SAVITRIBAI PHULE PUNE UNIVERSITY

Syllabus

S.Y.B.Sc. Electronic Science

(FOR AFFILIATED COLLEGES)

FACULTY OF SCIENCE AND TECHNOLOGY

UNDER NATIONAL EDUCATION POLICY

(NEP 2020)

TO BE IMPLEMENTED FROM

ACADEMIC YEAR 2025-26

The detailed structure for **Electronic Science as a Major Subject** is explained in Table 1 - 3.

Credit distribution structure for three/ four-year Honours/ Honours with Research Degree Programme

For Major Courses – Refer Table 1, 2 and 3 For all Other Courses – Refer table 4

Table 1: Credit distribution structure for Major Courses for Level at 4.5 and 5.0

Level/ Degree	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Hrs. to be engaged
4.5 UG Certificate	I	Subject-I: Electronic Science	ELS-101-T	Fundamentals of Analog Electronics	Theory	2	30
			ELS-102-P	Practical Course-I	Practical	2	60
		Open Elective	OE -101-ELS	Basics of Computer Hardware	Theory	2	30
		Skill Enhancement Course (SEC)	SEC-101-ELS	Electronic Circuit Building and Testing	Practical	2	60
		Generic IKS	IKS-100-T	Indian Knowledge System	Theory	2	30
		Subject 2	ELS-101-T	Fundamentals of Analog Electronics	Theory	2	30
		Subject 2	ELS-102-P	Practical Course-I	Practical	2	60
	II	Subject-I: Electronic Science	ELS-151-T	Fundamentals of Digital Electronics	Theory	2	30
			ELS-152-P	Practical Course-II	Practical	2	60
		Open Elective	OE-151-ELS	Basics of Computer Hardware	Theory/ Practical	2	60
		Skill Enhancement Course (SEC)	SEC-151-ELS	PCB Designing and Fabrication	Practical	2	60
		Subject 2	ELS-101-T	Fundamentals of Analog Electronics	Theory	2	30
		Subject 2	ELS-102-P	Practical Course-I	Practical	2	60
5.0 UG Diploma	III	Major Core	ELS-201-MJ	Analog Circuit Design	Theory	2	30
			ELS-202-MJ	Digital Circuit Design	Theory	2	30
			ELS-203-MJP	Practical Course-III	Practical	2	60
		Vocational Skill Courses	ELS-221-VSC	Circuit Simulation-I	Practical	2	60
		Field Project	ELS-231-FP	Field Project	Field Work	2	60
		IKS (Major Subject Specific)	IKS-200-T	Development of Electronic Communication In India	Theory	2	30
		Minor	ELE-241-MN	Instrumentation and Measurement Systems	Theory	2	30

		Minor	ELE-242-MNP	Lab course on Instrumentation and Measurement Systems	Practical	2	60
		Open Elective	OE-201-ELS	Fundamentals of Information Technology	Theory	2	30
	IV	Major Core	ELS-251-MJ	Linear Integrated Circuits	Theory	2	30
			ELS-252-MJ	Microcontroller Programming and Applications	Theory	2	30
			ELS-253-MJP	Practical Course-IV	Practical	2	60
		VSC	ELS-271-VSC	Circuit Simulation-II	Practical	2	60
		Community Engagement Project (CEP)	ELS-281-CEP	Community Engagement Project	Socio-Economic Survey + Activities	2	60
		Minor	ELE-291-MN	Communication Electronics	Theory	2	30
		Minor	ELE-292-MNP	Lab course on Communication Electronics	Practical	2	60
		Open Elective	OE-251-ELS	Lab Course on Fundamentals of Information Technology	Practical	2	60

Table 2: Credit Distribution Structure for Major Courses at Level 5.5

Level/ Degree	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Hrs. to be engaged
5.5 UG Degree	V	Major Core	ELS-301-MJ	Principles of Semiconductor Devices	Theory	2	30
			ELS-302-MJ	Embedded System Design	Theory	2	30
			ELS-303-MJ	Instrumentation and Process Control	Theory	2	30
			ELS-304-MJ	Communication Electronics	Theory	2	30
			ELS-305-MJP	Practical Course-V	Practical	2	60
			ELS-306-MJP	Practical Course-VI	Practical	2	60
		Major Elective	ELS-310-MJ	Nanoelectronics		2	30

