Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Structure and Curriculum of Three-Year Degree Programme with Multiple Entry and Exit option

Undergraduate Programme of Science and Technology

B.Sc. (Degree) in Electronics

Level: 5.5

Board of Studies

in

Electronics

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

[UG III Year]

w.e.f. June, 2025

(In Accordance with NEP-2020)

Academic Year 2025-26

Review Statement

The NEP Cell reviewed the Curriculum of **B.Sc. (Degree) in Electronics** Programme to be effective from the **Academic Year 2025-26.** It was found that, the structure is as per the NEP-2020 guidelines of Govt. of Maharashtra.

Date: 08/04/2025

Place: Latur

NEP Cell
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

CERTIFICATE

I hereby certify that the documents attached are the Bonafide copies of the Curriculum of **B.Sc. (Degree) in Electronics** Programme to be effective from the **Academic Year 2025-26.**

Date: 08/04/2025

Place: Latur

(Dr A. A. Yadav)
Chairperson
Board of Studies in Electronics
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Members of Board of Studies in the Subject Electronics

Under the Faculty of Science and Technology

Sr. No.	Name	Designation	In position
1	**Dr Abhijit Yadav** Head, Department of Physics and Electronics, Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Chairperson	HoD
2	**Dr Ganesh Shinde** Principal, Yashwant Mahavidyalaya, Nanded	Member	V.C. Nominee
3	**Dr S.D. Gothe** HoD Electronics Sangmeshwar College, Solapur (Autonomous)	Member	Academic Council Nominee
4	**Dr G.S. Shahane** DBF Dayanand college, Solapur	Member	Expert from outside for Special Course
5	**Dr R.V. Dhekale** Perfect Electronics, Dattanagar Wai, Satara.	Member	Expert from Industry
6	**Dr Rangrao Suryawanshi** Azad College, Ausa	Member	P.G. Alumni
7	**Dr Renuka Londhe** Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)	Member	Faculty Member
8	**Dr Dayanand Raje**	Member	Member from Same Faculty
9	**Mr Atul More**	Member	Member from Same Faculty
10	**Miss Mayuri Hawaldar**	Member	Member from Same Faculty
11	**Miss Vishakha Patil**	Member	Member from Same Faculty
12	**Miss Kranti Bhosale**	Member	Member from Same Faculty

From the Desk of the Chairperson…

"Electronics is clearly the winner of the day"

- John Ford

We have immense pleasure to share that our department is with the state-of-the-art facilities and has highly qualified and dignified faculty. This specific program is in accordance with NEP 2020 which enables electronics graduates to develop the technological and competitive skills needed in the design and operating modern telecommunication systems and networks. I take great pride in sharing that this programme follows outcome-based education in the teaching learning process. The department strives to provide a favorable environment for the students to develop electronic insights and practical skills and apply them to real world problems. To motivate the students, the department organizes regular trainings in various aspects of Electronics and to enrich their knowledge, the department arranges various workshops, national and international conferences every year. Faculty visits to leading universities in the globe are very much encouraged and appreciated. Awards, scholarships and recognitions speak a long way about the quality of faculty and students with the constant support and encouragements of the Management of the College.

Our Electronics curriculum which is in accordance with NEP 2020 integrates the Science and technology of all that makes communication through electronic devices. Electronics students design, build and manage systems that transmit process and store information as electrical or optical signals, addresses the critical challenges to face the society, industry and the academia. It is worthwhile to express our care and commitment to our students, guiding them to learn, grow, develop and achieve their goals in their pursuits to excel in their career in a every influencing domain. Let me take the opportunity to thank and wish you all a great success.

Dr. A. A. Yadav
Chairperson
Board of Studies in Electronics

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Index

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Structure for Four Year Multidisciplinary Undergraduate Degree Programme in Electronics

Multiple Entry and Exit (In accordance with NEP-2020)

Year & Level	Sem	Major		Minor	GE/ OE	VSC/ SEC (VSEC)	AEC/ VEC	OJT, FP, CEP, RP	Credit per Sem.	Cum./Cr. per exit
		DSC	DSE							
1	**2**	**3**		**4**	**5**	**6**	**7**	**8**	**9**	**10**
III 5.5	V	DSC IX: 04 Cr. DSC X: 04 Cr.	DSE-I :04 Cr	DSM III: 04 Cr. DSM IV: 02 Cr.	NA	VSC III: 02 Cr	VEC II: 02 Cr EVS	NA	22	132 Cr. UG Degree
	VI	DSC XI: 04 Cr. DSC XII: 04 Cr.	DSE-I :04 Cr	DSM V: 04 Cr.	NA	VSC IV: 02 Cr	NA	Academic Project: 04 Cr.	22	
	Cum. Cr.	16	08	10	-	06		04	44	
Exit Option: Award of UG Degree in Major with 132 Credits or continue with Major and Minor										

Abbreviations:

1.	DSC	: Discipline Specific Core (Major)
2.	DSE	: Discipline Specific Elective (Major)
3.	DSM	: Discipline Specific Minor
4.	OE	: Open Elective
5.	VSEC	: Vocational Skill and Skill Enhancement Course
6.	VSC	: Vocational Skill Courses
7.	SEC	: Skill Enhancement Course
8.	AEC	: Ability Enhancement Course
9.	MIL	: Modern Indian Languages
10.	IKS	: Indian Knowledge System
11.	VEC	: Value Education Courses
12.	OJT	: On Job Training
13.	FP	: Field Projects
14.	CEP	: Fostering Social Responsibility & Community Engagement (FSRCE)
15.	CC	: Co-Curricular Courses
16.	RP	: Research Project/Dissertation
17.	SES	: Shahu Extension Services

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

B.Sc. (Degree) in Electronics

Year & Level	Semester	Course Code	Course Title	Credits	No. of Hrs.
III 5.5	V	301ELE5101 (DSC-IX)	Operational Amplifier and its Applications	04	60
		301ELE5102 (DSC-X)	Electronic Instrumentations	04	60
		301ELE5201A DSE-I(a)/ 301ELE5201B DSE-I(b)	Communication Electronics-I Or Microprocessors & Microcontrollers	04	60
		_____ (DSM-III)	From Basket	04	60
		_____ (DSM-IV)	From Basket	02	30
		301ELE5501 (VSC-III)	Electrical Circuits and Network	02	30
		_____ (VEC-II)		02	30
	Total Credits			**22**	
	VI	301ELE6101 (DSC-XI)	Digital Electronics	04	60
		301ELE6102 (DSC-XII) IKS	Photonics and Science of Aeronautics (Vymaanika Shaashtra)	04	60
		301ELE6201A DSE-II(a)/ 301ELE6201B DSE-II(b)	Communication Electronics-II Or Optical Fibre Communications	04	60
		(DSM-V)	From Basket	04	60
		301ELE6501 (VSC-IV)	Basic Instrumentation Skill	02	45
		AIPC/OJT-I	Academic Project	04	60
	Total Credits			**22**	
Total Credits (Semester I & II)				**44**	

Programme Outcomes (POs) for B.Sc. Programme	
PO1	**Disciplinary Knowledge** Comprehensive knowledge of science subjects which constitute the graduate programme and execution of scientific knowledge in the specific area.
PO2	**Scientific Outlook** The qualities of a science graduate such as observation, precision, analytical mind, logical thinking, clarity of thought and expression and systematic approach.
PO3	**Self-Directed Life-long Learning** Ability to appear for various competitive examinations or choose the post graduate programme or other related programme of their choice.
PO4	**Research Skills** Functional knowledge and applications of instrumentation and laboratory techniques to do independent experiments, interpret the results and develop research ethos.
PO5	**Problem Solving Skills** Analytical and logical skills and critical thinking to extract information from qualitative and quantitative data, formulate and solve problems in a systematic and rational manner.
PO6	**Professional Competence and Ethics** Aptitude and skills to perform the jobs in diverse fields such as science, engineering, industries, survey, education, banking, development and planning, business, public service, self-business etc. with human rationale and moral values.

Programme Specific Outcomes (PSOs) for B.Sc. Electronics (Degree)	
PSO No.	Upon completion of this programme the students will be able to
PSO 1	Demonstrate knowledge of fundamental electronic components, circuits, and their applications in analog and digital systems.
PSO 2	Design, analyze, and troubleshoot basic electronic circuits such as amplifiers, oscillators, and power supplies using theoretical and practical approaches.
PSO 3	Develop and program microcontroller-based systems for automation and control applications.
PSO 4	Apply digital electronics principles to design logic circuits and understand the basics of communication systems, including modulation techniques.
PSO 5	Operate electronic test and measurement instruments (like CRO, DMM, function generators) to analyze and validate electronic circuits.
PSO 6	Use software tools for circuit simulation and PCB design.
PSO 7	Apply analytical and problem-solving skills to develop innovative solutions for real-world electronic applications.
PSO 8	Gain hands-on experience with industry-relevant projects, preparing for careers in electronics manufacturing, maintenance, and research.

Curriculum

Major and VSC Courses

Semester - V

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-IX
Course Title: Operational Amplifier and its Applications
Course Code: 301ELE5101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. This course is aimed to provide exposure on applications of op-amps and its importance in the real world.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Analyze and design basic operational amplifier circuits, understand differential amplifier operations, and apply AC/DC analysis to evaluate performance parameters such as gain, CMRR, and feedback configurations.

CO 2. Examine different electrical parameters of operational amplifiers, interpret their frequency response, and assess performance metrics such as gain, CMRR, slew rate, and bandwidth.

CO 3. Analyze and design linear and non-linear applications of operational amplifiers.

CO 4. Understand the working principles of specialized ICs, analyze oscillator circuits, design waveform generators using Op-Amp IC 741, and implement timer IC 555 in various applications.

Unit No.	Title of Unit & Contents	Hrs.
I	**Basics of Operational Amplifiers**	**13**
	1. Differential Amplifier: Basic Circuit and Operation of a Differential Amplifier 2. AC Analysis of a Differential Amplifier (Single-Ended Voltage Gain), CMRR, and DC Analysis of a Differential Amplifier 3. Operational Amplifier: Introduction and Block Diagram of an Op-Amp 4. Schematic Symbol of an Op-Amp, The Ideal Op-Amp, and Power Supplies for an Op-Amp IC 5. Open-Loop Op-Amp Configuration 6. Closed-Loop Op-Amp Configurations: Inverting and Non-Inverting Op-Amp Configurations 7. Voltage Gain Expression for Inverting and Non-Inverting Op-Amps	

Unit No.	Title of Unit & Contents	Hrs.
	8. Numerical Problems	
	Unit Outcomes: UO1. Analyze the operation and performance of differential amplifiers, including AC and DC analysis, single-ended voltage gain, and CMRR calculations. UO2. Design and evaluate closed-loop operational amplifier configurations, such as inverting and non-inverting amplifiers, and derive their voltage gain expressions.	
II	**Op-Amp Parameters**	**10**
	1. Electrical Parameters of an Op-Amp: Input Offset Voltage, Input Offset Current, and Input Bias Current 2. Input Resistance, Output Resistance, Common-Mode Configuration, Common-Mode Rejection Ratio (CMRR), and Voltage Supply Rejection Ratio (VSRR) 3. Frequency Response of an Op-Amp, Open-Loop Voltage Gain, and Closed-Loop Voltage Gain 4. Slew Rate and Bandwidth 5. Numerical Problems	
	Unit Outcomes: UO1. Evaluate key electrical parameters of an operational amplifier, including input offset voltage, input offset current, input bias current, input resistance, output resistance, CMRR, and VSRR. UO2. Analyze the frequency response, slew rate, and bandwidth of an Op-Amp, and differentiate between open-loop and closed-loop voltage gain characteristics.	
III	**Linear and Non-Linear Applications of Op-Amp**	**12**
	1. Linear Applications of an Op-Amp: Introduction, Unity Gain Buffer, Op-Amp as an Adder and Subtractor 2. Non-Linear Applications of an Op-Amp: Introduction, Op-Amp as an Integrator, Op-Amp as a Differentiator 3. Basic Comparator: Zero-Crossing Detector, Non-Zero Reference Comparators (Inverting and Non-Inverting Op-Amp) 4. Schmitt Trigger, Analog Computation: Solving Differential Equations (Second- and Third-Order Types) 5. Op-Amp as a Logarithmic Amplifier (using a diode and transistor), Antilog Amplifier (using a diode and transistor)	

Unit No.	Title of Unit & Contents	Hrs.
	6. Numerical Problems	
	Unit Outcomes: UO1. Design and analyze linear applications of operational amplifiers. UO2. Implement and evaluate comparator circuits (zero-crossing and non-zero reference) and Schmitt triggers, and apply Op-Amps in analog computation for solving differential equations and logarithmic/antilogarithmic operations.	
IV	**Specialized IC Applications**	**10**
	1. Introduction, 2. Pin Diagram of Op-Amp IC 741 and Its Functions, 3. Oscillators: RC Phase-Shift Oscillator, Wien Bridge Oscillator, 4. Square Wave Generator Using Op-Amp IC 741, 5. Timer IC 555: Pin Functions and Block Diagram, 6. IC 555 as an Astable and Monostable Multivibrator, 7. Numerical Problems,	
	Unit Outcomes: UO1. Understand the pin configuration and functional characteristics of Op-Amp IC 741 and apply it in designing oscillators, such as RC phase-shift and Wien bridge oscillators, as well as square wave generators. UO2. Analyze and implement Timer IC 555 in Astable and Monostable multivibrator configurations, and solve numerical problems related to specialized IC applications.	

