**: Binary, Octal & Hexadecimal number system and their inter conversion, Binary arithmetic: Addition and Subtraction using 1's & 2's compliments, Multiplication & Division. Binary codes: 8421 BCD, Excess-3 & Gray code.	8 Hrs	8 Marks	• Besides classroom teaching demonstration of semiconductor devices and its applications (physically and/or virtually), wherever applicable. • Process of IC fabrication using virtual tools.
Unit II	**Logic Gates:** Definition and truth tables of NOT, OR, AND, NAND, NOR gates. EX-NOR & EX-OR gates, Universal gates, Designing of Basic gates using NAND and NOR gates, Half adder, Full adder, 4-bit binary full adder.	7 Hrs	7 Marks	
Unit III	**Boolean Algebra:** Boolean laws, De-morgan's theorem, Simplification of Boolean equations using Boolean algebra, Fundamental Products & Sum terms, K-maps: upto 4 and 8 variables.	8 Hrs	8 Marks	
Unit IV	**Logic Families:** Classification of logic families, Characteristics of logic families: Fan-in, Fan-out, Noise immunity, Prorogation delay, Power dissipation; DTL, TTL & CMOS logic.	7 Hrs	7 Marks	

References:	1. Digital and analog technique by Navneet, Kale and Gokhale (Kitab mahal prakashan) 2. Introduction to digital electronics by Mohinder Singh 3. Digital principle and application by Malvino and Leach 4. Modern digital electronics by R. P. Jain 5. Pulse, digital and switching waveforms by Millman and Taub 6. Principle of electronics by V. K. Mehta 7. Basics of electronics by B. L. Theraja 8. Digital principle and application by Malvino and Leach
Model questions for theory external examination.	
MCQs for Internal Assessment:	1. The base of octal number system is: (a) 2 (b) 4 (c) 8 (d) 16 2 . The base of Hexadecimal number system is: 1. 2 (b) 4 (c) 8 (d) 16

	3.1's complement of 010 l is: (a) 111 l (b) 1100 (c) 1010 (d) None 4. The Boolean equation of OR gate is : (a) A+ B (b) AB (c) AB (d) $A+B$ 5.According to Boolean law : A + 1 = ? a) 1 b) A c) 0 d) A' 6. IC stands for _____. (a) Integrated circuit (b) Ionization current (c) Inverse current (d) Integrated current 7. ---- cannot be fabricated in an IC. (a) Transistors (b) Diodes (c) Resistors (d) Inductors 8. The LED emits light only when it is in ---- biased. 2. (a) forward (b) reverse (c) inverse (d) none.
Short answer questions	1. What is Number system? 2. Define Decimal Number system. 3. Draw the symbol of Basic gates. 4. Define Universal gates. 5. Write scale of integration of IC's. 6. Write steps of fabrication of monolithic IC's. 7. What is SSI? 8. State De-Morgans Theorem.
Long answer questions	1. Explain 8421 BCD code and Excess-3 code. 2. Write symbol, truth table and Boolean equation of Basic gates. 3. State and prove De-Morgans theorems. 4. Explain fabrication of diode in IC. 5. Explain characteristics of logic families.

IKS Electronics Theory: Evolution of Number System in Ancient India

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113214	**IKS - Evolution of Number System in Ancient India**	2	30	2 Hrs	30

Course Objectives:	• To understand the key features of Indian Numeral System. • Appreciate the key role India has played in advancement of Science & technology. • To Understand how measures for time, length and weight were used in Ancient India. • To identify the roots of modern-day binary system.
Course Outcomes:	**After completing the course, the student will** • Student will come to know about key features of Indian Numeral System. • Student will know about role India played in advancement of Science & technology. • Student will Understand how measures for time, length and weight were used in Ancient India. • Student will come to know about roots of modern-day binary system.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Gautama-Buddha on Number System, Historical Evidence, Silent features of the Indian numeral system and the concept of Zero and its importance.	8 Hrs	8 Marks	• Classroom teaching. • Visit to historical places. • Demo of ancient units of measurements.
Unit II	Large Numbers and their representation, place value of numerals and Decimal System.	7 Hrs	7 Marks	
Unit III	Measurements for time, distance and weight, Notion of Paramanu, Measures for length, Measures for time and Measures for weight.	8 Hrs	8 Marks	
Unit IV	Pingala and the Binary System, Identification of the Laghu and Guru as per Rules of Chandra Sastra, Eight Ganas Defined by Pingala and Laghus & Gurus in the Phrase.	7 Hrs	7 Marks	

References:	1 Introduction to Indian knowledge System- Concepts and Applications by Mahadevan, B. Bhat, Vinayak Rajat, Narendra, Narendra Pavana R. N. NAGENDRA PAVANA R.N.
Model questions for theory external examination.	
MCQs for Internal Assessment:	1. **Who is credited with treating zero as a number and providing arithmetic rules for it?** a) Aryabhata b) Bhaskara c) **Brahmagupta** d) Pingala

	2. Which text mentions numbers up to in a conversation with Buddha? a) **Lalitavistara Sutra** b) Arthashastra c) Lilavati d) Yajurveda 3. **In Pingala's Chhandasastra, what is the 'Laghu' symbol?** a) -- b) U c) 0 d) 1 4. **What is the earliest recorded use of a dot to represent zero?** a) **Bakhshali Manuscript** b) Gwalior Inscription c) Arthashastra d) Romaka Siddhanta 5. **What does 'Paramanu' represent?** a) A measurement of time b) A measurement of weight c) **The smallest indivisible particle** d) A type of poetic metr
Short answer questions	1. When was the concept of zero discovered in India? What is its special significance? 2. What are the uses of a word or letter in numeral system? 3. Why is a bhūta-samkhyā system called so? 4. Identify the numbers represented by the bhūta-samkhyā system in the following cases:(a) rama-chandra-guna-nanda-rtu-padāḥ (b) guna-adri-tri-veda-nayana-bhujangāḥ (c) pūrṇa-kha-śāstra-gruha-nanda-riṣi-vedāḥ 5. What is a binary cycle? Can you develop a binary cycle of length four and identify all possible binary words of length four?
Long answer questions	1. List down the key inferences that one can make about the Indian Mathematical tradition based on historical evidence. 2. What are the advantages of the Indian numeral system over the Roman numerals? Explain with the help of a few examples. 3. What are the key characteristics of a place-value system of numerals? How is it advantageous? 4. What do you understand by the term 'decimal system'? Where did it originate and what are its advantages? 5. Fill up the table below with correct answers.