			ELS-311-MJ	Fiber Optic Communication	Theory – (Select any one)	2	30
			ELS-313-MJP	Major Elective Practical Lab-I	Practical	2	60
		Vocational Skill Courses	ELS-321-VSC	Sensors, Actuators and Signal Conditioning	Theory / Practical	2	30/60
		FP/CEP	ELS-331-FP		Field Project work	2	60
	VI	Major Core	ELS-351-MJ	Advanced Embedded Systems	Theory	2	30
			ELS-352-MJ	Digital System Design using Verilog	Theory	2	30
			ELS-353-MJ	Power Electronics	Theory	2	30
			ELS-354-MJ	Digital Communication	Theory	2	30
			ELS-355-MJP	Practical Course-VII	Practical	2	60
			ELS-356-MJP	Practical Course-VIII	Practical	2	60
		Major Elective	ELS-360-MJ	Internet of Things (IoT)	Theory (Select anyone)	2	30
			ELS-361-MJ	Signals and Systems		2	30
			ELS-362-MJP	Major Elective Practical Lab -II	Practical	2	60
		VSC	ELS-371-VSC	PLC Programming	Theory / Practical	2	30/60
		On Job Training	ELS-381-OJT			4	30 hr / Cr

Table 3: Credit distribution structure for Major Courses at Level 6.0

Level/ Degree	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Hrs. to be engaged
6.0 UG	VII	Major Core	ELS-401-MJ	RF and Microwave	Theory	4	60
			ELS-402-MJ	Optoelectronics	Theory	2	30
			ELS-403-MJP	Practical Course-VIII	Practical	2	60
			ELS-404-MJP	Practical Course-IX	Practical	2	60
		Major Elective	ELS-410-MJ	Consumer Electronics	Theory (Select any one)	2	30
			ELS-411-MJ	Electronics for Robotics		2	30

Honours with Research Degree in Major and Minor			ELS-412-MJP	Major Elective Practical Lab -III	Practical	2	60
		Research Methodology	ELS-405-MJ	Research Methodology	Theory	4	60
		Research Project	ELS-406-MJP	Research Project	Project	4	120
	VIII	Major Core	ELS-451-MJ	Internet of Things	Theory	4	60
			ELS-452-MJ	Electronics for E-Mobility	Theory	2	30
			ELS-453-MJP	Practical Course-X	Practical	2	60
			ELS-454-MJP	Practical Course-XI	Practical	2	60
		Major Elective	ELS-461-MJ	VLSI	Theory (Select any one)	2	60
			ELS-462-MJP	Mechatronics		2	60
			ELS-412-MJP	Major Elective Practical Lab -IV	Practical	2	60
		Research Project	ELS-481-RP	ResearchProject	Project	8	240

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Title of the Course : Analog Circuit Design								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-201-MJ**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

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

1. Recall and explain the general classification of amplifiers.
2. Analyze and perform AC and DC analysis of amplifiers.
3. Identify and compare different multistage amplifier types.
4. Explain the characteristics of Op-Amp.
5. Design and analyze basic Op-Amp circuits.
6. Design and analyze multivibrator circuits using IC-555.

Course Contents:

Unit 1	**Single Stage Transistor Amplifier**	**4**
Introduction, General classification of amplifiers, ac and dc analysis of small signal amplifier, Design of single stage common emitter amplifier, Explanation of terms- gain, frequency response, bandwidth and gain bandwidth product.		
Unit 2	**Multistage Transistor Amplifiers**	**6**
Introduction, Block diagram, Types of multistage amplifiers: Two stage R-C coupled, Transformer coupled, Direct coupled transistor amplifiers (Circuit diagram, Working, frequency response, advantages, disadvantages and applications of all types).		
Unit 3	**Op-Amp and Its Applications**	**12**
Differential Amplifier, Block diagram, Equivalent circuit, Symbol, Characteristics of an Ideal and Practical Op-Amp, Concept of feedback, negative and positive feedback, advantages of negative feedback, Open and closed loop configuration, Inverting, Non-inverting amplifier, Concept of differential amplifier, Summing and Difference Amplifier, Integrator, Differentiator, Comparator, Schmitt trigger, Active low pass and high pass filters.		
Unit 4	**Oscillators and Multivibrators**	**8**
Oscillators: Concept, Barkhausen criterion for sustained oscillations, Phase Shift oscillator and Wien-bridge oscillator (no derivation for each), Multivibrators: Introduction to IC-555, Functional Block diagram, Astable and Monostable multivibrator circuits. (Numerical Examples wherever applicable).		