Learning Resources:

1. Electronic Fundamentals and Applications Integrated and Discrete systems- John D. Ryder, Prentice _ Hall of India Pvt. Ltd New- Delhi (5th Edition)
2. Principles of Electronics-V.K. Mehta and Rohit Mehta, S Chand and company 11th Edition
3. Op-Amp and Linear Integrated Circuits-By Ramakant A. Gayakwad, PHI Learning Pvt. Ltd. New Delhi (4th Edition)
4. A textbook of Applied Electronics by R.S. Sedha
6. Integrated Electronics- By Millman-Halkias, International Students Edition.
5. Handbook of Integrated Circuit Operational Amplifier- By George B. Rutkowski, D.B. Taraporevala Sons and Co. Pvt. Ltd Prentice –Hall, Inc.
6. Electronic Principles –by A. P. Malvino, David Bates (7th Edition))

7. Electrical Machines and Appliances Theory-Tamil Nadu Textbook Corporation, College Road, Chennai - 600 006
8. Electric Principles, Third Edition, A.P. Malvino, Tata McGraw-Hill Publications
9. Principal of Electronics, V.K. Mehta and Rohit Mehta, S. Chand and Company Ltd. Ramnagar, New Delhi. (Reprint 2010).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course–IX (Based on Operational Amplifier and its Applications)

Course Code: 301ELE5103

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. Students are expected to analyze the response of differential amplifier using BJTs, amplifier circuits using op-amps and the applications circuits using op-amp.

Course Outcomes:

After completion of the laboratory course, students will be able to-

CO 1. Analyze and evaluate key operational amplifier parameters, including CMRR, input/output resistance, and frequency response.

CO 2. Design and implement inverting and non-inverting amplifier circuits for both AC and DC signal processing.

CO 3. Develop and test arithmetic circuits such as adders, subtractors, differentiators, and integrators using operational amplifiers.

CO 4. Construct and analyze waveform generation circuits, including Schmitt triggers and phase-shift oscillators, using Op-Amp IC 741.

Practical No.	Experiments
1	Determination of Op-Amp Parameters
2	Determination of CMRR Using an Op-Amp
3	AC Analysis of an Inverting Op-Amp
4	DC Analysis of an Inverting Op-Amp
5	AC Analysis of a Non-Inverting Op-Amp
6	DC Analysis of a Non-Inverting Op-Amp
7	Implementation of Adder and Subtractor Using an Op-Amp
8	Design and Analysis of Differentiator and Integrator Using an Op-Amp
9	Study of Schmitt Trigger Using an Op-Amp
10	Design of a Phase-Shift Oscillator Using Op-Amp IC 741

Learning Resources:

1. Electronic Fundamentals and Applications Integrated and Discrete systems- John D. Ryder, Prentice _ Hall of India Pvt. Ltd New- Delhi (5th Edition)
2. Principles of Electronics-V.K. Mehta and Rohit Mehta, S Chand and company 11th edition
3. Op-Amp and Linear Integrated Circuits-By Ramakant A. Gayakwad, PHI Learning Pvt. Ltd. New Delhi (4th Edition)
4. A textbook of applied electronics by R.S. Sedha
7. Integrated Electronics- By Millman-Halkias, International Students Edition.
5. Handbook of Integrated Circuit Operational Amplifier- By George B. Rutkowski, D.B. Taraporevala Sons and Co. Pvt. Ltd Prentice –Hall, Inc.
6. Electronic Principles –by A. P. Malvino, David Bates (7th Edition))
7. Electrical Machines and Appliances theory-Tamil Nadu Textbook corporation, College Road, Chennai - 600 006
8. Electric Principles, Third Edition, A.P. Malvino, Tata McGraw-Hill Publications
9. Principal of Electronics, V.K. Mehta and Rohit Mehta, S. Chand and Company Ltd. Ramnagar, New Delhi. (Reprint 2010).

Shiv Chhatrapati Shikshan Sanstha's
Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Faculty of Science and Technology
Department of Physics and Electronics

Course Type: DSC-X
Course Title: Electronic Instrumentations
Course Code: 301ELE5102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. The course typically focuses on understanding the principles of measurement, utilizing various instruments, and applying them to real-world applications, including troubleshooting and maintenance.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Use basic and digital measurement instruments, connectors, and probes in electronic instrumentation.

CO 2. Understand the principles of A/D and D/A conversion, analyze different resistance measurement techniques, and apply appropriate methods for measuring low, medium, and high resistances in electrical circuits.

CO 3. Analyze waveform measurements, and apply various oscilloscope techniques for voltage, frequency, and phase analysis in electronic circuits.

CO 4. Apply appropriate measurement techniques for temperature, light, and mechanical parameters in electronic systems.

Unit No.	Title of Unit & Contents	Hrs.
I	**Qualities of Measurement**	**10**
	1. Instrument Specifications: Overview of Static and Dynamic Characteristics 2. Types of Errors: Gross Error, Systematic Error, Absolute Error, and Relative Error 3. Uncertainty and Data Analysis: Uncertainty Analysis, Statistical Analysis of Data, and Curve Fitting 4. Basic Measurement Instruments: PMMC Instrument, Galvanometer, and DC Measurement Devices (Ammeter, Voltmeter, and Ohmmeter) 5. Digital Measurement Devices: Digital Multimeter and Digital Frequency Meter System (Various Modes and Universal Counter)	

	6. Connectors and Probes: Low-Capacitance Probes, High-Voltage Probes, and Current Probes.	
	Unit Outcomes: UO1. Analyze and differentiate between static and dynamic characteristics of instruments. UO2. Identify and classify types of errors such as gross, systematic, absolute, and relative errors in measurement systems.	
II	**A/D and D/A Converters and Measurement of Resistance**	**10**
	1. A/D and D/A Conversion: 4-Bit Binary-Weighted Resistor-Type D/A Conversion, Circuit, and Working, 2. R-2R Ladder Circuit: Structure and Working Principle, 3. A/D Conversion Characteristics, and Successive Approximation ADC, 4. Low Resistance Measurement: Kelvin Double Bridge Method 5. Medium Resistance Measurement: Voltmeter-Ammeter Method and Wheatstone Bridge Method, 6. High Resistance Measurement: Megger, A.C. Bridges, and Measurement of Self-Inductance, 7. Numerical Problems	
	Unit Outcomes: UO1. Design and analyze digital-to-analog (D/A) conversion circuits, including 4-bit binary-weighted resistor-type and R-2R ladder networks. UO2. Perform resistance measurements using appropriate methods.	
III	**Oscilloscopes and Function Generators**	**13**
	1. CRT and Waveform Display: Principles of Electrostatic Focusing 2. Time Base and Sweep Synchronization: Fundamentals and Applications 3. Measurement Techniques: Voltage, Frequency, and Phase Measurement using CRO; Oscilloscope Probes 4. Types of Oscilloscopes: Dual-Trace Oscilloscope and Sampling Oscilloscope 5. DSO and Power Scope: Block Diagram, Principles, Working, Advantages, and Applications 6. CRO Specifications: Bandwidth, Sensitivity, and Rise Time 7. Signal Generators: Audio Oscillator, Pulse Generator, and Function Generator	

	Unit Outcomes: UO1. Understand the principles of electrostatic focusing, time base, and sweep synchronization in CRT-based oscilloscopes, UO2. Apply measurement techniques for voltage, frequency, and phase using CRO.	
IV	**Transducers and Sensors**	**12**
	1. Classification of Transducers: Types and Applications 2. Basic Requirements and Characteristics: Active and Passive Transducers 3. Resistive Transducers: Potentiometer, Strain Gauge – Theory, Types, Temperature Compensation, and Applications 4. Capacitive Transducers: Variable Area Type, Variable Air Gap Type, and Variable Permittivity Type 5. Inductive and Piezoelectric Transducers: LVDT and Piezoelectric Sensors 6. Temperature Measurement: RTD, Thermistor, Thermocouple, and Semiconductor IC Sensors (E.G., LM335 Temperature Sensors) 7. Light Transducers: Photoresistors, Photovoltaic Cells, and Photodiodes	
	Unit Outcomes: UO1. Classify and analyze various types of transducers, including resistive, capacitive, inductive, and piezoelectric transducers, UO2. Design and implement temperature and light measurement systems using transducers.	

Learning Resources:

1. H. S. Kalsi, Electronic Instrumentation, TMH (2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).
3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
4. E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book – fifth Edition (2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, “Electronic Measurements and Instrumentation”, TMH (2009).
8. Alan S. Morris, “Measurement and Instrumentation Principles”, Elsevier (Buterworth Heinmann-2008).

9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata McGraw Hill (1998).
11. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course –IX (Based on Electronic Instrumentations)

Course Code: 301ELE5104

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To equip students with practical skills to understand, operate, and troubleshoot various electronic instruments and measurement techniques.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Design and implement multi-range ammeters and voltmeters using a galvanometer for accurate electrical measurements.

CO 2. Develop the ability to measure resistance, capacitance, and low resistance using bridge methods and analyze their sensitivity.

CO 3. Understand the working principles and characteristics of various transducers, including strain gauges, LVDTs, and thermistors, for practical applications.

CO 4. Gain hands-on experience in temperature and light sensor measurements, including thermocouples, RTDs, LDRs, and photodiodes, for real-world instrumentation applications.

Practical No.	Experiment
1	Design and Implementation of a Multi-Range Ammeter and Voltmeter Using a Galvanometer
2	Measurement of Resistance Using a Wheatstone Bridge and Analysis of Bridge Sensitivity
3	Measurement of Capacitance Using De Sauty's Bridge
4	Measurement of Low Resistance Using Kelvin's Double Bridge
5	Determination of the Characteristics of a Resistance Transducer – Strain Gauge (Half and Full Bridge Measurement)
6	Determination of the Characteristics of an LVDT (Linear Variable Differential Transformer)
7	Determination of the Characteristics of Thermistors and RTDs (Resistance Temperature Detectors)

8	Measurement of Temperature Using Thermocouples and Study of Temperature Sensors (AD590, PT-100, J-Type, K-Type)
9	Study of the Characteristics of Light Sensors – LDR and Photodiode
10	Analysis of the Characteristics of a Solid-State Sensor or Fiber Optic Sensor

Learning Resources:

1. H. S. Kalsi, Electronic Instrumentation, TMH (2006)
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice- Hall (2005).
3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
4. E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book – fifth Edition (2003).
5. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education (2005)
6. David A. Bell, Electronic Instrumentation and Measurements, Prentice Hall (2013).
7. Oliver and Cage, "Electronic Measurements and Instrumentation", TMH (2009).
8. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann-2008).
9. A. K Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Sons (2007).
10. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata McGraw Hill (1998).
11. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.

Course Type: DSE-I
Course Title: Communication Electronics-I
Course Code: 301ELE5201A
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. The fundamental objectives of this course are to make the student understand and use the basic concepts of the circuits found in communications.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the fundamental concepts of communication systems, including signal transmission, modulation techniques, and bandwidth requirements.

CO 2. Analyze the principles of amplitude modulation, including its mathematical representation, power relations, generation, and detection techniques.

CO 3. Comprehend the fundamentals of frequency and phase modulation.