1Nādikā =	Nimeṣa
1 Dhanus=	Dhanumusti
10 Laghus =	Lava
5 Bhāras =	Karṣa
1 Goruta =	Dhanus
20 Maśakas=	Sarṣapa
1 Muhūrta	Kāsthā
1 Anguli - parva	Likṣā - rajas

6. What are the differences between the katapayadi system and bhūta-samkhyä systems

Lab / Practical – 6: Practical based on Major Theory Papers 3 & 4

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113215	Practical based on Major Theory 3 & 4	2	60	4 Hrs	50

Course Objectives:	1. Develop skills amongst the students. 2. Identify the analog and digital electronic circuits.
Course Outcomes:	**After completing the course, the student will** 1. Students will be able to identify the analog and digital electronic circuits. 2. Develop skills amongst the students.

Contents

1) Study of CE Amplifier.
2) Study of CB Amplifier.
3) Study of Class B Push-pull Power Amplifier.
4) Study of RC Phase Shift Oscillator.
5) Study of Wein Bridge Oscillator.
6) Study of IC-555 as Astable Multivibrator.
7) Study of IC-555 as Monostable Multivibrator.
8) Study of IC-555 as Bistable Multivibrator.
9) Identification and Verification of Logic gates.
10) Identification and Verification of Universal gates.
11) Construct and study of Ex-OR gate using Basic gates.
12) Construct and study of Ex-NOR gate using Basic gates.
13) Construction and verification of De-Morgans Theorems.
14) Construct & study of Half Adder.
15) Construct & study of Full Adder
16) Construction and Study of IC-7483 as 4-bit parallel Adder.

Note : Students shall have to perform at least 10 experiments out of 16 prescribed as below:

Minor Theory 3 – Electronic Circuits and Digital Techniques- I

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113216	Electronic Circuits and Digital Techniques- I	2	30	2 Hrs	30

Course Objectives:	• Read, understand and interpret electrical/electronic circuits through verbal, mathematical and graphical methods. • To give need-based education in Electronics of the highest quality at the undergraduate level. • Use Information Digital Technology to gather knowledge. • Impart skills required to gather information from resources. • Equip students in methodology related to electronic circuits, devices and systems.
Course Outcomes:	**After completing the course, the student will** • Identify electronic components and ICs. • Design system components that meet the requirement of public safety and offer solutions to the societal and environmental concerns. • Apply research-based knowledge to design and conduct experiments. • Construct, choose and apply the techniques, resources and modern electronics tools required for Electronics applications. • Utilize the basic knowledge in Electronics science. • Apply Electronics knowledge in their day-to-day life.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Hybrid-parameters & Cascaded Amplifiers**: Hybrid-parameters, Transistor equivalent circuit of CE, CB and CC, Analysis of small signal CE amplifier. Concept of cascaded amplifier, Types of coupling, RC Coupled Amplifier, Direct Coupled amplifier, Transformer Coupled amplifier and Single Tuned amplifier.	8 Hrs.	8 Marks	Besides classroom teaching demonstration of components and measuring instruments (physically and/or virtually), wherever applicable.
Unit II	**Feedback Amplifier and Timer:** Concept of feedback, Feedback theory, Positive and negative feedback, Advantage of negative feedback, Physical idea of feedback amplifier: Block diagram only. Functional block diagram of IC-555, Applications of IC-555: Astable, Bistable and Monostable multivibrators, Construction, working and time period of each. ,	7 Hrs.	7 Marks	
Unit III	**Binary Arithmetic**: Binary, Octal & Hexadecimal number system and their inter conversion, Binary arithmetic Addition and Subtraction using 1's & 2's compliments, Multiplication & Division. Binary codes: 8421 BCD, Excess-3 & Gray code.	8 Hrs.	8 Marks	
Unit IV	**Logic Gates:** Definition and truth tables of NOT,	7 Hrs.	7 Marks	

	OR, AND, NAND, NOR gates. EX-NOR & EX-OR gates, Universal gates, Designing of Basic gates using NAND and NOR gates, Half adder, Full adder, 4-bit binary full adder.			
References:	1. Principles of electronics by V. K. Mehta 2. Elements of electronics by Bagde and Singh 3. Basic electronics by B. L. Theraja (S. Chand and Company) 4. Digital and analog techniques by Navneet, Kale and Gokhale (Kitab mahal prakashan) 5. Introduction to digital electronics by Mohinder Singh 6. Digital principles and applications by Malvino and Leach 7. Modern digital electronics by R. P. Jain			
Model questions for theory external examination.				
MCQs for Internal Assessment:	1. Cross over distortion occurred in …power amplifier a) Class A b) Push pull c) Class C d) None of the above 2.Class B push pull power amplifier consist of ..... transistor (a) 3 (b) 2 (c)1 (d) 4 3.Center tap transformer is needed in ..... Class B power amplifier (a) Transformer coupled (b) Push pull (c) Coupled (d) None of the above 4 The base of Hexadecimal number system is: (a) 2 (b) 4 (c) 8 (d) 16 5. The base of Binary number system is: (a) 2 (b) 4 (c) 8 (d) 16 6.1's complement of 011 l is: (a) 111 l (b) 1100 (c) 1010 (d) None 7. The Boolean equation of AND gate is: (a) A+ B (b) AB (c) AB (d) $A+B$ 8.According to Boolean law: A + 1 =? 1. a) 1 b) A c) 0 d) A’			
Short answer questions	1. Classify Power Amplifiers. 2. What is mean by Hybrid? 3. Write pin No. Of IC555. 4. How Many Pins IC 555? 5. Which gates are the Basic gates? 6. Define number System.			
Long answer questions	1. Draw the hybrid equivalent circuit of CE and Explain. 2. Explain construction and working of CB and Explain. 3. Explain construction and working of CC and Explain. 4. Draw the symbol, truth table and Boolean equation of NAND and NOR gates. 5. Define Number system? Also define Decimal, Binary, Octal and Hexadecimal number system.			

Minor Lab / Practical – 7: Electronic Circuits and Digital Techniques- I

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113217	Practical on Electronic Circuits and Digital Techniques- I	2	60	4 Hrs	50

Course Objectives:	1. Develop skills amongst the students. 2. Identify the analog and digital electronic circuits.
Course Outcomes:	**After completing the course, the student will** 1. Students will be able to identify the analog and digital electronic circuits. 2. Develop skills amongst the students.

Contents

1. Study of CE Amplifier.
2. Study of CB Amplifier.
3. Study of Class B Push-pull Power Amplifier.
4. Study of RC Phase Shift Oscillator.
5. Study of Wein Bridge Oscillator.
6. Study of IC-555 as Astable Multivibrator.
7. Study of IC-555 as Monostable Multivibrator.
8. Study of IC-555 as Bistable Multivibrator.
9. Identification and Verification of Logic gates.
10. Identification and Verification of Universal gates.
11. Construct and study Ex-OR gate using Basic gates.
12. Construct and study Ex-NOR gate using Basic gates.
13. Construction and verification of De Morgans Theorems.
14. Construct & study of Half Adder.
15. Construct & study of full Adder
16. Construction and Study of IC 7483 as a 4-bit parallel Adder.