Text / Reference Books:

1. Principles of Electronics, V. K. Mehta, Rohit Mehta, 12th Edition, S Chand and Co., 2020.
2. Electronic Devices and Circuit Theory, Robert Boylestead, Louis Nashelsky, 11th Edition, PHI.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Operational Amplifiers & Linear Integrated Circuits, James M. Fiore, Jaico Publishing House, 2016.
5. Electronic devices and applications, S. Salivahanan, N. Suresh Kumar, Tata McGraw-Hill, 4th Edition, 2016.
6. Linear Integrated Circuits, D. Roy Choudhury, Sahil Bala Jain, 6th Edition, New Age 2021.

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Title of the Course : Digital Circuit Design								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-202-MJ**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

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

1. Design and analyze combinational circuits like code converters, adders and encoders.
2. Design synchronous counters using JK and T Flip-Flops.
3. Study and explain the features of ICs 7476 and 7490 for counters.
4. Describe the fundamental logic families such as TTL, CMOS, and ECL, and compare their electrical and performance characteristics.
5. Apply knowledge of PLDs in designing digital systems for real-world applications.
6. Interface and program switches, keypads, and thumbwheel switches.

Course Contents:

Unit 1	**Combinational Circuit Design**	**10**
Introduction to K-map, Simplification of Boolean expression using K-map, Design of code converters: Binary to Gray and Gray to binary, BCD to Seven segments, Parallel adder, Priority encoder, Parity generator/Checker, Magnitude comparator. (Study of ICs -7447, 7483, 74148, 7485).		
Unit 2	**Designing of Counters**	**10**
Flip-flops: Flip-flop operation, timing diagrams and Excitation Tables (SR, D, JK, and T flip-flops), Counter Design: State diagram, State table, Excitation table and Transition table, Design of synchronous counter using JK Flip-Flop and T Flip-Flop, Study of IC 7476, Modulo Counter Design: Mod 2, Mod 5 and Mod 10, Design of counter for given sequence. (, 7490).		
Unit 3	**Logic Families and PLDs**	**6**
Introduction to Logic Families: TTL, CMOS and ECL, Characteristics: Propagation delay, fan-in/fan-out, power dissipation and noise margin, Interfacing TTL and CMOS Introduction to PLDs: PROM, PLA, PAL and GAL, Basics of CPLD and FPGA (only overview), Applications of PLDs.		
Unit 4	**Peripheral Interfacing**	**4**
Interfacing of LED's, single and multi-digit 7 segment displays/ drivers, Switches, Keypad, Thumbwheel switches and Relays.		

Text / Reference Books:

1. Modern Digital Electronics, R. P. Jain, McGraw Hill, 5th Edition, 2022.
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia, 11th Edition, 1994.
3. Fundamentals of Digital Circuits, A. Anand Kumar, 3rd Edition, PHI, 2014.
4. Digital Principles and Applications, A.P. Malvino, D. P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill.

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Title of the Course : Practical Course-III								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-203-MJP**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

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

1. Design and analyze different types of amplifiers.
2. Study the operation of integrator and differentiator circuits.
3. Design Oscillators and Multivibrators.
4. Design a Butterworth low-pass filter and study its frequency response.
5. Design a 3-bit synchronous up/down counter using JK Flip-Flops.
6. Design and implement counter for given sequence

Experiments (Any 12 from Group A and B) + Activity / Study tour report / Assignments /Demonstration / Virtual lab

Group A: List of Practicals based on Analog Circuit Design (Any 6)

1. Design of an inverting and non-inverting amplifier using IC-741 for a given dc voltage gain.
2. Study of summing amplifier and difference amplifier.
3. Study of comparator and its application as zero-crossing detector.
4. Study of op-amp as an Integrator and Differentiator.
5. Design of a phase shift oscillator for a given frequency.
6. Design of a Wien bridge oscillator for a given frequency.
7. Design a Butterworth Low Pass active Filter (1^{st}order) & study its frequency Response
8. Design of Single Stage CE amplifier for a given voltage gain.
9. Design of a Astable/Monostable Multivibrator for given specification using IC-555 Timer.