CO 4. Understand the principles of pulse modulation techniques, analyze their generation and detection methods, compare different pulse modulation systems, and evaluate the impact of noise on Pulse Code Modulation (PCM).

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Communication Systems**	**10**
	1. Introduction to Communication Systems and Basic Communication Model, 2. Classification of Electronic Communication Systems: Based on the Direction of Communication, 3. Nature of Information Signals and Techniques of Signal Transmission, 4. Need for Modulation and Different Types of Modulation: Amplitude Modulation, Frequency Modulation, Phase Modulation, Pulse Analog Modulation, and Pulse Code Modulation 5. Demodulation or Detection Techniques, 6. Concept of Bandwidth in Communication Systems.	
	Unit Outcomes: UO1. Understand the basic communication model, classify electronic communication systems based on the direction of communication.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Explain the need for modulation, differentiate between various modulation techniques.	
II	**Amplitude Modulation**	**12**
	1. Introduction to Amplitude Modulation (AM) 2. Mathematical Representation of an AM Wave: Modulation Index, Frequency Spectrum of an AM Wave, 3. Concept of Over-Modulation, 4. Calculation of Modulation Index Using an AM Wave and Trapezoidal Display 5. Power Relations in an AM Wave 6. Generation of AM: Low-Level Modulation, High-Level Modulation, and High-Level Collector Modulator Circuit 7. Grid-Modulated Class C Amplifier and Plate-Modulated Class C Amplifier 8. AM Detector Circuits: Simple Diode Detector, Distortions in the Detector Output, and Practical Diode Detector 9. Numerical Problems	
	Unit Outcomes: UO1. Analyze the mathematical representation of an AM wave, including modulation index, frequency spectrum, and power relations. UO2. Design and evaluate AM generation circuits, such as low-level and high-level modulators, and AM detector circuits.	
III	**Frequency Modulation**	**12**
	1. Introduction to Frequency Modulation (FM) and Phase Modulation (PM) 2. Mathematical Representation of FM: Modulation Index and Deviation Ratio 3. Frequency Spectrum of an FM Wave and Practical Bandwidth 4. Phase Modulation (PM), Comparison of FM and PM, and Comparison of FM and AM Systems 5. Generation of FM: Direct Methods for FM Generation, FM Generation from PM, Varactor Diode Modulator, and Basic FM Demodulators (Principle of Slope Detection and Balanced Slope Detector) 6. Numerical Problems	
	Unit Outcomes: UO1. Understand the principles of frequency modulation (FM) and phase modulation (PM), and analyze the mathematical representation of FM waves.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Compare FM with PM and AM systems, design FM generation circuits using direct methods and varactor diode modulators.	
IV	**Pulse Modulation**	**11**
	1. Classification of Pulse Modulation Systems, Continuous and Discrete-Time Signals, and the Sampling Process 2. Pulse Amplitude Modulation (PAM): Generation, Types, and Detection of PAM 3. Pulse Width Modulation (PWM): Generation and Detection of PWM Signals 4. Pulse Position Modulation (PPM): Generation and Demodulation of PPM Signals 5. Comparison of PAM, PWM, and PPM Systems 6. Pulse Code Modulation (PCM): PCM Transmitter (Encoder) and PCM Receiver (Decoder) 7. Quantization Process, 8. Effect of Noise on PCM Systems, Signaling Rate, and Transmission Bandwidth of PCM 9. Numerical Problems	
	Unit Outcomes: UO1. Analyze and classify pulse modulation systems, including PAM, PWM, and PPM, and compare their generation, detection, and demodulation techniques. UO2. Understand the principles of pulse code modulation (PCM), including the quantization process, encoder and decoder operations.	

Learning Resources:

1. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.
2. Communication Electronics by Louis E. Frenzel (Second Edition) McGraw-Hill International Editions.
3. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
4. Radio Engineering (Applied Electronics Vol.II) by G. K. Mithal, Khanna Publishers, Delhi
5. Handbook of Electronics by Gupta and Kumar, Pragati Prakashan.
6. Electronic Communications by Dennis Roddy, John Coolen, and Prentice- Hall of India private limited New Delhi.

7. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata Mc Graw Hill Publishing Company Limited.
8. R.K. Jain & S R K Iyengar, Advanced Engineering Mathematics, Narosa Pub. House
9. Thomas & Finney, Advanced calculus and geometry Addison-Wesley Pub. Co.
10. D. W. Jordan & P Smith, Mathematical Techniques, OXFORD

Course Type: Lab Course
Course Title: Lab Course Based on Communication Electronics-I
Course Code: 301ELE5202A
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. The learning objective of this laboratory course is to supplement the theory course of Communication Electronics with adequate introduction various modulation techniques.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Demonstrate the generation and detection of Amplitude Modulated (AM) and Frequency Modulated (FM) signals using appropriate circuits and ICs.

CO 2. Analyze and compare different pulse modulation techniques, including PAM, PWM, and PPM, for signal transmission.

CO 3. Implement and evaluate the working principles of Pulse Code Modulation (PCM) and its significance in digital communication.

CO 4. Examine the characteristics and applications of specialized modulation and detection techniques, such as the Varactor Diode Modulator and Balanced Slope Detector.

Practical No.	Experiments
1	Implementation of a Class C Modulator for AM Generation
2	Analysis of a Linear Diode Detector for AM Demodulation
3	FM Signal Generation Using IC 565
4	FM Signal Detection Using IC 566
5	Study and Analysis of Pulse Amplitude Modulation (PAM)
6	Study and Analysis of Pulse Width Modulation (PWM)
7	Study and Analysis of Pulse Position Modulation (PPM)
8	Study and Implementation of Pulse Code Modulation (PCM)
9	Characteristics and Applications of a Varactor Diode Modulator
10	Study and Implementation of a Balanced Slope Detector

Learning Resources:

1. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.
2. Communication Electronics by Louis E. Frenzel (Second Edition) McGraw-Hill International Editions.
3. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
4. Radio Engineering (Applied Electronics Vol.II) by G. K. Mithal, Khanna Publishers, Delhi
5. Handbook of Electronics by Gupta and Kumar, Pragati Prakashan.
6. Electronic Communications by Dennis Roddy, John Coolen, and Prentice- Hall of India private limited New Delhi.
7. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata Mc Graw Hill Publishing Company Limited.
8. R.K. Jain & S R K Iyengar, Advanced Engineering Mathematics, Narosa Pub. House
9. Thomas & Finney, Advanced calculus and geometry Addison-Wesley Pub. Co.
10. D. W. Jordan & P Smith, Mathematical Techniques, OXFORD

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSE-I
Course Title: Microprocessors & Microcontrollers
Course Code: 301ELE5201B
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To introduce students to the architecture and operation of typical microprocessors and microcontrollers.

LO 2. To familiarize students with the programming and interfacing of microprocessors and microcontrollers.

LO 3. To provide a strong foundation for designing real-world applications using microprocessors and microcontrollers.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the architecture, instruction set, addressing modes, and operational concepts of the 8085 microprocessors, enabling them to develop basic assembly language programs and comprehend interrupt handling mechanisms.

CO 2. Interface memory, input/output devices, and peripherals with a microprocessor, enabling them to design and implement practical embedded system applications.

CO 3. Gain a fundamental understanding of the Intel 8051 microcontroller architecture, its instruction set, memory organization, and I/O operations, enabling them to develop embedded system applications.

CO 4. Acquire the knowledge and skills to interface memory, display devices, sensors, and communication modules with the 8051 microcontrollers, enabling them to design and implement real-world embedded system applications.

Unit No.	Title of Unit & Contents	Hrs.
I	**Basics of 8085 Microprocessor**	**10**
	1. Introduction to the 8085 Microprocessor and CPU Architecture 2. Register Organization 3. 8085 Instruction Set 4. Addressing Modes of the 8085 Microprocessor 5. Stack and Subroutine	

Unit No.	Title of Unit & Contents	Hrs.
	6. Instruction Cycle 7. Interrupts in the 8085 Microprocessor (Hardware and Software)	
	Unit Outcomes: UO1. Understand the architecture and register organization of the 8085 microprocessors. UO2. Explain the concepts of stack, subroutines, and instruction cycles, and evaluate the interrupt mechanisms (hardware and software) in the 8085 microprocessors.	
II	**Interfacing:**	**12**
	1. Memory Interfacing 2. I/O Interfacing 3. Memory-Mapped I/O 4. I/O-Mapped I/O 5. Peripheral Interfacing – Programmable I/O (8255 Interface) 6. ADC (0809), DAC (0808), and Seven-Segment LED Display 7. 4×4 Matrix Keyboard 8. Stepper Motor Interfacing	
	Unit Outcomes: UO1. Design and implement memory and I/O interfacing techniques, including memory-mapped I/O and I/O-mapped I/O, for efficient data transfer and communication in microprocessor-based systems. UO2. Interface peripheral devices such as programmable I/O (8255), ADC (0809), DAC (0808), seven-segment LED displays, matrix keyboards, and stepper motors with the 8085 microprocessors for practical applications.	
III	**Introduction to MCS51**	**12**
	1. Introduction to the Concept of Microcontrollers 2. Comparison of Microprocessors and Microcontrollers, Comparison of All 8-Bit Microcontrollers 3. Intel 8051 Microcontroller Architecture 4. Pin Diagram of 8051 5. Memory Organization of 8051 and Special Function Registers (SFRs) 6. Internal Structure and Operation of I/O Ports 7. Interfacing of 8051 with External Memory, Addressing Modes, and Instruction Set.	

Unit No.	Title of Unit & Contents	Hrs.
	Unit Outcomes: UO1. Understand the architecture, memory organization, and special function registers (SFRs) of the 8051 microcontrollers. UO2. Analyze the internal structure and operation of I/O ports, and implement interfacing techniques for external memory while utilizing the addressing modes and instruction set of the 8051 microcontrollers.	
IV	**Interfacing & Application**	**11**
	1. Interfacing: RAM, ROM, LCD, ADC, DAC, and Keyboard 2. Stepper Motor: Minimum System Design 3. Applications: Interfacing of Temperature Sensor (LM35) with 8051, Connection to RS232	
	Unit Outcomes: UO1. Design and implement interfacing solutions for RAM, ROM, LCD, ADC, DAC, and keyboard with the 8051 microcontrollers, and develop a minimum system design for stepper motor control. UO2. Apply the 8051 microcontrollers in practical applications, such as interfacing with temperature sensors (e.g., LM35) and establishing RS232 communication for data transfer.	

Learning Resources:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar – Wiley Eastern Limited- IV Edition.
2. Muhammad Ali Mazidi, “Microprocessors and Microcontrollers”, Pearson, 2006.
3. Fundamentals of Microprocessor & Microcomputer: B. Ram—Dhanpat Rai Publications.
4. PIC Microcontrollers, Milan Verle, Mikro Elektronika, 1st edition (2008)
5. Microchip PIC16F87X datasheet
6. 8085 Microprocessor by Ramesh Gaonkar.
7. Microprocessor architecture programming and application with the 8085 by R Gaonkar.
8. Microprocessor by John Uffenbeck.
9. Fundamentals of Microprocessors and Microcontrollers by B Ram.
10. Microprocessor principle and application by a Pal.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course based on Microprocessors & Microcontrollers

Course Code: 301ELE5202B

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To provide hands-on experience in assembly language programming, understanding microprocessor/microcontroller architecture, interfacing with peripherals, and designing real-time applications.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Demonstrate arithmetic, logical, and data transfer operations using the 8085 microprocessors.

CO 2. Implement interfacing techniques for peripheral devices such as stepper motors, DACs, and LCDs with microprocessors and microcontrollers.

CO 3. Analyze and apply interrupt handling mechanisms and delay generation techniques in the 8085 microprocessors.

CO 4. Develop real-time applications by interfacing ADCs and DACs with the 8085 microprocessors.