Note : Students shall have to perform at least 10 experiments from prescribed list:

GOEC Theory 5: Solar Power Plant Installation and Maintenance

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113218	Solar Power Plant Installation and Maintenance	2	30	2 Hrs	30

Course Objectives:	1. To introduce students to various resources of renewable energy 2. To make students acquainted with the working principle of photovoltaic cell. 3. To develop practical skills required for installation and interfacing of solar panels. 4. To learn troubleshooting, repairing and proper maintenance of solar photovoltaic systems.
Course Outcomes:	After the completion of the course, students will be able to: 1. Identify and testing of photovoltaic cells and related components 2. Demonstrate various input and output running loads of devices, ratings and estimations. 3. Apply practical knowledge and skills regarding installation and interfacing of solar panels. 4. Time to time maintenance and updating of solar photovoltaic systems. 5. Troubleshooting, repairing and proper maintenance of solar photovoltaic systems.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	Need of renewable and sustainable energy; Various resources of renewable energy; Working principle of photovoltaic cell; Monocrystalline, Polycrystalline and Bifacial solar panels; Photovoltaic materials, Modules and arrays; Factors affecting output of photovoltaic modules.	8 Hrs	8 Marks	BoS shall be recommend suitable pedagogical strategies, both classical and contemporary innovations, for integration into the Teaching, Learning, and Evaluation (T, L, & E) Processes. These strategies should be tailored to enhance the delivery and comprehension of the course content within each Unit, ensuring that they align with the educational objectives and learning outcomes.
Unit II	Solar photovoltaic systems and key benefits; Block diagram of solar photovoltaic system; Solar charge controller; Interfacing of solar charge controller to battery station; PWM and MPPT type Inverters; Interfacing of batteries to power inverters.	7 Hrs	7 Marks	
Unit III	Calculations of Voltage, Current and Power ratings of photovoltaic systems; Installation of solar panels to a roof; On grid and off grid solar systems; Solar charge controllers; Testing and running of loads to PV systems.	8 Hrs	8 Marks	
Unit IV	Calculations of Voltage, Current and Power ratings of batteries and its charging time; Costing and estimation of 1KVA, 5KVA and 10KVA solar systems; Safety and	7 Hrs	7 Marks	

	maintenance of rechargeable batteries; Safety precautions, testing and troubleshooting of solar photovoltaic systems			
References:	1. Solanki C. S.; 'Solar Photovoltaic Technology & Systems: A Manual for Technicians & Engineers', PHI Publisher 2. Dr. Sundaravadivelu, Dr. Suresh Kumar; 'Solar Photovoltaic Power Systems: Principles, Design & Applications'; Notion Press Pvt. Ltd., 2018 Edition. 3. DIY Source; 'Solar Power for Beginners: A Technical Guide'; 2021 Edition. 4. A. K. Gupta; 'Solar PV Power and Solar Products Handbook'; NIIR Project Consultancy Services, First Edition 2022. 5. B. L. Theraja, 'Basic Electronics'; S. Chand & Company Publication, 2022 Edition.			
Model questions for theory external examination.				
MCQs for Internal Assessment	1. Bifacial solar panel accepts solar energy from -------- side. a) Top b) Bottom c) Both d) None 2. Factors affecting output voltage of photovoltaic modules are --------. a) Light Intensity b) Distance c) Panel material d) Above all 3. Solar panel consists of number of ---------- cells. a) Piezoelectric b) Solovoltaic c) Photovoltaic d) Monovoltaic 4. Power rating of any solar power plant is indicated in ----------. a) KPA b) KAV c) KPV d) KVA 5. The term KVA stands for ----------. a) Kilo Value Ampere b) Kilo Volt Amplitude c) Kilo Volt Ampere d) Kilo Watt Ampere			
Short answer questions	1. What is renewable energy? 2. What is photovoltaic cell? 3. What is Bifacial solar panel? 4. What is Solar charge controller? 5. What do you mean by on-grid and off-grid solar systems?			
Long answer questions	1. Explain the need of renewable and sustainable energy. 2. Explain the working principle of photovoltaic cell? 3. Compare Monocrystalline and Polycrystalline solar panels. 4. Explain on-grid and off-grid solar systems. 5. Explain block diagram of solar photovoltaic system.			

Vocational Skill Course 2: Lab/ Practical 8: Advanced applications/ practical on Major Electronics

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	III	113219	Advanced applications/ practical on Major Electronics	2	60	4 Hrs	50

Course Objectives:	● To reduce the unemployment by providing self- employment schemes. ● To make the students skilled technician. ● To reduce the mismatch between the demand and supply of skill man-power. ● To develop attitudes, knowledge, and skills for entrepreneurship and self-employment.
Course Outcomes:	**After successful completion of the course, the students will be able to:** ● Apply their practical knowledge/ hands on training in the workplace. ● It fulfills the demand of industry. ● It develops skilled technician. ● Start business-oriented services.
	Contents
Lab/ Practical 10	**Perform any five of the followings using Bread Board:** 1) Design any type of Power Amplifier. 2) Construct RC Phase Shift Oscillator. 3) Construct Wein Bridge Oscillator. 4) Design IC -555 as a Timer circuit. 5) Construct School Bell Using IC -555. 6) Construct Astable Multivibrator using IC -555. 7) Construct Monostable Multivibrator using IC -555. 8) Construct Bistable Multivibrator using IC -555. 9) Design Basic gates using NAND gates. 10) Design Basic gates using NOR gates. 11) Construct Half Adder circuit. 12) Construct Full Adder circuit. 13) Design Arithmetic logic circuit using gates.