Practical No.	Title of Experiment
1	Arithmetic and Logical Operations Using the 8085 Microprocessor
2	Data Transfer and Exchange Operations Using the 8085 Microprocessor
3	Interfacing and Controlling a Stepper Motor Using the 8085 Microprocessor
4	Interfacing a DAC with the 8051 Microcontroller
5	Interfacing a 2×16 LCD Display with the 8085 Microprocessor
6	Interfacing and Rotating a Stepper Motor Using the 8085 Microprocessor
7	Clockwise and Anticlockwise Rotation with Speed Control of a Stepper Motor Using the 8085 Microprocessor
8	Interfacing ADC and DAC with the 8085 Microprocessor
9	Interrupt Handling Mechanism Using the 8085 Microprocessor
10	Study and Implementation of Delay Generation Using the 8085 Microprocessor

Learning Resources:

1. Microprocessor Architecture, Programming and Applications with 8085, Ramesh S. Gaonkar – Wiley Eastern Limited- IV Edition.
2. Muhammad Ali Mazidi, "Microprocessors and Microcontrollers", Pearson, 2006.
3. Fundamentals of Microprocessor & Microcomputer: B. Ram—Dhanpat Rai Publications.
4. PIC Microcontrollers, Milan Verle, mikro Elektronika, 1st Edition (2008)
5. Microchip PIC16F87X datasheet
6. 8085 Microprocessor by Ramesh Goankar.
7. Microprocessor architecture programming and application with the 8085 by R Gaonkar.
8. Microprocessor by John Uffenbeck.
9. Fundamentals of Microprocessors and Microcontrollers by B Ram.
10. Microprocessor principle and application by a Pal.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Minor III
Course Title: Optoelectronic Devices
Course Code: 301ELE5301
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. The objective of the course is to give students an introduction to optoelectronic fundamentals and devices.

LO 2. This course serves as a perquisite course to prepare students to do research in the semiconductor optics and optoelectronics devices

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the fundamental interaction between optics and electronics,

CO 2. Analyze the conditions required for light amplification, compare different types of LASERs, and explore their special properties and applications in various fields.

CO 3. Explore the advantages and applications of optical fiber communication.

CO 4. Gain an understanding of various light detection mechanisms, differentiate between thermal and quantum detectors, analyze the working principles of quantum photodetectors, and evaluate their key characteristics and material properties.

Unit No.	Title of Unit & Contents	Hrs.
I	**Introduction to Optoelectronics**	**11**
	1. Basic Interaction Between Optics and Electronics; 2. Review of P-N Junction Characteristics; 3. Band Structures and Semiconductor Heterojunctions; 4. Principles of LEDs, Spontaneous Emission, Absorption, Stimulated Emission; 5. Population Inversion; 6. LED Structures – Surface-Emitting LEDs; LED Characteristics; Opto-Isolators; 7. Fundamentals of Reflection, Refraction, Transmission, and Absorption of Light Radiation.	
	Unit Outcomes: UO1. Understand the fundamental principles of optoelectronics, including the interaction between optics and electronics.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Evaluate the design, operation, and characteristics of Light Emitting Diodes (LEDs).	
II	**Laser Properties**	**12**
	1. LASER as an amplifier of light, 2. necessary condition for amplification, 3. special properties of LASER, 4. Study of three & four level LASERs, 5. study of tunable and semiconductor LASER, 6. applications of LASER, 7. Ruby Laser, 8. He-Ne Laser. 9. CO_2 Laser. 10. Laser diode	
	Unit Outcomes: UO1. Understand the principles of LASER operation. UO2. Analyze the design, functionality, and applications of various types of LASERs.	
III	**Optical Fiber: Theory and Application**	**11**
	1. Action of optical fiber as a waveguide, 2. Advantages of optical fiber communications, 3. Necessity condition for waveguide mechanism of optical fiber, 4. Types of optical fibers, step index and graded index, 5. Comparison of waveguiding action, Numerical aperture, 6. Loss in optical fiber communication, 7. Fiber losses, 8. Intrinsic and extrinsic losses, comparison between losses, 9. Modes of transmission and dispersion in optical fiber, 10. Application of optical fiber.	
	Unit Outcomes: UO1. Understand the fundamental principles of optical fibers as waveguides. UO2. Evaluate the performance and limitations of optical fiber communication systems.	
IV	**Light Detectors**	**11**
	1. Idea of light detectors, 2. Natural and quantum specialized light detectors,	

Unit No.	Title of Unit & Contents	Hrs.
	3. Types of special light detector – thermal and quantum detectors, 4. Types of quantum photo detectors- photo resistive, photovoltaic and photoelectric cell, photo multiplier tube, 5. Important characteristics of light detectors-spectral response, efficiency material used for photodetectors.	
	Unit Outcomes: UO1. Understand the principles and types of light detectors, including thermal and quantum detectors, and analyze their working mechanisms, such as photo-resistive, photovoltaic, photoelectric cells, and photomultiplier tubes. UO2. Evaluate the key characteristics of light detectors, including spectral response, efficiency, and materials used.	

Learning Resources:

1. An Introduction of Optical Fiber: Cherin A.H, Mc. Graw Hill, Int. Student.
2. Optical Fiber Communication: Keiser G., Mc. Graw Hill.
3. Introduction of Optical Electronics: K.A. Jones, Harper and Row.
4. Optical Communication System: John Grower, Prentice, India.
5. The Laser: Hecth, Mc Graw Hill.
6. S. O. Kasap. “Optoelectronics and Photonics”, Pearson Prentice Hall, Second Edition, 2012.
7. Govind P. Agrawal, Niloy K. Dutta. “Semiconductor Lasers”, Second Edition, Springer-Verlag, 1993.
8. Mitsuo Fukuda, “Optical Semiconductor Devices”, John-Wiley and Sons, 2005.
9. Ben G. Streetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices,” Seventh Edition Global Edition, Pearson, 2016.
10. Pallab Bhattacharya, “Semiconductor Optoelectronic Devices,” Second Edition, Prentice-Hall, 2017.
11. Clifford R. Pollock, “Fundamentals of Optoelectronics”, Richard d Irwin, 1995.
12. Emmanuel Rosencher, Borge Vinter, “Optoelectronics”, First Edition, Cambridge University Press, 2002.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course
Course Title: Lab Course (Based on Optoelectronic Devices)
Course Code: 301ELE5303
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objectives:

LO 1. Provide learners with hands-on experience in the characterization of optoelectronic components such as photodiodes, phototransistors, and solar cells; measurement of key optical parameters in fiber optics; and application of fundamental optical principles like diffraction, polarization, and interference for precise optical measurements.

Course Outcomes:

After completion of the course, students will be able to -

CO 1. Analyze the characteristics of photodetectors such as photodiodes and phototransistors, and evaluate their performance in optoelectronic applications.

CO 2. Measure and interpret key optical fiber parameters, including numerical aperture and bending loss, to assess fiber optic communication efficiency.

CO 3. Demonstrate fundamental optical principles, including polarization, diffraction, and total internal reflection, through experimental validation.

CO 4. Apply laser-based measurement techniques, such as Michelson interferometry and wedge plate analysis, for precise wavelength and thickness determinations.

Practical No.	Experiments
1	Characterization of a Photodiode
2	Characterization of a Phototransistor
3	Measurement of Numerical Aperture (NA) in Optical Fiber
4	Study of Bending Loss in Optical Fiber
5	Determination of the Efficiency of a Given Solar Cell
6	Calculation of Laser Wavelength Using a Michelson Interferometer
7	Observation of Polarization Properties of Light and Verification of Malus's Law
8	Diffraction Pattern Analysis Using a Ruled Grating to Determine the Grating Pitch
9	Observation of Total Internal Reflection in a Transparent Bar and Determination of Its Refractive Index

Practical No.	Experiments
10	Diffraction Using a Transmission Grating to Determine the Grating Pitch
11	Determination of the Angle of a Given Wedge Plate Using Laser and Calculation of Its Thickness

Learning Resources:

1. An Introduction of Optical Fiber: Cherin A.H, Mc. Graw Hill, Int. Student.
2. Optical Fiber Communication: Keiser G., Mc. Graw Hill.
3. Introduction of Optical Electronics: K.A. Jones, Harper and Row.
4. Optical Communication System: John Grower, Prentice, India.
5. The Laser: Hecth, Mc Graw Hill.
6. S. O. Kasap. “Optoelectronics and Photonics”, Pearson Prentice Hall, Second Edition, 2012.
7. Govind P. Agrawal, Niloy K. Dutta. “Semiconductor Lasers”, Second Edition, Springer-Verlag, 1993.
8. Mitsuo Fukuda, “Optical Semiconductor Devices”, John-Wiley and Sons, 2005.
9. Ben G. Streetman and Sanjay Kumar Banerjee, “Solid State Electronic Devices,” Seventh Edition Global Edition, Pearson, 2016.
10. Pallab Bhattacharya, “Semiconductor Optoelectronic Devices,” Second Edition, Prentice-Hall, 2017.
11. Clifford R. Pollock, “Fundamentals of Optoelectronics”, Richard d Irwin, 1995.
12. Emmanuel Rosencher, Borge Vinter, “Optoelectronics”, First Edition, Cambridge University Press, 2002.

Course Type: Minor IV
Course Title: Consumer Electronics
Course Code: 301ELE5303
Credits: 02 **Max. Marks: 50** **Lectures: 30 Hrs.**

Learning Objectives:

LO 1. To familiarize students with various consumer electronic devices and their specifications.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Demonstrate an understanding of audio systems, including microphones, amplifiers, loudspeakers, radio receivers (AM/FM), and audio recording and reproduction technologies such as cassettes, CDs, and MP3s.

CO 2. Develop an understanding of TV and video systems, including television standards, display technologies (CRT, LCD, Plasma, LED, HDTV), video playback devices, broadcasting systems, and advanced home entertainment technologies such as projectors and home theaters.

CO 3. Explain the principles and functionalities of landline and mobile telephony, intercom and EPABX systems, wireless communication technologies (GPRS, Bluetooth, GPS), smartphones, and essential office equipment such as scanners, printers, and multifunction units.

CO 4. Establish an understanding of the working principles, functionalities, and applications of various electronic gadgets and domestic appliances, including digital clocks, cameras, home security systems, and household appliances like air conditioners, refrigerators, and microwave ovens.

Unit No.	Title of Unit & Contents	Hrs.
I	**Audio Systems**	**08**
	1. Introduction, 2. Audio systems: PA system, 3. Microphone, 4. Amplifier, 5. Loudspeakers. 6. Radio receivers,	

Unit No.	Title of Unit & Contents	Hrs.
	7. AM/FM. 8. Audio recording and reproduction, 9. Cassettes, CD and MP3.	
	Unit Outcomes: UO1. Understand the components and functionality of audio systems, including PA systems, microphones, amplifiers, and loudspeakers. UO2. Explore the principles of radio receivers (AM/FM) and audio recording technologies, such as cassettes, CDs, and MP3s.	
II	**TV and Video Systems**	**08**
	1. TV and Video systems 2. Television standards, 3. BW/Colour, 4. CRT/HDTV 5. Video system, 6. VCR/VCD/DVD players, 7. MP4 players, Set Top box, CATV and Dish TV, 8. LCD, Plasma & LED TV. 9. Projectors: DLP, Home Theatres, Remote Control	
	Unit Outcomes: UO1. Understand the principles and standards of television systems, including BW/Color TV, CRT/HDTV, and modern display technologies such as LCD, Plasma, and LED TVs. UO2. Evaluate the working mechanisms and applications of video systems and devices.	
III	**Landline and Mobile Telephony:**	**07**
	1. Landline and Mobile telephony: Basic landline equipment, CLI, Cordless. 2. Intercom/EPABX system. 3. Mobile phones: 4. GPRS & Bluetooth. 5. GPS Navigation system. 6. Smart Phones 7. Office Equipment: Scanners, Barcode/Flat bed, Printers, Xerox, Multifunction units (Print, Scan, fax, and copy)	
	Unit Outcomes: UO1. Understand the fundamentals of landline and mobile telephony systems.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Evaluate the functionality and applications of office equipment, such as scanners, printers, Xerox machines, and multifunction units.	
IV	**Electronic Gadgets and Domestic Appliances:**	**07**
	1. Electronic Gadgets and Domestic Appliances: 2. Digital clock, Digital camera, Handicam, 3. Home security system, CCTV 4. Air conditioners, 5. Refrigerators, 6. Washing Machine/Dish Washer, 7. Microwave oven, 8. Vacuum cleaners	
	Unit Outcomes: UO1. Understand the working principles and applications of electronic gadgets, such as digital clocks, digital cameras, handicams, and home security systems (CCTV). UO2. Evaluate the functionality and technological features of domestic appliances.	