Note: Mode of Examination: Internal Exam (There is no need of External Examiner)

Electronics FP/CES- Project

Electronics FP/CES- Project (113220)	
Field Project / CE Services in Electronics: Phase-I	
Credits: 02	**Workload (Hrs./Week): 04**
Course Objectives:	1. To provide hands-on experience in applying theoretical Electronics knowledge to real-world challenges through field-based projects or community engagement (CE) services. 2. To train students in identifying, problems encountered in Electronics and related fieldwork or community service activities. 3. To encourage students to integrate Electronics and field Electronics concepts with interdisciplinary knowledge, technology, and societal needs. 4. To develop students' abilities to document, present, and communicate their field-based or community engagement work effectively to diverse audiences. 5. To instill a sense of responsibility and service by involving students in projects that address community issues related to science and technology.
Course Outcomes:	1. Students will be able to apply Electronics related analytical techniques to investigate and solve real-world problems in field settings. 2. Students will demonstrate proficiency in using experimental tools, instruments, and data analysis methods relevant to their field project or CE service. 3. Students will be able to design, plan, and execute a field Electronics project or community service activity from inception to completion, including documentation and reporting. 4. Students will effectively communicate their project findings and outcomes through written reports, presentations, or community engagement events. 5. Students will demonstrate an understanding of the ethical, environmental, and societal impacts of their work, showing a commitment to responsible scientific practice and community well-being.
Guidelines/SOP for Selection and Implementation of Field Projects / CE Services	
1. Project Selection and Planning	• **Faculty Guidance:** Students will be assigned a faculty mentor to guide their project, providing expertise and resources. • **Project Topic:** The project topic should be relevant to Electronics and align with the student's interests and the available resources. • **Literature Review:** Students are expected to conduct a thorough literature review to understand existing knowledge and identify research gaps. • **Data Collection and Analysis:** Projects often involve experiments, field sampling , simulations, or data analysis from existing sources, depending on the topic. • Project Timeline: The total time allocation for the student to carry out field project is 60 hours. • The students shall have to submit the report regarding the project in printed form containing the project title, abstract, literature review and references, etc.

2. Data Analysis and Interpretation	• **Statistical Methods**: Students will learn and apply appropriate statistical methods to analyze data. • **Interpretation of Results:** Data should be interpreted within the context of the project, highlighting significant findings and limitations.
3. Report Writing and Presentation	• **Report Format**: A structured report format is usually followed, including an abstract, introduction, methodology, results, discussion, and conclusion. • **Data Presentation**: Data should be presented clearly and accurately using tables, graphs, and figures. • **Oral Presentation:** Students will be required to present their findings to peers and faculty.
4. CE Services (Community Engagement)	• **Community Needs**: Projects may focus on addressing specific community needs or challenges relevant to Electronics. • **Collaboration:** Students can collaborate with local organizations to implement their projects. • **Impact Assessment**: The impact of the project on the community should be evaluated**.**
5. Evaluation and Assessment	• **Project Report:** The final report will be assessed based on its content, organization, and the quality of the research. (20 Marks) • **Oral Presentation:** The presentation will be evaluated on clarity, engagement, and the ability to answer questions. (10 Marks) • **Faculty Evaluation:** The faculty mentor will assess the student's performance throughout the project. (20 Marks) • **Total 50 Marks**
Examples of Field Projects/CE Services in Electronics	• **Environmental Electronics**: Studying the local ecosystems and developing renewable energy solutions. • **Community Outreach:** Organizing Safety measures and awareness workshops or engaging in scientific literacy initiatives. • **Research Project:** Study related to the subject that contribute to the advancement of knowledge and the well-being of living things.

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
FACULTY: Science and Technology
Subject: ELECTRONICS
Teaching and Learning Scheme: for the Degree of Bachelor of Electronics (B.Sc.)
Three Years / Four Years- (Six / Eight Semesters) Bachelor's Degree Programme

SECOND YEAR: Level 5.0 - SEMESTER – IV (T & L Credit Scheme)

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/ Week)	Vertical Workload (Hrs/ Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field/ Online/ Hybrid	a	Major	Theory 5	113221	Electronic Devices and Circuits-2	2	2	10
			Theory 6	113222	Digital Techniques-2	2	2	
			Theory 7	113230	Microprocessor 8085 & 8086	2	2	
			Lab/Practical-9	113223	Practical based on Theory 5, 6 & 7	2	4	
	b	Minor	Theory 4	113224	Electronic Circuits and Digital Techniques-II	2	2	6
			Lab/Practical-10	113225	Practical on Minor Theory 4	2	4	
	c	Generic/ Open Elective	Theory 6	113226	Basics of Biomedical Instrumentation	2	2	2
	d	VSC	Lab/Practical-11	113227	Advanced Practical on Major Theory 5, 6 & 7	2	4	4
	f	FP/CES	Project	113229	Field Project / CE Services on Electronics	2	4	8
		CC	Outdoor	----	Separate SOP will be released	2	4	
		TOTAL				**20**	**30**	**30**

Major Theory 5 - Electronic Devices and Circuits-II

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113221	Electronic Devices and Circuits-II	2	30	2 Hrs	30

Course Objectives:	• Read, understand and interpret electrical/electronic circuits through verbal, mathematical and graphical methods. • To give need-based education in Electronics of the highest quality at the undergraduate level. • Use Information Communication Technology to gather knowledge. • Impart skills required to gather information from resources. • Equip students in methodology related to electronic circuits, devices and systems.
Course Outcomes:	**After completing the course, the student will** • Identify electronic components and ICs. • Design system components that meet the requirement of public safety and offer solutions to the societal and environmental concerns. • Apply research-based knowledge to design and conduct experiments. • Construct, choose and apply the techniques, resources and modern electronics tools required for Electronics applications. • Utilize the basic knowledge in Electronics science. • Apply Electronics knowledge in their day-to-day life.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Operational Amplifier:** Construction and working of Difference amplifier, Block diagram of OP-AMP, Characteristics of Ideal OP-AMP, Concept of virtual ground, Parameters of OP-AMP: Input impedance, Output impedance, Open loop gain, Close loop gain, CMRR, Slew rate, Input offset voltage and current, Input bias current.	8 Hrs	8 Marks	Besides classroom teaching demonstration of components and measuring instruments (physically and/or virtually), wherever applicable is expected.
Unit II	**Applications of OP-AMP:** OP-AMP as Inverting and Non-inverting amplifier, Adder, Subtractor, Differentiator and Integrator, Comparator and Voltage Follower.	7 Hrs	7 Marks	
Unit III	**Advanced Applications of OP-AMP:** Solution to simultaneous equations, Differential equation for Harmonic oscillator, Damped harmonic oscillator,	8 Hrs	8 Marks	

	Regenerative comparator, Logarithmic amplifier, Construction, working and time period of Astable, Monostable and Bistable multivibrators.			
Unit IV	**Analog to Digital and Digital to Analog converters:** Need of A/D and D/A converters. D/A converter: R-2R ladder type, Weighted resistor type, Sample and hold circuit, Definitions of Resolution, Accuracy and Linearity. A/D converter: Single and Dual slope, Counter type, Successive approximation type.	7 Hrs	7 Marks	
References:	1. Op-amp theory and application by Ramakant Gaykwad 2. Basic electronics by B. L. Thereja 3. Element of electronics by Bagde and Singh 4. Principles of electronics by V. K. Mehta 5. Integrated electronics by Millman Halkis 6. Linear integrated circuit by Ramakant Gaykwad 7. Digital principle and application by Malvino Leach			
Model questions for theory external examination.				
MCQ for Internal Assessment	1. An OP-AMP can be classified as _____ amplifier a) linear b) low-r_{in} c) positive feedback d)RC-coupled 2. Two input terminals of an Op-Amp are known as_____ a) Positive and Negative b) Differential and non-differential c) Inverting and non-inverting d) High and Low 3. A DAC is a_____ a) digital-to-analog computer b) digital analysis calculator c) data accumulation converter d) digital-to-analog converter 4. The number of comparators in a parallel conversion type 8-bit analog to digital converter is ? a) 8 b) 16 c) 255 d) 256 5. The Op-Amp Comparator circuit uses_____ a) Positive Feedback b) Negative Feedback c) Regenerative feedback d) No Feedback 6. When in a negative scalar, both $R_1$and R_f are reduced to zero, the circuit functions as_____ a) Integrator b) Subtractor c) Comparator d) Unity Follower 7. _____ analog-to-digital converters (ADCs) use no clock signal, because there is no timing or sequencing required. a) Actuator b) Dual c) Flash d) Bipolar 8. The problems of the binary-weighted resistor digital-to-analog converter (DAC) can be overcome by using _____. a) an 8-bit binary-weighted resistor DAC b) an R/2R ladder DAC c) a staircase DAC d) a flash DAC			

Short answer questions	1. Write ideal characteristics of Op-amp 2. What is virtual ground? 3. What is CMRR? 4. Define Accuracy. 5. Define Resolution. 6. Explain the term slew rate. 7. Explain A/D convertor. 8. Explain D/A convertor.
Long answer questions	1. Draw the block diagram of Op. Amp and explain each block. 2. Explain the Operational Amplifier as an adder. 3. Explain the harmonic oscillator. 4. Explain the Op Amp as an Astable multivibrator. 5. Explain the R-2R type D/A convertor. 6. Explain the successive approximation type A/D convertor.

Major Theory 6- Digital Techniques-II

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113222	Digital Techniques-II	2	30	2 Hrs	30

Course Objectives:	• Read, understand and interpret electrical/electronic circuits through verbal, mathematical and graphical methods. • To give need-based education in Electronics of the highest quality at the undergraduate level. • Use Information Digital Technology to gather knowledge. • Impart skills required to gather information from resources. • Equip students in methodology related to electronic circuits, devices and systems.
Course Outcomes:	**After completing the course, the student will** • Identify electronic components and ICs. • Design system components that meet the requirement of public safety and offer solutions to the societal and environmental concerns. • Apply research-based knowledge to design and conduct experiments. • Construct, choose and apply the techniques, resources and modern electronics tools required for Electronics applications. • Utilize the basic knowledge in Electronics science. • Apply Electronics knowledge in their day-to-day life.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Multivibrators and Flip Flops:** Construction & working of Astable, Monostable and Bistable Transistorized multivibrators, Flip Flops: Logic diagram, Truth table, construction & working of RS, CK-RS, JK, JKMS, T and D type Flip Flops Concept of Edge trigger Flip-Flop, Concepts of Preset & Clear terminals.	8 Hrs	8 Marks	Besides classroom teaching demonstration of components and measuring instruments (physically and/or virtually), wherever applicable is expected.
Unit II	**Shift registers and Counters:** **Shift registers**: Construction & working of SISO, SIPO, PISO & PIPO, Bidirectional Shift registers, Shift register IC–7495, Applications of shift register. **Counters**: 4-bits Asynchronous & Synchronous Counters, Up-down counter, Modified asynchronous counters: Mod-7, Mod-10 and Mod-13, Ring counter and Johnson's counter.	7 Hrs	7 Marks	
Unit III	**Combinational Logic Circuits:** Definition, construction, operation and applications: **Encoders**: Binary to BCD, Decimal to BCD, IC-74147. **Decoders:** 2:4 lines, BCD to Decimal, BCD to 7 Segment, IC- 7447, **Multiplexers:** 4:1 and 8:1 Mux, **De-multiplexers:** 1:4 and 1:8 Demux,	8 Hrs	8 Marks	

Unit IV	**Semiconductor Memories:** Concept of memory, Primary and Secondary memory, Classification of memories, Volatile and Non-volatile memories, Memory Hierarchy, Semiconductor memory: RAM, ROM, PROM, EPROM, EEPROM, Flash memory.	7 Hrs	7 Marks	
References:	1. Digital and analog technique by Navneet, Kale and Gokhale 2. Modern digital electronics by R.P.Jain 3. Introduction to digital electronics by Mohinder Singh 4. Digital principle and application by Malvino Leach 5. Integrated electronics by Millman Halkis 6. Pulse digital and switching waveforms by Millman and Taub 7. Basic electronics by B. L. Thereja			
Model questions for theory external examination.				
MCQ for Internal Assessment	1. When both inputs of a J-K flip-flop cycle, the output will _____ a) Be invalid b) Change c) Not change d) Toggle 2. In digital logic, a counter is a device which _____ a) Counts the number of outputs b) Stores the number of times a particular event or process has occurred c) Stores the number of times a clock pulse rises and falls d) Counts the number of inputs 3. Based on how binary information is entered or shifted out, shift registers are classified into _____ categories. a) 2 b) 3 c) 4 d) 5 4. A serial in/parallel out, 4-bit shift register initially contains all 1s. The data nibble 0111 is waiting to enter. After four clock pulses, the register contains _____ a) 0000 b) 1111 c) 0111 d) 1000 5. The instruction used in a program for executing them is stored in the _____ a) CPU b) Control Unit c) Memory d) Microprocessor 6. A flip flop stores _____ a) 10 bit of information b) 1 bit of information c) 2 bit of information d) 3-bit information 7. How many inputs will a decimal-to-BCD encoder have? a) 4 b) 8 c) 10 d) 16			
Short answer questions	1. What is flip flop? 2. Draw truth table of JK Flip Flop. 3. Draw truth table of D and T Flip Flop. 4. Write application of Counter. 5. Write advantages of JK flip flop. 6. What is shift register? 7. What is multiplexer? 8. State classification of memory.			
Long answer questions	1. Explain construction and working of Monostable multivibrator. 2. Explain construction, working and truth table of JKFF. 3. Explain construction, working and truth table of up counter. 4. Explain flash memory. 5. Explain Ring counter in detail. 6. Explain BCD to 7 segment decoder. 7. Explain hierarchy of memory. 8. Differentiate between volatile and non-volatile memory.			