Learning Resources:

1. R. P. Bali, Consumer Electronics Pearson Education (2008)
2. R. G. Gupta, Audio and Video systems Tata McGraw Hill (2004)
3. Douglas Kinney, A Beginners Guide to Consumer Electronics Repair: Hand Book and Tutorial (2006)
4. Philip Hoff, Philip Herbert Hoff, Consumer Electronics for Engineers (1998)

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: VSC III
Course Title: Electrical Circuits and Network
Course Code: 301ELE5501
Credits: 02 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. The course aims to provide students with a solid understanding of electric circuits and networks, including their principles, analysis techniques, and design methodologies.

LO 2. To help students to acquire a strong foundation in electrical engineering concepts.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Demonstrate an understanding of fundamental electrical principles, including voltage, current, resistance, and power, and apply Ohm's law and Kirchhoff's laws to analyze DC and AC circuits.

CO 2. Explain the principles and operation of generators, transformers, and solid-state devices.

CO 3. Demonstrate the application of fundamental circuit theorems, including Kirchhoff's laws, Superposition, Thevenin's, Norton's, and Maximum Power Transfer Theorem, to analyze and validate electrical circuits.

CO 4. Develop practical skills in studying and evaluating transformer characteristics and electrical protection devices such as fuses and switches.

Unit No.	Title of Unit & Contents	Hrs.
I	**Basic Electricity Principles**	**07**
	1. Introduction to Voltage, Current, Resistance, and Power, 2. Introduction to DC and AC circuits, 3. Active and passive two terminal elements, 4. Ohm's law, 5. Kirchhoff's laws.	
	Unit Outcomes: UO1. Understand and apply fundamental electrical concepts, including voltage, current, resistance, power, and Ohm's law, to analyze basic DC and AC circuits. UO2. Use Kirchhoff's laws to solve circuit problems and differentiate between active and passive two-terminal elements in electrical networks.	

Unit No.	Title of Unit & Contents	Hrs.
II	**Transformers and Solid-State Devices**	**08**
	1. DC Power sources. 2. Inductance, capacitance, and impedance. 3. Operation of transformers. 4. Solid-State Devices: Resistors, inductors and capacitors. 5. Diode and rectifiers. 6. Components in Series or in shunt 7. Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers.	
	Unit Outcomes: UO1. Analyze the principles of DC power sources, inductance, capacitance, impedance, and transformer operations in electrical circuits. UO2. Demonstrate an understanding of solid-state devices, rectifiers, and electrical protection components such as relays, fuses, and circuit breakers.	
III	**Practical**	**30**
	1. Verification of Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL) 2. Verification of Superposition Theorem 3. Verification of Maximum Power Transfer Theorem 4. Verification of Thevenin's Theorem 5. Verification of Norton's Theorem 6. Study and Analysis of Transformer Characteristics 7. Study of Fuses and Switches for Electrical Protection	

Learning Resources:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
2. A text book in Electrical Technology – B.L. Theraja - S Chand & Co.
3. A text book of Electrical Technology – A. K. Theraja
4. Performance and design of AC machines - M G Say ELBS Edn.
5. Solid-State Electronic Devices by Ben G. Streetman and Sanjay Banerjee
6. Electric Power Systems by B.M. Weedy and B.J. Cory
7. Electrical Engineering: Principles and Applications" by Allan R. Hambley
8. Semiconductor Devices: Physics and Technology by S.M. Sze
9. Basic Electrical Engineering by D. C. Kulshreshtha
10. Fundamentals of Electric Circuits by Charles Alexander and Matthew N.O. Sadiku

Semester - VI

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSC-XI
Course Title: Digital Electronics
Course Code: 301ELE6101
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To imbibe basic digital design techniques.

LO 2. To familiarize students with the different number systems, logic gates in the different digital circuits and systems.

LO 3. To introduce the basic concepts and laws involved in the Boolean algebra and logic families and digital circuits.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Analyze and design various combinational circuits, including arithmetic circuits, encoders, decoders, multiplexers, and demultiplexers, to develop efficient digital systems.

CO 2. Understand the operation, characteristics, and applications of various flip-flops and apply them in designing sequential circuits for data storage and processing.

CO 3. Analyze and design different types of digital counters, understand their operation, and apply them in various practical applications.

CO 4. Analyze and implement shift register counters like Johnson and Ring counters in various applications.

Unit No.	Title of Unit & Contents	Hrs.
I	**Combinational Circuits**	**13**
	1. Introduction 2. Exclusive-OR (XOR) Gate–Gate Formation, 3. Multi-Input XOR Gate as Controlled Inverters, and XNOR Gate Using NAND and NOR Gates 4. Half Adder, Full Adder, 5. Half Subtractor, and Full Subtractor, 6. Serial and Parallel Addition, Parallel Adder, BCD (8421) Adder, and Excess-3 Adder 7. Encoders: Decimal to BCD (Diode Matrix) Encoder and Decimal to BCD Priority Encoder	

Unit No.	Title of Unit & Contents	Hrs.
	8. Decoders: BCD-to-Decimal Decoder and BCD-to-7-Segment Decoder 9. Multiplexers and Demultiplexers	
	Unit Outcomes: UO1. Design and analyze combinational circuits, including XOR/XNOR gates, adders (half, full, parallel, BCD, and Excess-3), and subtractors (half and full), for arithmetic and logic operations. UO2. Implement and evaluate encoders, decoders, multiplexers, and demultiplexers, and understand their applications in digital systems.	
II	**Flip–Flops**	**10**
	1. Introduction 2. Flip-Flops: Basic Flip-Flop Circuit (Latch), RS Flip-Flop 3. Clocking Mechanisms: Level Clocking vs. Edge Clocking 4. Clocked RS Flip-Flop 5. JK Flip-Flop and Master-Slave JK Flip-Flop 6. D Flip-Flop and T Flip-Flop 7. Asynchronous Inputs (PRESET and CLEAR) 8. Flip-Flop Timing Considerations 9. Flip-Flop Applications: Data Storage and Transfer, Flip-Flop as a Debouncer Switch.	
	Unit Outcomes: UO1. Understand the working principles of basic flip-flops (RS, JK, D, and T). UO2. Apply flip-flops in practical applications such as data storage, data transfer, and switch debouncing, and evaluate timing considerations and asynchronous inputs (PRESET and CLEAR) in flip-flop operations.	
III	**Digital Counters (Binary Counters)**	**15**
	1. Introduction 2. Basic Flip-Flop Counter and Modulus of a Counter 3. Types of Counters: Asynchronous (Ripple) Counters: Mod-2, Mod-4, Mod-6, Mod-8 Ripple Counters, Asynchronous Mod-8 Down Counter, Asynchronous Up/Down Counter, Asynchronous Mod-10 (Decade) Counter, Example of Asynchronous BCD Counter, Disadvantages of Asynchronous Counters 4. Synchronous Counters: Synchronous Mod-16 Counter (Serial Carry), Synchronous Mod-10 Counter (Decade) 5. Applications of Counters	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Design and analyze asynchronous (ripple) counters, including Mod-2, Mod-4, Mod-6, Mod-8, and Mod-10 counters, and evaluate their advantages and disadvantages in digital systems. UO2. Implement synchronous counters, such as Mod-16 and Mod-10 counters, and explore their applications in digital circuits for counting and sequencing operations.	
IV	**Shift Registers**	**07**
	1. Introduction 2. Basic Shift Register Operations 3. Types of Shift Registers: Serial In/Serial Out Shift Registers, Serial In/Parallel Out Shift Registers, 4. Parallel In/Serial Out Shift Registers, Parallel In/Parallel Out Shift Registers 5. Shift Register Counters: The Johnson Counter, The Ring Counter	
	Unit Outcomes: UO1. Understand the basic operations of shift registers and design various types of shift registers, including serial-in/serial-out, serial-in/parallel-out, parallel-in/serial-out, and parallel-in/parallel-out configurations. UO2. Implement and analyze shift register counters, such as Johnson counters and ring counters, and evaluate their applications in digital systems for data storage, transfer, and sequencing.	

Learning Resources:

1. Digital Principles and Circuits- Dr. C. B. Agarwal, Himalaya Publishing House (1st Edition)
2. Digital Fundamentals (10th Edition) Thomas L. Floyd – Pearson.
3. Digital Principle and Applications- By Donald P. Leach, Albert Paul Malvino Gautam Saha (Seventh Edition) Tata McGraw Hill Education Private Limited New Delhi
4. Digital Fundamentals (Eighth Edition)- Floyd and Jain Pearson Education.
5. Modern digital Electronics (25th Ann. Edition Fourth edition, -TATA McGraw Hill) by R. P. Jain.
6. Digital Electronics- (Second Edition) In introduction to theory and Practice by William H. Gothmanm
7. "Basic Digital Electronics (Physics and Its Applications)" by J. A. Strong.
8. "Basic Electronics" by S Y Kulkarni and B Somanathan Nai.
9. Contemporary Logic Design, Randy H. Katz, Benjamin-Cummings, 1994.
10. Schaum's Outline of Theory and Problems of Boolean Algebra and Switching Circuits, Elliott Mendelson, McGraw-Hill, 1970.

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)
Faculty of Science and Technology
Department of Physics and Electronics

Course Type: Lab Course
Course Title: Lab Course – XI (Based on Digital Electronics)
Course Code: 301ELE6103
Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To equip students with practical skills to understand, design, implement, and troubleshoot digital circuits, including combinational and sequential logic, through hands-on experimentation and analysis

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Design and implement basic combinational circuits, such as half subtractors, full subtractors, and BCD adders, using logic gates.

CO 2. Understand the working principles of various flip-flops and their applications in sequential circuits.

CO 3. Analyze and implement different types of counters, including synchronous and asynchronous counters, for digital systems.

CO 4. Gain hands-on experience in designing and testing multiplexers, de-multiplexers, and decoders for data selection and display applications.

Practical No.	Experiment
1	Implementation of Binary Half Subtractor and Full Subtractor Using NAND Gates
2	Design and Analysis of BCD (8421) Adder
3	Study and Implementation of RS, JK, T, and D Type Flip-Flops
4	Design and Testing of Mod-8 Synchronous Counter
5	Implementation of Asynchronous BCD Counter
6	Design of Ring Counter Using Flip-Flops
7	Study and Implementation of Multiplexer (4:1)
8	Study and Implementation of De-Multiplexer
9	Implementation of BCD to Decimal Decoder
10	Implementation of BCD to 7-Segment Decoder

Learning Resources:

1. Digital Principles and Circuits- Dr. C. B. Agarwal, Himalaya Publishing House (1st Edition)
2. Digital Fundamentals (10th Edition) Thomas L. Floyd – Pearson.

3. Digital Principle and Applications- By Donald P. Leach, Albert Paul Malvino Gautam Saha (Seventh Edition) Tata McGraw Hill Education Private Limited New Delhi
4. Digital Fundamentals (Eighth Edition)- Floyd and Jain Pearson Education.
5. Modern digital Electronics (25th Ann. Edition Fourth edition, -TATA McGraw Hill) by R. P. Jain.
6. Digital Electronics- (Second Edition) In introduction to theory and Practice by William H. Gothmanm
7. "Basic Digital Electronics (Physics and Its Applications)" by J. A. Strong.
8. "Basic Electronics" by S Y Kulkarni and B Somanathan Nai.
9. Contemporary Logic Design, Randy H. Katz, Benjamin-Cummings, 1994.
10. Schaum's Outline of Theory and Problems of Boolean Algebra and Switching Circuits, Elliott Mendelson, McGraw-Hill, 1970.

Course Type: DSC-XII
Course Title: Photonics and Science of Aeronautics (Vymaanika Shaashtra)
Course Code: 301ELE6102
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. Developing understanding about the fundamental principles of light-matter interactions,

LO 2. Explore the theories and concepts of aerodynamics and advanced technology attributed to ancient civilizations.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Explain the principles of laser operation, light-matter interaction, and the working mechanisms of lasers and light-emitting diodes (LEDs), including their construction, materials, and applications.

CO 2. Understand the working principles, characteristics, and applications of various photodetectors and LCD displays, including their efficiency, responsiveness, and technological significance.

CO 3. Analyze the concepts of Vimana Shastra, including its historical context, textual interpretations, and the theoretical components and architecture of ancient Indian aeronautics.

CO 4. Understand the theoretical principles of power generation in Vimana Shastra, including energy sources, machinery components, and the distinct structural and functional characteristics of different types of Vimanas.