Major Theory 7- Microprocessor 8085 & 8086

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113230	Microprocessor 8085 & 8086	2	30	2 Hrs	30

Course Objectives:	• Describe the organization and architecture of 8085 and 8086 microprocessor. • Understanding the classification of instructions. • Addressing modes of instructions. • Realizing the interfacing of memory. • Interfacing various peripheral ICs.
Course Outcome:	• Understanding the the organization and architecture of 8085 and 8086 microprocessor • Applying the instruction set of 8085 and 8086 Microprocessor. • Relating the addressing modes used in the instructions. • Interfacing the memory and other I/O devices. • Familiarizing the architecture and operation with 8085 and 8086 microprocessors.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Architecture of 8085 microprocessor:** Evolution of microprocessor, Block and pin diagram of 8085 microprocessor and its function, instruction format, Types of instruction set, simple program on data transfer, 8 bit addition, subtraction etc.	8 Hrs	8 Marks	Besides classroom teaching demonstration on microprocessor kit (physically and/or virtually), wherever applicable is expected.
Unit II	**Architecture of 8086 Microprocessor:** Block diagram and pin diagram of 8086 microprocessor, BIU and EU, operating modes of 8086, G.P.R,pointer and index register, segment register, concept of segmented memory, instruction pointer, status flag,physical and effective address.	7 Hrs	7 Marks	
Unit III	**Instruction set of 8086 microprocessors:** MOV, PUSH, POP, LEA, LDS, LES, Arithmetic & Logic Instructions. Addressing mode, Bus cycle etc.	8 Hrs	8 Marks	
Unit IV	**Programming of 8086 microprocessor**: Programs of data transfer, addition, subtraction, division, multiplication using various addressing modes.	7 Hrs	7 Marks	

References:	1. Microprocessor architecture and programming and application with 8085by Ramesh Gaokar 2. Microprocessor 8085 by B.Ram 3. Microprocessor architecture and application by Dougulus Hall 4. Intel microprocessor 8086 by Brey:PHI 5. Introduction of microprocessor by A.P.Mathur
Model questions for theory external examination.	
MCQ for Internal Assessment	**MCQ for internal assessment :** 1) Intel 8085 is a _____ bit microprocessor. a) 4-bit b) 8-bit c) 16-bit d) 32-bit 2) What is the maximum addressable memory size of the microprocessor 8085? a) 16 KB b) 32 KB c) 64 KB d) 128 KB

	3) Which of the following signals is used to demultiplex the address/data bus? a) READY b) HOLD c) ALE d) INTA 4) How many general-purpose registers are available in the 8085? a) 4 b) 5 c) 6 d) 8 5) Which interrupt has the highest priority in the 8085? a) RST 7.5 b) RST 6.5 c) TRAP d) INTR 6) The intel 8086 microprocessor is ……. a processor a) 8 bit b) 16 bit c) 32 bit d) 4 bit 7) The CF is known as …….. a) carry flag b) B. condition flag c) common flag d) single flag 8) The index register are used to hold ……. a) memory register b) offset address c) segment memory d) offset memory 9) The push source copies a word from source to …….. a) stack b) memory c) register d) destination 10) The 8086 fetches instruction one after another from of memory a) code segment b) IP c) ES d) SS
Short answer questions	Short answer Type (2/3 Marks) 1. What is microprocessor? 2. Write function of READY and HOLD. 3. Write function of HLDA and ALU. 4. Write name of buses used in 8085. 5. What is function of Program counter? 6. What is function of Stack pointer? 7. What is size of address bus of 8085 and 8086 microprocessor? 8. Write instruction types of 8086.
Long answer questions	Long answer Type (4/5 Marks) : 1. Draw block diagram of 8085 microprocessor and write function of each. 2. Draw block diagram of 8086 microprocessor and write function of each. 3. Draw pin diagram of 8085 microprocessor and write function of each. 4. Draw pin diagram of 8086 microprocessor and write function of each. 5. Explain flag register in 8085 microprocessors. 6. Explain flag register in 8086 microprocessors. 7. Explain operating modes of 8086 microprocessor. 8. Explain addressing modes of 8086 microprocessor.

Lab / Practical – 9: Practical based on Theory 5, 6 and 7

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113223	**Practical based on Theory 5, 6 and 7**	2	60	4 Hrs	50

Lab/ Practical 9	Minimum ten experiments, at least one on each of the following aspects. 1. OP-AMP applications. 2. OP-AMP as Astable, Monostable and Bistable mode 3. ADC and DAC convertor 4. Transistorized Astable, Monostable and Bistable Multivibrator, RS,CK RS,D,T,JK and JKMS FF. 5. 4-bit binary counter, modifying counter, Ring and Johnson's counter (using ICs), SISO, SIPO, PISO and PIPO 6.Decoder, Multiplexer, IC74147 mounting and testing 7. Study of memory

Note :

- Students during lab hours shall have to perform at least 10 experiments from given group, however students shall have to perform one experiment at the time of examination

Minor Theory 4 – Electronic Circuits and Digital Techniques-II

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113224	Electronic Circuits and Digital Techniques-II	2	30	2 Hrs	30

Course Objectives:	• Read, understand and interpret electrical/electronic circuits through verbal, mathematical and graphical methods. • To give need-based education in Electronics of the highest quality at the undergraduate level. • Use Information Communication Technology to gather knowledge. • Impart skills required to gather information from resources. • Equip students in methodology related to electronic circuits, devices and systems.
Course Outcomes:	**After completing the course, the student will** • Identify electronic components and ICs. • Design system components that meet the requirement of public safety and offer solutions to the societal and environmental concerns. • Apply research-based knowledge to design and conduct experiments. • Construct, choose and apply the techniques, resources and modern electronics tools required for Electronics applications. • Utilize the basic knowledge in Electronics science. • Apply Electronics knowledge in their day to day life.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Operational Amplifier: C**onstruction and working of Difference amplifier, Block diagram of OP-AMP, Characteristics of Ideal OP-AMP, Concept of virtual ground, Parameters of OP-AMP: Input impedance, Output impedance, Open loop gain, Close loop gain, CMRR, Slew rate, Input offset voltage and current, Input bias current.	8 Hrs	8 Marks	Besides classroom teaching demonstration of components and measuring instruments (physically and/or virtually), wherever applicable is expected.
Unit II	**Applications of OP-AMP:** OP-AMP as Inverting and Non-inverting amplifier, Adder, Subtractor, Differentiator and Integrator, Comparator and Voltage Follower.	7 Hrs	7 Marks	
Unit III	**Multivibrators and Flip Flops:** Construction & working of Astable, Monostable and Bistable Transistorized multivibrators, Flip Flops: Logic diagram, Truth table, construction & working of RS, CK-RS, JK, JKMS, T and D type Flip Flops Concept of Edge trigger Flip-Flop, Concepts of Preset & Clear terminals.	8 Hrs	8 Marks	

Unit IV	**Shift registers and Counters:** **Shift registers**: Construction & working of SISO, SIPO, PISO & PIPO, Bidirectional Shift registers, Shift register IC–7495, Applications of shift register. **Counters**: 4-bits Asynchronous & Synchronous Counters, Up-down counter, Modified asynchronous counters: Mod-7, Mod-10 and Mod-13, Ring counter and Johnson's counter.	7 Hrs	7 Marks	

References:	1. Op-amp theory and application by Ramakant Gaykwad 2. Basic electronics by B. L. Thereja 3. Element of electronics by Bagde and Singh 4. Principles of electronics by V. K. Mehta 5. Integrated electronics by Millman Halkis 6. Linear integrated circuit by Ramakant Gaykwad 7. Digital principle and application by Malvino Leach 6. Digital and analog technique by Navneet, Kale and Gokhale 7. Modern digital electronics by R.P.Jain 8. Introduction to digital electronics by Mohinder Singh
Model questions for theory external examination.	
MCQ for Internal Assessment	1`. An OP-AMP can be classified as _____ amplifier. a) linear b) low-r_{in} c) positive feedback d)RC-coupled 2. Two input terminals of an Op-Amp are known as_____. a) Positive and Negative b) Differential and non-differential c) Inverting and non-inverting d) High and Low 3. _____ analog-to-digital converters (ADCs) use no clock signal, because there is no timing or sequencing required. a) Actuator b) Dual c) Flash d) Bipolar 4. The problems of the binary-weighted resistor digital-to-analog converter (DAC) can be overcome by using _____. a) an 8-bit binary-weighted resistor DAC b) an R/2R ladder DAC c) a staircase DAC d) a flash DAC 5. Based on how binary information is entered or shifted out, shift registers are classified into _____ categories. a) 2 b) 3 c) 4 d) 5 6. The instruction used in a program for executing them is stored in the _____ a) CPU b) Control Unit c) Memory d) Microprocessor 6. A flip flop stores _____ a) 10 bit of information b) 1 bit of information c) 2 bit of information d) 3-bit information 7. How many inputs will a decimal-to-BCD encoder have? a) 4 b) 8 c) 10 d) 16 8. A multivibrator is an electronic circuit used to implement _____ a) Oscillator b) Timer c) Flip-flop d) All of the Mentioned
Short answer questions	1. Write ideal characteristics of Op-amp. 2. What is virtual ground? 3. What is CMRR? 4. Explain the term slew rate. 5. What is flip flop? 6. Draw truth table of JK Flip Flop. 7. Draw truth table of D and T Flip Flop. 8. Write application of Counter.

	9. Write advantages of JK flip flop. 10. What is shift register?
Long answer questions	1. Draw block diagram of Op-amp and explain each part. 2. Explain how Op-amp is use as Adder. 3. Explain how Op-amp is use as Differentiator. 4. Explain construction and working of Monostable multivibrator. 5. Explain construction, working and truth table of JKFF. 6. Explain construction, working and truth table of asynchronous counter. 7. Explain construction, working and truth table of up counter. 8. Explain Ring counter in detail.

Minor Lab / Practical – 10: Practical on Electronic Circuits and Digital Techniques - II

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113225	Practical on Electronic Circuits and Digital Techniques - II	2	60	4 Hrs	50

Lab/ Practical 12	**Minimum ten experiments, at least one on each of the following aspects.** 1 OP-AMP study. 2. OP-AMP as Adder, Subtractor, Integrator, Differentiator, 3.Transistorized Astable, Monostable and Bistable Multivibrators 4. RS, CK RS, D, T, JK and JKMS Flip Flops . 5 .4-bit binary counter, modifying counter, Ring and Johnson's counter (using ICs), SISO, SIPO, PISO and PIPO.

Note :

- Students during lab hours shall have to perform at least 10 experiments from given group, however students shall have to perform one experiment at the time of examination.

GOEC Theory 6: Basics of Biomedical Instrumentation

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113226	Basics of Biomedical Instrumentation	2	30	2 Hrs	30

Course Objectives:	• To understand and interpret Biomedical Signal. • To learn about different types of sensors and transducers. • To provide the knowledge about the biomedical instruments. • The ability to assess the performance, safety, and limitations of existing biomedical instrumentation.
Course Outcomes:	**After completing the course, the student will** • They are able to understand the biomedical signal. • Identify and analyze the bio-electric signals and electrodes. • Identify and analyze different sensors and transducers. • Understand advanced instruments in health care.

Unit System	Contents	Workload Allotted	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Biomedical Instruments:** Introduction, Importance of Biomedical instruments, Classification of Biomedical Equipments, Physiological signals, Physiology of Human Body, Safety Standards in Biomedical Instruments, Introduction of commonly used medical instruments: Electronic Thermometer, Stethoscope, BP monitor: Systolic and Diastolic.	7 Hrs.	7 Marks	While teaching Basics of Biomedical Instrumentation, the suitable pedagogical strategies should be adapted. • These strategies include Electrodes Sensors & transducers. • Process of using Biomedical instrumentation using Both physically and virtual tools.
Unit II	**Bioelectric Signals and Electrodes:** Bioelectric Signals: ECG, EEG and EMG, Characteristics of Bioelectric Signals, Electrodes and its types: Needle electrode, Micro electrode, Disposable electrode, Silver/Sliver chloride electrode, Glass type electrode, Floating electrode.	8 Hrs.	8 Marks	
Unit III	**Biomedical Sensors and Transducers**: Basics of Sensors and Transducers in Biomedical Applications, Biomedical Sensors: Temperature Sensors, Pressure Sensors: Flow Sensors, Piezoelectric Sensors, Pulse & Movement Sensors, Signal Conditioning and	8 Hrs.	8 Marks	