Unit No.	Title of Unit & Contents	Hrs.
I	**Lasers and Light Emitting Diodes**	08
	1. Interaction of Radiation and Matter. 2. Einstein Coefficients and the Condition for Amplification. 3. Laser Cavity and the Threshold for Laser Oscillation. 4. Line Shape Function and Examples of Common Lasers. 5. The Semiconductor Injection Laser Diode. 6. Light-Emitting Diodes: Construction, Materials, and Operation.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Understand and analyze the fundamental principles of laser operation, including the interaction of radiation with matter. UO2. Evaluate the design and functionality of semiconductor-based light sources, such as laser diodes and light-emitting diodes (LEDs).	
II	**Photodetectors and LCD Displays**	**07**
	1. Bolometer 2. Photomultiplier tube 3. Charge-Coupled Device (CCD) 4. Phototransistors and photodiodes (p-i-n, avalanche) 5. Quantum efficiency and responsivity 6. LCD displays: Types of liquid crystals 7. Principle of Liquid Crystal Displays (LCDs)	
	Unit Outcomes: UO1. Evaluate the working principles and performance characteristics of various photodetectors. UO2. Analyze the operation and design of Liquid Crystal Displays (LCDs).	
III	**Introduction to Ancient Indian Aeronautics**	**14**
	1. Overview of Vymaanika Shaastra by Maharshi Bharadwaja 2. Commentary by Bodhaananda and Siddhanaatha 3. Components of the Vimaana: On Clothing (Vasthraadhikaranam), On Food (Aahaaraadhikaranam), On Metals (Lohaadhikaranam) 4. Architecture of Vimaana: Introduction, Instrumentation system, Detection and ranging system, Air conditioning system	
	Unit Outcomes: UO1. Examine the foundational concepts of ancient Indian aeronautics as described in the Vymaanika Shaastra. UO2. Analyze the structural and functional components of Vimaanas, such as clothing, food, metals, and advanced systems.	
IV	**Process of Power Generation in Vimaana**	**16**
	Process of Power Generation in Vimaana 1. Introduction 2. Power generation systems: The Power (Shaktyadhikaranam), Shaktayassapta Sootra, 3. Heat-absorbing metals 4. Electrical power generator and electric motor	

Unit No.	Title of Unit & Contents	Hrs.
	5. Parts of machinery: Athha Yantraangaani, Naalapanchaka (Five tubes), Pancha-dhaara-loha **Varieties of Vimaana**: 6. Shakuna Vimaana: The Peetha, Naalastambha (Hollow mast), The wheels, Window dome, Sun-crystal, 7. Sundara Vimaana: Electric dynamo, Air-spreading machine, 8. Rukma Vimaana: The Peetha (Ground plate), Ayas-Chakra (Tyres), Button-switch pole, Flying mechanism 9. Tripura Vimaana: Constructed entirely from pure mica	
	Unit Outcomes: UO1. Examine the principles and mechanisms of power generation in Vimaanas. UO2. Analyze the structural and functional components of various Vimaana types.	

Learning Resources:

1. An Introduction to Laser: Theory and Applications-M.N. Avadhanulu (S. Chand and Company Ltd. Ram Nagar, New Delhi 2008)
2. Lasers and Non-Linear Optics- B.B. Laud (New Age International Publishers 2006)
3. Laser Fundamentals- William T. Silfvast Cambridge University, Press
4. Laser and its Applications – Ghatak and Thyagarajan (Mcmillan, India 2004)
5. Laser- Principles, Types and Applications- K.R. Nambiar, (New Age Inter. Publishers 2006)
6. Optical Fiber Communication- G. Keiser (Mc Graw Hill) Third Edition
7. Introduction to Fiber Optics- A. Ghatak and Tyagrajan (Cambridge University Press)
8. Shruti Mohanty, Liquid Crystals - The 'Fourth' Phase of Matter, RESONANCE November 2003 Page 52-70
9. Practical Optics, Naftaly Menn, Academic Press (2004)
10. Fundamentals of Fiber Optics in Telecommunication and Sensor System, Edited by B. P. Pal, New Age International Publisher, New Delhi, First Edition Reprint 2006
11. Maharshu Bharadwaj's "VYMAANIKA SHAASTRA", Pandit subbraya sastry, Translated into English by G.R. Josyer, Coronation Press, Mysore, India.
12. VIMANA Flying Machines of the Ancient, Childress David Hatcher.
13. https://www.academia.edu/22735116/Electronics_and_Technology_used_in_Ancient_Indian_Aeronautical_Science.
14. Brihad Vimanasastra - Ancient Indian Science of Aeronautics Parimal publication Pvt. Ltd, B.S. Bist.

15. Wings of India - The Aeronautics of Ancient India, Kiyoto publication, Shubham Ramesh Chavan.
16. Science of aeronautics in ancient India
17. Vimana Aircraft of Ancient India & Atlantis, David Hatcher, adventure digital Press, one Adventure Place, Kempton, Illinois 60946 USA.
18. Aircraft Metallurgy (Revised) By Arjun Singh Soa
19. Basic Aircraft Electrical, Instrument & Radio System by Soa.
20. Indian Aircraft Industry: Possible Innovations for Success in The Twenty First Century, Capt. Vivek Kapur.
21. Aero plane Science in Ancient India, Harsh Dev Kumar

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course- XII (Based on Photonics and Science of Aeronautics (Vymaanika Shaashtra)

Course Code: 301ELE6104

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To provide students with hands-on experience in observing optical phenomena, mastering experimental techniques, and applying theoretical knowledge to practical problems, ultimately fostering a deeper understanding of photonics principles and their applications.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Apply the principles of optics to determine the refractive index and absorption coefficient of liquids.

CO 2. Analyze laser diffraction patterns to measure data track spacing on CDs.

CO 3. Investigate the V-I characteristics of optoelectronic devices such as phototransistors, photodiodes, and LEDs.

CO 4. Examine the diffraction of light through various apertures and study the characteristics of light-dependent resistors (LDRs).

Practical No.	Experiments
1	Determination of the Refractive Index of Liquids Using Total Internal Reflection
2	Measurement of the Absorption Coefficient of a Transparent Liquid
3	Analysis of CD Track Patterns Using Lasers and Determination of Data Track Spacing
4	Investigation of V-I Characteristics of a Phototransistor
5	Investigation of V-I Characteristics of a Photodiode
6	Study of LED Characteristics
7	Calibration and Sensitivity Measurement of an Optical Sensor
8	Diffraction of Laser Light Through a Single Slit
9	Study of Light-Dependent Resistor (LDR) Characteristics
10	Diffraction of Laser Light Through a Straight Edge

Learning Resources:

1. An Introduction to Laser: Theory and Applications-M.N. Avadhanulu (S. Chand and Company Ltd. Ram Nagar, New Delhi 2008)
2. Lasers and Non-Linear Optics- B.B. Laud (New Age International Publishers 2006)
3. Laser Fundamentals- William T. Silfvast Cambridge University, Press
4. Laser and its Applications – Ghatak and Thyagarajan (Mcmillan, India 2004)
5. Laser- Principles, Types and Applications- K.R. Nambiar, (New Age Inter. Publishers 2006)
6. Optical Fiber Communication- G. Keiser (Mc Graw Hill) Third Edition
7. Introduction to Fiber Optics- A. Ghatak and Tyagrajan (Cambridge University Press)
8. Shruti Mohanty, Liquid Crystals - The 'Fourth' Phase of Matter, RESONANCE November 2003 Page 52-70
9. Practical Optics, Naftaly Menn, Academic Press (2004)
10. Fundamentals of Fiber Optics in Telecommunication and Sensor System, Edited by B. P. Pal, New Age International Publisher, New Delhi, First Edition Reprint 2006

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSE-II
Course Title: Communication Electronics-II
Course Code: 301ELE6201A
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. The fundamental objectives of this course are to make the student understand and use the basic concepts of the circuits found in radiocommunication

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Demonstrate an understanding of different types of radio receivers, their working principles, and key performance characteristics such as sensitivity, selectivity, and fidelity.

CO 2. Explain the fundamental principles of RADAR, its types, key performance factors, and essential components such as duplexers and moving target indicators (MTI).

CO 3. Describe the principles of optical fibre communication, including light propagation, fibre types, numerical aperture, and practical applications.

CO 4. Explain modern communication technologies, including satellite systems, digital modulation, network topologies, and fiber-optic communication systems.

Unit No.	Title of Unit & Contents	Hrs.
I	**Radio Receivers**	**10**
	1. Functions of a Receiver and Classification of Receivers. 2. Types of AM Receivers: Tuned Radio Frequency (TRF) Receiver, Issues in TRF Receivers. 3. Superheterodyne Receivers: Block Diagram and Characteristics of Radio Receivers, including Sensitivity, Selectivity, and Fidelity. 4. Image Frequency and Its Rejection: Image Rejection Using a Single-Tuned Circuit. 5. Double Spotting. 6. FM Receiver: Block Diagram of an FM Receiver.	
	Unit Outcomes: UO1. Understand and classify the functions of radio receivers,	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Analyze the challenges and solutions in receiver design, such as image frequency rejection, double spotting, and the block diagram and functionality of FM receivers.	
II	**RADAR Systems**	**12**
	1. Basic Principles of RADAR. 2. The Radar Equation. 3. Factors Influencing Maximum Range and the Effect of Noise. 4. Power and Frequencies Used in RADAR. 5. Types of RADAR. 6. Basic Pulsed RADAR System. 7. Important Terms Used in Pulsed RADAR. 8. Duplexers and Their Types. 9. Moving Target Indicators (MTI).	
	Unit Outcomes: UO1. Understand and apply the fundamental principles of RADAR systems. UO2. Analyze the components and operation of different types of RADAR systems, such as pulsed RADAR, duplexers, and Moving Target Indicators (MTI).	
III	**Introduction to Optical Fibres**	**12**
	1. Importance of Optical Fibres. 2. Generations of Telephone Systems and Optical Fibre Technology. 3. Propagation of Light in Different Media. 4. Propagation of Light Waves in an Optical Fibre. 5. Basic Structure of an Optical Fibre. 6. Propagation of Light Waves Through an Optical Fibre. 7. Acceptance Angle and Acceptance Cone of a Fibre. 8. Numerical Aperture (General). 9. Comparison of Single-Mode and Multi-Mode Fibres. 10. Comparison of Step-Index and Graded-Index Fibres. 11. Applications of Optical Fibres. 12. Classification of Optical Fibres: Step-Index Fibre, Step-Index Monomode Fibre. 13. Graded-Index Multi-Mode Fibre. 14. Numerical Problems.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Understand the fundamental principles of optical fibre technology. UO2. Analyze and compare the characteristics of various optical fibre types, such as step-index and graded-index fibres.	
IV	**Modern Communication Applications**	**11**
	1. Satellite Communication Systems 2. Modems: Digital Data Transmission 3. Block Diagram of an FSK Modem 4. General Block Diagram of a UART 5. Digital FSK Modulator 6. Digital FSK Demodulator 7. Introduction to Networks: A Simple Communication Network 8. Star LAN Configuration 9. Ring LAN Configuration 10. Bus LAN Configuration 11. Comparison of LAN Topologies 12. Light-Wave Communication Systems: Basic Elements of a Fiber-Optic Communication System	
	Unit Outcomes: UO1. Understand and analyze modern communication systems, including satellite communication, modems, and digital data transmission techniques. UO2. Evaluate and compare different network topologies and configurations.	

Learning Resources:

1. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.
2. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
3. Radio Engineering (Applied Electronics Vol. II) by G. K. Mithal, Khanna Publishers, Delhi-6
4. Optical Fibers & Fiber Optic Communication Systems- Dr. Subir Kumar Sarkar, S. Chand & Company Ltd
5. Communication electronics by Louis E. Frenzel (Second Edition) McGraw-Hill International Editions.
6. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata McGraw Hill Publishing Company Limited.

7. Electronics communication, by Dennis Roddy and John Coolen, Prentice-Hall of India private limited, New Delhi.
8. Optical Communication Networks, B. Mukherjee, McGraw-Hill Education (1997).
9. Fundamentals of Optical Fiber Communication, K. P. S. Suresh, Wiley-India (2007).
10. Fundamentals of Optical Fibre Communication, Biswanath Mukherjee, PHI Learning Pvt. Ltd (2006).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course (Based on Communication Electronics II)

Course Code: 301ELE6202A

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To provide exposure to the students with hands on experience on various basic experiments in Communication Electronics.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Analyze the key performance characteristics of a radio receiver, including selectivity, sensitivity, and fidelity.