	Processing for Sensors.			
Unit IV	**New Technologies in Healthcare**: Wearable devices: Smart watches, Fitness trackers, Remote healthcare, Telemedicine: Talking to doctors using video calls, AI in healthcare, Future trends in medical technology, Calibration techniques.	7 Hrs.	7 Marks	
References:	1. **Handbook of Biomedical Instrumentation** by R. S. Khandpur **Publisher**: Tata McGraw-Hill 2. **Biomedical Instrumentation Technology and Applications** **Author**: Dr. Shakti Chatterjee and Dr. Aubert Miller **Publisher**: Cengage India 3. **Medical Instrumentation: Application and Design** by John G. Webster, John W. Clark **Publisher**: Wiley 4. **Biomedical Signal Processing and Signal Modeling** by Eugene N. Bruce **Publisher**: Wiley-Interscience 5. **Introduction to Biomedical Engineering** by John Enderle, Joseph Bronzino **Publisher**: Academic Press 6. **Biomedical Sensors and Instruments** by Tatsuo Togawa, Toshiyo Tamura, P. Ake Öberg **Publisher**: CRC Press 7. **AI in Healthcare: The Grand Challenges by** Thomas Davenport and Ravi Kalakota **Publisher**: CRC Press 8. **Wearable Sensors: Fundamentals, Implementation, and Applications** by Edward Sazonov, Michael R. Neuman **Publisher**: Academic Press 9. **The Physiological Basis of Medical Practice by** John B. West, Taylor **Publisher**: Lippincott Williams & Wilkins 10. **Principles of Biomedical Engineering by** Sundararajan V. Madihally **Publisher**: Artech House 11. **Telemedicine Technologies: Information Technologies in Medicine and Telehealth** by Bernard Fong, A. C. M. Fong, C. K. Li **Publisher**: Wiley			
Model questions for theory external examination.				
MCQs for Internal Assessment	1. **What is the primary purpose of biomedical instruments?** a) To entertain patients b) To diagnose and monitor health conditions c) To replace human doctors d) To create artificial organs 2. **Which of the following is a bioelectric signal?** a) Blood pressure b) ECG			

	c) Body temperature d) Heartbeat sound 3. **Which sensor is commonly used in a blood pressure monitor?** a) Temperature sensor b) Pressure sensor c) Flow sensor d) Pulse sensor 4. **What is telemedicine used for?** a) Teaching medical students b) Connecting patients with doctors remotely c) Performing surgeries
Short answer questions	1. What is the importance of biomedical instrumentation? बायोमेडिकल इन्स्ट्रुमेंटेशनचे महत्त्व काय आहे? जैवचिकित्सा उपकरण का क्या महत्वहै? 2. State the classification of biomedical electrodes? बायोमेडिकल इलेक्ट्रोडचे वर्गीकरण करा? बायोमेडिकल इलेक्ट्रोड का वर्गीकरण किजीए?
Long answer questions	1. Explain the role of physiological signals and the importance of safety standards in the design and use of biomedical instruments. 2. Discuss the classification of biomedical equipment and explain the importance of biomedical instruments. 3. Describe the characteristics of bioelectric signals such as ECG, and EEG. 4. Discuss the surface electrodes, needle electrodes. 5. Classify and explain the working principles of sensors like temperature sensors, and biosensors. 6. How are technologies like telemedicine and wearable devices improving healthcare?

Vocational Skill Course 3: Lab/ Practical 11: Advanced Practical on Major Theory 5, 6 and 7.

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Mark
5.0	IV	113227	Advanced Practical on Major Theory 5 and 6	2	60	4 Hrs	50

Lab/ Practical 11	Design minimum five applications, at least two on each of the following aspects. 1 Design any five advanced applications of OP-AMP. 2 Design any five advanced applications on Flip Flop and Counter.

Note :

- Students during lab hours shall have to perform at least 10 experiments from given group, however students shall have to perform one experiment at the time of examination.

- **Mode of Examination: Internal (There is no External Examination)**

Electronics FP/CES- Project

Electronics FP/CES- Project (113229)	
Field Project / CE Services in Electronics: Phase-II	
Credits: 02	**Workload (Hrs./Week): 04**
Course Objectives:	1. To provide hands-on experience in applying theoretical Electronics knowledge to real-world challenges through field-based projects or community engagement (CE) services. 2. To train students in identifying, problems encountered in Electronics and related fieldwork or community service activities. 3. To encourage students to integrate Electronics and field Electronics concepts with interdisciplinary knowledge, technology, and societal needs. 4. To develop students' abilities to document, present, and communicate their field-based or community engagement work effectively to diverse audiences. 5. To instill a sense of responsibility and service by involving students in projects that address community issues related to science and technology.
Course Outcomes:	1. Students will be able to apply Electronics related analytical techniques to investigate and solve real-world problems in field settings. 2. Students will demonstrate proficiency in using experimental tools, instruments, and data analysis methods relevant to their field project or CE service. 3. Students will be able to design, plan, and execute a field Electronics project or community service activity from inception to completion, including documentation and reporting. 4. Students will effectively communicate their project findings and outcomes through written reports, presentations, or community engagement events. 5. Students will demonstrate an understanding of the ethical, environmental, and societal impacts of their work, showing a commitment to responsible scientific practice and community well beings.
Guidelines/SOP for Selection and Implementation of Field Projects / CE Services	
1. Project Selection and Planning	• **Faculty Guidance:** Students will be assigned a faculty mentor to guide their project, providing expertise and resources. • **Project Topic:** The project topic should be relevant to Electronics and align with the student's interests and the available resources. • **Literature Review:** Students are expected to conduct a thorough literature review to understand existing knowledge and identify research gaps. • **Data Collection and Analysis:** Projects often involve experiments, field sampling, simulations, or data analysis from existing sources, depending on the topic. • Project Timeline: The total time allocation for the student to carry out field project is 60 hours. • The students shall have to carry the same project done in Semester III and submit the report regarding the methodology, Recent trends, hardware required, applications for the community services etc.

2. Data Analysis and Interpretation	• **Statistical Methods**: Students will learn and apply appropriate statistical methods to analyze data. • **Interpretation of Results:** Data should be interpreted within the context of the project, highlighting significant findings and limitations.
3. Report Writing and Presentation	• **Report Format**: A structured report format is usually followed, including an abstract, introduction, methodology, results, discussion, and conclusion. • **Data Presentation**: Data should be presented clearly and accurately using tables, graphs, and figures. • **Oral Presentation:** Students will be required to present their findings to peers and faculty.
4. CE Services (Community Engagement)	• **Community Needs**: Projects may focus on addressing specific community needs or challenges relevant to Electronics. • **Collaboration:** Students can collaborate with local organizations to implement their projects. • **Impact Assessment**: The impact of the project on the community should be evaluated**.**
5. Evaluation and Assessment	• **Project Report:** The final report will be assessed based on its content, organization, and the quality of the research. (20 Marks) • **Oral Presentation:** The presentation will be evaluated on clarity, engagement, and the ability to answer questions. (10 Marks) • **Faculty Evaluation:** The faculty mentor will assess the student's performance throughout the project. (20 Marks) • **Total 50 Marks**
Examples of Field Projects/CE Services in Electronics	• **Environmental Electronics**: Studying the local ecosystems and developing renewable energy solutions. • **Community Outreach:** Organizing Safety measures and awareness workshops or engaging in scientific literacy initiatives. • **Research Project:** Study related to the subject that contribute to the advancement of knowledge and the well-being of living things.

Note: The extended portion of the Field Project/CE Services in Electronics from Phase-I may be carried forward as Field Project/CE Services in Electronics: Phase-II in the fourth semester, subject to the approval of the assigned faculty mentor.