CO 2. Determine the acceptance angle and numerical aperture of an optical fibre to understand its light propagation properties.

CO 3. Investigate attenuation loss in an optical fibre link and measure optical power using a coupler for efficient signal transmission.

CO 4. Implement and analyze a fibre optics voice link using frequency modulation and study digital FSK modulation and demodulation techniques.

Practical No.	Experiments
1	Analysis of Radio Receiver Characteristics: Selectivity, Sensitivity, and Fidelity
2	Measurement of the Acceptance Angle of a Given Optical Fibre
3	Determination of the Numerical Aperture of a Given Optical Fibre
4	Investigation and Calculation of Attenuation Loss in an Optical Fibre Link
5	Study of a Superheterodyne Radio Receiver
6	Experiment on Coupling Light into an Optical Fibre
7	Measurement of Optical Power Using a Coupler
8	Implementation of a Fibre Optics Voice Link Using Frequency Modulation
9	Study and Analysis of a Digital FSK Modulator
10	Study and Analysis of a Digital FSK Demodulator

Learning Resources:

1. Communication Engineering by J.S. Katre (Second Revised Edition 2011) Tech- Max Publications, Pune.
2. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
3. Radio Engineering (Applied Electronics Vol. II) by G. K. Mithal, Khanna Publishers, Delhi-6
4. Optical Fibers & Fiber Optic Communication Systems- Dr. Subir Kumar Sarkar, S. Chand & Company Ltd
5. Communication electronics by Louis E. Frenzel (Second Edition) McGraw-Hill International Editions.
6. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata McGraw Hill Publishing Company Limited.
7. Electronics communication, by Dennis Roddy and John Coolen, Prentice-Hall of India private limited, New Delhi.
8. Optical Communication Networks, B. Mukherjee, McGraw-Hill Education (1997).
9. Fundamentals of Optical Fiber Communication, K. P. S. Suresh, Wiley-India (2007).
10. Fundamentals of Optical Fibre Communication, Biswanath Mukherjee, PHI Learning Pvt. Ltd (2006).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: DSE-II
Course Title: Optical Fibre Communications
Course Code: 301ELE6203A
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objectives:

LO 1. To familiarize students with various system components and processes used in different applications.

LO 2. To introduce students to the latest trends in optical communication technology.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the fundamental principles of optical fibres, including light propagation, numerical aperture, modes of propagation, and their practical applications.

CO 2. Understand the characteristics, fabrication techniques, and performance differences of step-index, monomode, and graded-index optical fibres.

CO 3. Analyze attenuation mechanisms in optical fibres and understand the design and performance of various fibre optic communication transmitters, including LED and LASER-based systems.

CO 4. Understand the principles of integrated optical fibre communication technology and perform key measurements related to fibre characteristics.

Unit No.	Title of Unit & Contents	Hrs.
I	**Ray Theory of Transmission**	**12**
	1. Introduction to Optical Fibres: Definition and Importance. 2. Propagation of Light in Different Media and in an Optical Fibre. 3. Basic Structure of an Optical Fibre and Light Propagation Through It. 4. Acceptance Angle, Acceptance Cone, and Numerical Aperture (General and for Graded-Index Fibre). 5. Modes of Propagation: Meridional and Skew Rays, Comparison of Step-Index and Graded-Index Fibres. 6. Applications of Optical Fibres.	
	Unit Outcomes: UO1. Understand the fundamental principles of optical fibres, including the propagation of light in different media and within optical fibres.	

Unit No.	Title of Unit & Contents	Hrs.
	UO2. Analyze key concepts such as acceptance angle, acceptance cone, and numerical aperture.	
II	**Classification of Fibres and Fibre Fabrication Techniques:**	**11**
	1. Step-Index Fibre and Step-Index Monomode Fibre: Characteristics and Disadvantages of Monomode Fibre. 2. Graded-Index Multimode Fibre. 3. Classification of Fibre Fabrication Techniques. 4. External Chemical Vapor Deposition, Axial Vapor Deposition (AVD), and Internal Chemical Vapor Deposition. 5. Fibre Drawing and Coating: Double Crucible Method and Rod-in-Tube Method. 6. Numerical Problems.	
	Unit Outcomes: UO1. Analyze the characteristics and limitations of step-index fibres, including step-index monomode fibres. UO2. Evaluate various fibre fabrication techniques, such as chemical vapor deposition methods and fibre drawing methods.	
III	**Fibre Losses and Communication Systems**	**12**
	1. Attenuation in Optical Fibres. 2. Material and Impurity Losses, Rayleigh Scattering Losses, Absorption Loss, Leaky Modes, Bending Losses, Radiation-Induced Losses, Temperature Dependence of Fibre Losses, and Core and Cladding Losses. 3. Communication Systems: Introduction and Transmitter for Fibre Optic Communication. 4. High-Performance Transmitter Circuits: LED Digital Transmitter and LED Analog Transmitter. 5. Comparison Between Analog and Digital Transmitters. 6. LASER Transmitter: Digital LASER Transmitter and Analog LASER Transmitter. 7. Analog LASER Transmitter with A/D Conversion and Digital Multiplexing.	
	Unit Outcomes: UO1. Understand and analyze the various sources of attenuation in optical fibres. UO2. Compare and evaluate the design and functionality of fibre optic communication transmitters.	
IV	**Optical Fibre Communication and Measurements on Optical Fibres**	**10**

Unit No.	Title of Unit & Contents	Hrs.
	1. Introduction and Important Applications of Integrated Optical Fibre Communication Technology. 2. Long-Haul Communication. 3. Introduction to Optical Fibre Measurements. 4. Measurement of Numerical Aperture (NA). 5. Measurement of Fibre Attenuation. 6. Measurement of Dispersion Losses. 7. Measurement of Refractive Index. 8. Cut-Off Wavelength Measurement. 9. Measurement of Mode Field Diameter (MFD): Direct Measurement of MFD.	
	Unit Outcomes: UO1. Understand the significance and applications of integrated optical fibre communication technology. UO2. Develop practical skills in optical fibre measurement techniques.	

Learning Resources:

1. Optical Fibre and Fibre Optic Communication Systems, S.K. Sarkar (S. Chand & Comp. Ltd, New Delhi.
2. Optical Fiber Communications: Principles and Practice- John M. Senior (PHI) Third Edition, Pearson Publications.
3. Optical Fiber Communications- Gerd Keiser (Mc Graw Hill Education) Fifth Edition.
4. Fundamentals of Fiber Optics in Telecommunication and Sensor Systems, Edited by B. P. Pal, New Age International Publisher, New Delhi, 1st Edition (2006).
5. Introduction to Fibre Optics- A. Ghatak and Thyagrajan (Cambridge University Press).
6. Principles of Optics-Max Born and Emil Wolf, Cambridge University Press, 7th (expanded) edition.
7. Optical Communication Networks, B. Mukherjee, McGraw-Hill Education (1997).
8. Fundamentals of Optical Fiber Communication, K. P. S. Suresh, Wiley-India (2007).
9. Fundamentals of Optical Fibre Communication, Biswanath Mukherjee, PHI Learning Pvt. Ltd (2006).
10. Optical Communication Systems, John G. Proakis, Masoud Salehi, Pearson Education (2005).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course Based on Optical Fibre Communications

Course Code: 301ELE5202B

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To provide the practical experience with key components, learn about fiber optic systems, and develop skills in experimentation, data analysis, and reporting, all while relating theory to real-world applications.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand and measure key parameters such as attenuation loss, numerical aperture, and propagation loss in optical fibre links.

CO 2. Demonstrate the transmission and reception of digital and analog signals using optical fibres.

CO 3. Implement and analyze pulse width modulation and frequency modulation in optical fibre communication systems.

CO 4. Investigate coupling efficiency, refractive index, cut-off wavelength, and the functioning of optocouplers in optical communication.

Practical No.	Experiments
1	Investigation and Calculation of Attenuation Loss in an Optical Fibre Link
2	Experiment on Coupling Light into an Optical Fibre
3	Measurement and Analysis of Numerical Aperture of an Optical Fibre
4	Implementation of Pulse Width Modulation Using an Optical Fibre
5	Frequency Modulation Using an Optical Fibre Link
6	Transmission and Reception of Digital Signals via Optical Fibre
7	Transmission and Reception of Analog Signals via Optical Fibre
8	Measurement of Propagation Loss in Optical Fibres
9	Determination of Refractive Index and Cut-Off Wavelength of Optical Fibres
10	Study and Analysis of Optocouplers

Learning Resources:

1. Optical Fibre and Fibre Optic Communication Systems, S.K. Sarkar (S. Chand & Comp. Ltd, New Delhi.
2. Optical Fiber Communications: Principles and Practice- John M. Senior (PHI) Third Edition, Pearson Publications.
3. Optical Fiber Communications- Gerd Keiser (McGraw Hill Education) Fifth Edition.
4. Fundamentals of Fiber Optics in Telecommunication and Sensor Systems, Edited by B. P. Pal, New Age International Publisher, New Delhi, 1st Edition (2006).
5. Introduction to Fibre Optics- A. Ghatak and Thyagrajan (Cambridge University Press).
6. Principles of Optics-Max Born and Emil Wolf, Cambridge University Press, 7th (expanded) edition.
7. Optical Communication Networks, B. Mukherjee, McGraw-Hill Education (1997).
8. Fundamentals of Optical Fiber Communication, K. P. S. Suresh, Wiley-India (2007).
9. Fundamentals of Optical Fibre Communication, Biswanath Mukherjee, PHI Learning Pvt. Ltd (2006).
10. Optical Communication Systems, John G. Proakis, Masoud Salehi, Pearson Education (2005).

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Minor V
Course Title: Communication System
Course Code: 301ELE6301
Credits: 03 **Max. Marks: 75** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. To equip students with fundamental concepts, analyzing different modulation techniques, and evaluating communication system performance, including noise and interference.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Explain the fundamental principles of electronic communication systems, including their classification, key concepts such as bandwidth, gain, and attenuation, and the role of modulation and multiplexing in signal transmission.

CO 2. Analyze the principles of Amplitude Modulation (AM), including modulation index, sidebands, power calculations, and single sideband modulation, while evaluating AM modulators, demodulators, and balanced modulator circuits.

CO 3. Explain the principles of Frequency and Phase Modulation, analyze modulation index, sidebands, and noise suppression effects, and compare FM with AM while evaluating various modulators and demodulators.

CO 4. Analyze the fundamentals of transmitters and receivers, including carrier generation, power amplification, impedance matching, and superheterodyne reception, while evaluating receiver characteristics and noise performance.

Unit No.	Title of Unit & Contents	Hrs.
I	**Principles of Electronic Communication**	**10**
	1. Communication Systems – Significance 2. Basic Concepts of Electronic Communication Systems 3. Types and Classification of Communication Systems 4. Electromagnetic Spectrum: Concepts of Bandwidth, Gain, and Attenuation 5. Block Diagram of a Generalized Communication System; Introduction to Modulation and Multiplexing	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Understand the significance and basic concepts of electronic communication systems. UO2. Evaluate the structure and functionality of a generalized communication system.	
II	**Amplitude Modulation (AM) and Demodulation**	**11**
	1. AM Concepts 2. Modulation Index, Sidebands, and Frequency Domain 3. AM Power and Single Sideband Modulation 4. Classification of AM and AM Modulators 5. AM Demodulators, Balanced Modulators, and SSB Circuits	
	Unit Outcomes: UO1. Understand the fundamental concepts of Amplitude Modulation (AM), including modulation index, sidebands, and frequency domain representation. UO2. Evaluate the design and functionality of AM modulators and demodulators.	
III	**Frequency Modulation (FM) and Demodulation**	**12**
	1. Principles of Frequency and Phase Modulation 2. Modulation Index 3. Sidebands and Noise Suppression Effects 4. Comparison of FM and AM 5. Frequency Modulators 6. Phase Modulators 7. Frequency Demodulators	
	Unit Outcomes: UO1. Understand the principles of Frequency Modulation (FM) and Phase Modulation (PM). UO2. Evaluate the design and functionality of frequency and phase modulators and demodulators, and compare their performance in communication systems for efficient signal transmission and reception.	
IV	**Radio Transmitters and Receivers**	**12**
	1. Fundamentals of Transmitters 2. Transmitter Circuits – Carrier Generators 3. Power Amplifiers 4. Impedance Matching – Introduction	

Unit No.	Title of Unit & Contents	Hrs.
	5. Superheterodyne Receiver, IF Images, and Noise 6. Receiver Characteristics	
	Unit Outcomes: UO1. Understand the fundamental principles of transmitter circuits, including carrier generators, power amplifiers, and impedance matching. Uo2. Evaluate the design and performance of superheterodyne receivers, including intermediate frequency (IF) images, noise considerations, and receiver characteristics.	

Learning Resources:

1. Principles of Electronic Communication System (4th edition), Louis Frenzel, McGraw Hill Education (2016).
2. Electronic Communication systems (4th edition), George Kennedy, Bernard Davis, McGraw Hill companies (2009).
3. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
4. Radio Engineering (Applied Electronics Vol. II) by G. K. Mithal, Khanna Publishers, Delhi
5. Handbook of Electronics by Gupta and Kumar, Pragati Prakashan.
6. Electronic Communications by Dennis Roddy, John Coolen, and Prentice- Hall of India private limited New Delhi.
7. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata McGraw Hill Publishing Company Limited.
8. Advanced Engineering Mathematics, R.K. Jain & S R K Iyengar, Narosa Pub. House
9. Advanced calculus and geometry, Thomas & Finney, Addison-Wesley Pub. Co.
10. D. W. Jordan & P Smith, Mathematical Techniques, OXFORD.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: Lab Course

Course Title: Lab Course (Based on Communication Electronics)

Course Code: 301ELE6302

Credits: 01 **Max. Marks: 50** **Hours: 30**

Learning Objective:

LO 1. To provide hands-on experience in designing, building, and testing communication systems, focusing on practical skills like understanding modulation/demodulation techniques, analyzing signal characteristics, and troubleshooting circuits.

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Analyze the principles of amplitude and frequency modulation, including their modulation and demodulation processes.

CO 2. Evaluate key parameters such as modulation index, power, and bandwidth in AM and FM signals.

CO 3. Demonstrate the working of SSB and phase modulation techniques and their demodulation methods.

CO 4. Examine analog multiplexing, impedance matching in audio systems, and the operation of AM/FM radio transmitters and receivers.

Practical No.	Unit
1	Study of Amplitude Modulation and Demodulation.
2	Study of Frequency Modulation and Demodulation.
3	Determination of Modulation Index (Depth of Modulation).
4	Determination of Power in AM Signal.
5	Determination Bandwidth of AM Signal.
6	Study of SSB modulation and demodulation.
7	Study of Phase modulation and demodulation.
8	Study of Analog Multiplexing and Demultiplexing Techniques.
9	Study of Impedance Matching in audio system.
10	Study of AM/FM Radio Transmitter and Receiver.

Learning Resources:

1. Principles of Electronic Communication System (4th edition), Louis Frenzel, McGraw Hill Education (2016).
2. Electronic Communication systems (4th edition), George Kennedy, Bernard Davis, McGraw Hill companies (2009).
3. Microwave Engineering by Sanjeev Gupta, Khanna Publishers.
4. Radio Engineering (Applied Electronics Vol. II) by G. K. Mithal, Khanna Publishers, Delhi
5. Handbook of Electronics by Gupta and Kumar, Pragati Prakashan.
6. Electronic Communications by Dennis Roddy, John Coolen, and Prentice- Hall of India private limited New Delhi.
7. Electronics Communication Systems, by George Kennedy Fourth Edition, Tata McGraw Hill Publishing Company Limited.
8. Advanced Engineering Mathematics, R.K. Jain & S R K Iyengar, Narosa Pub. House
9. Advanced calculus and geometry, Thomas & Finney, Addison-Wesley Pub. Co.
10. D. W. Jordan & P Smith, Mathematical Techniques, OXFORD.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Faculty of Science and Technology

Department of Physics and Electronics

Course Type: VSC IV
Course Title: Basic Instrumentation Skill
Course Code: 301ELE6501
Credits: 02 **Max. Marks: 50** **Lectures: 45 Hrs.**

Learning Objective:

LO 1. The objective of the course is to get exposure with various aspects of instruments and their usage through hands-on mode

Course Outcomes:

After completion of the course, students will be able to-

CO 1. Understand the fundamental principles of measurement accuracy, precision, and errors, and effectively utilize analog and digital multimeters for accurate electrical measurements.

CO 2. Understand the working principles of CRO, digital storage oscilloscopes, and impedance bridge meters, and apply them for accurate measurement of electrical parameters such as voltage, frequency, time period, and impedance.

CO 3. Evaluate the limitations and loading effects of multimeters in measuring low and high resistance voltages, as well as high-frequency voltages and currents, to understand their practical constraints in electrical measurements.

CO 4. Develop proficiency in using advanced measurement instruments, such as Q-meters, CROs, and LCR bridges, to measure key electrical parameters like quality factor (Q), voltage, frequency, time period, phase angle, rise time, fall time, delay time, resistance (R), inductance (L), and capacitance (C).

Unit No.	Title of Unit & Contents	Hrs.
I	**Basics of Measurement**	**08**
	1. Instrument Accuracy and Precision: Concepts of accuracy, precision, sensitivity, resolution, and range. Discussion on errors in measurements. 2. Multimeter: Principles of measuring DC voltage, DC current, AC voltage, AC current, and resistance. Specifications of a multimeter and their significance. 3. Digital Multimeter: Block diagram and working principle of a digital multimeter. Measurements using a digital multimeter, including DC voltage, DC current, AC voltage, AC current, and resistance.	
	Unit Outcomes:	

Unit No.	Title of Unit & Contents	Hrs.
	UO1. Understand and apply the fundamental concepts of instrument accuracy, precision, sensitivity, resolution, and range, UO2. Analyze the types of errors in measurements to ensure reliable and accurate results in practical applications.	
II	**CRO, DSO and Impedance Bridge Meters**	**07**
	1. Basic CRO: Block diagram and working principle. 2. Construction of CRT: Electron gun, electrostatic focusing, and acceleration (conceptual explanation, no mathematical treatment). 3. Screen Phosphor: Brief discussion on visual persistence and chemical composition. 4. Time Base Operation and Synchronization. 5. Front Panel Controls of CRO. 6. Measurement Using CRO: Voltage (DC and AC), frequency, and time period. 7. Digital Oscilloscope: Introduction, probes, block diagram, and working principle of a digital storage oscilloscope (DSO). 8. Impedance Bridges and Q-Meters – Block diagram and working principles of a basic (balancing-type) RLC bridge.	
	Unit Outcomes: UO1. Understand the construction and working principles of a Cathode Ray Oscilloscope (CRO). UO2. Analyze the functionality of digital storage oscilloscopes (DSO) and impedance bridge meters.	
III	**Practical**	**30**
	1. Study of the Loading Effect of a Multimeter on Low and High Resistance Voltage Measurements. 2. Investigation of Multimeter Limitations in Measuring High-Frequency Voltage and Current. 3. Measurement of the Quality Factor (Q) of a Coil and Its Frequency Dependence Using a Q-Meter. 4. Measurement of Voltage, Frequency, Time Period, and Phase Angle Using a CRO and DSO. 5. Measurement of Rise Time, Fall Time, and Delay Time Using a CRO. 6. Measurement of Resistance (R), Inductance (L), and Capacitance (C) Using an LCR Bridge/Universal Bridge. 7. Practical Applications of a Dual-Trace Oscilloscope.	

Unit No.	Title of Unit & Contents	Hrs.
	8. Measurement of Impedance Using Impedance Bridge	

Learning Resources:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012,
3. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.
4. Introduction to Instrumentation and Measurements, Robert B. Northrop, CRC Press 2005.
5. Electronic Instrumentation and Measurements, David A. Bell, 2006Publisher: Pearson Education
6. Fundamentals of Instrumentation and Control, William C. Dunn, 2005, William C. Dunn, Prentice Hall.
7. Principles of Measurement and Instrumentation, A. K. Sawhney, 2004 (3rd Edition), Prentice Hall.
8. Electrical and Electronic Measurements and Instrumentation, H.S. Kalsi, 2003, Tata McGraw-Hill.
9. Modern Electronic Instrumentation and Measurement Techniques, Albert D. Helfrick and William D. Cooper, 2002 (2nd Edition), Pearson Education.
10. Instrumentation and Measurement in Electrical Engineering, B.R. Gupta, 2003, S. Chand & Company Ltd.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Extra Credit Activities

Sr. No.	Course Title	Credits	Hours T/P
1	MOOCs	Min. of 02 credits	Min. of 30 Hrs.
2	Certificate Courses	Min. of 02 credits	Min. of 30 Hrs.
3	IIT Spoken Tutorial Courses	Min. of 02 credits	Min. of 30 Hrs.

Guidelines:

Extra -academic activities

1. All extra credits claimed under this heading will require sufficient academic input/ contribution from the students concerned.
2. Maximum 04 extra credits in each academic year will be allotted.
3. These extra academic activity credits will not be considered for calculation of SGPA/CGPA but will be indicated on the grade card.

Additional Credits for Online Courses:

1. Courses only from SWAYAM and NPTEL platform are eligible for claiming credits.
2. Students should get the consent from the concerned subject Teacher/Mentor/Vice Principal and Principal prior to starting of the course.
3. Students who complete such online courses for additional credits will be examined/verified by the concerned mentor/internal faculty member before awarding credits.
4. Credit allotted to the course by SWAYAM and NPTEL platform will be considered as it is.

Additional Credits for Other Academic Activities:

1. One credit for presentation and publication of paper in International/National/State level seminars/workshops.
2. One credit for measurable research work undertaken and field trips amounting to 30 hours of recorded work.
3. One credit for creating models in sponsored exhibitions/other exhibits, which are approved by the concerned department.
4. One credit for any voluntary social service/Nation building exercise which is in collaboration with the outreach center, equivalent to 30 hours
5. All these credits must be approved by the College Committee.

Additional Credits for Certificate Courses:

1. Students can get additional credits (number of credits will depend on the course duration) from certificate courses offered by the college.
2. The student must successfully complete the course. These credits must be approved by the Course Coordinators.
3. Students who undertake summer projects/ internships/ training in institutions of repute through a national selection process, will get 2 credits for each such activity. This must be done under the supervision of the concerned faculty/mentor.

Note:

1. The respective documents should be submitted within 10 days after completion of Semester End Examination.
2. No credits can be granted for organizing or for serving as office bearers/ volunteers for Inter-Class / Associations / Sports / Social Service activities.
3. The office bearers and volunteers may be given a letter of appreciation by the respective staff coordinators. Besides, no credits can be claimed for any services/ activities conducted or attended within the college.
4. All claims for the credits by the students should be made and approved by the mentor in the same academic year of completing the activity.
5. Any grievances of denial/rejection of credits should be addressed to Additional Credits Coordinator in the same academic year.
6. Students having a shortage of additional credits at the end of the third year can meet the Additional Credits Coordinator, who will provide the right advice on the activities that can help them earn credits required for graduation.

Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur

(Autonomous)

Examination Framework

Theory:

40% Continuous Assessment Tests (CATs) and 60% Semester End Examination (SEE)

Practical:

50% Continuous Assessment Tests (CATs) and 50% Semester End Examination (SEE)

Course	Marks	CAT & Mid Term Theory				CAT Practical		Best Scored CAT & Mid Term	SEE	Total
1	2	3				4		5	6	5 + 6
		Att.	CAT I	Mid Term	CAT II	Att.	CAT			
DSC/DSE/ GE/OE/Minor	100	10	10	20	10	-	-	40	60	100
DSC	75	05	10	15	10	-	-	30	45	75
Lab Course/AIPC/ OJT/FP	50	-	-	-	-	05	20	-	25	50
VSC/SEC/ AEC/VEC/CC	50	05	05	10	05	-	-	20	30	50

Note:

1. All Internal Exams are compulsory
2. Out of 02 CATs best score will be considered
3. Mid Term Exam will be conducted by the Exam Section
4. Mid Term Exam is of Objective nature (MCQ)
5. Semester End Exam is of descriptive in nature (Long & Short Answer)
6. CAT Practical (20 Marks): Lab Journal (Record Book) 10 Marks, Overall Performance 10 Mark