Group B: List of Practicals based on Digital Circuit Design (Any 6)

1. Study of Nibble Adder/Subtractor.
2. Study of JK and T flip flops.
3. Interfacing of seven segment display with IC 7447 / CD4511.
4. Design a 3 bit synchronous up/down counter using JK Flip-Flop IC 7476 / 4027.
5. Study of magnitude comparator IC 7485 / 4063.
6. Study of Decade Counter.
7. Study of Event Counter.
8. Study of Ring Counter.
9. Study of Modulus of Counter.
10. Design of counter for given sequence.

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Title of the Course : Circuit Simulation-I								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC	ELS-221-VSC	00	02	02	60	15	35	50

Course Outcomes: On completion of the course, student will be able to simulate:

1. Basic laws of Analog circuit design.
2. Half-wave and full-wave rectifiers.
3. Single-stage common-emitter amplifier.
4. Op-amp amplifiers, Oscillators and Multivibrators.
5. 4-bit synchronous counter using flip-flops.
6. Interfacing of various peripherals to digital IC's.

List of Experiments

Experiments (Any 12) + Activity / Study tour report / Assignments / Demonstration / Virtual lab: Any available simulation software can be used to conduct the following experiments.

1. Study of Series and Parallel combination of Resistors.
2. Study of Voltage Divider and Current Divider Rules.
3. Half wave and full wave rectifier circuit.
4. RC Low pass and RC high pass filter circuit.
5. Verification of Kirchhoff's laws.
6. Verification of Network Theorems,
7. Design and Simulate single stage CE amplifier.
8. Study of LCR series and parallel circuit.
9. Study of wave shaping circuits.
10. Simulate the inverting and non-inverting amplifiers for a given voltage gain.
11. Design and Simulate an Astable Multivibrator using Timer IC-555.
12. Simulate 4-bit synchronous counter using Flip-Flop IC 7476 / 4027.
13. Simulate Seven Segment Display decoder for common cathode and common anode displays.
14. Simulate two digit decimal counter using IC 7490/ 4518.
15. Simulate the interfacing of TWS and SSD.

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Title of the Course : Field Project								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
FP	ELS-231-FP	00	02	02	60	15	35	50

The guidelines for field project will be given by the college. The student has to follow the guidelines given by the Savitribai Phule Pune University while completing field project.

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Title of the Course : Development of Electronic Communication In India								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
IKS	IKS-200-T	02	00	02	30	15	35	50

Course Outcomes: On completion of the course, student will be able to:

1. Analyze the impact of radio communication systems (AM, FM, digital).
2. Demonstrate knowledge of telegram and telephone systems in India.
3. Understand the principles of radio and mobile communication systems.
4. Describe the history and evolution of television in India.
5. Use modern communication tools (email, social media and Internet telephony).
6. Understand advancements in mobile communication and emerging technologies (3G, 4G, 5G, IoT, AI).

Course Contents:

Unit 1	Overview of Communication Systems in India	8
Growth and development of telecommunication in India: Telegram, Telephone, Pager, Mobile phone, Smart phones, Radio: AM, FM and Pocket Radio (transistor radio), Digital Radio, Internet Radio, Television: Black and White TV, Color TV and Smart TV.		
Unit 2	**Telecommunication Systems in India**	**8**
Telegram system in India: Block diagram and working, Telephone system in India: Block diagram of telephone set, Telephone exchange, Wireless communication - Radio Communication, Mobile communication (Block diagram and working).		
Unit 3	**Evolution of Television in India**	**8**
Television: Block diagram and working, History of Television in India: Door - Darshan, Cable and Satellite Television Evolution: Black and White television, Color television, Smart TV, LED, LCD, Plasma and OLED.		

Unit 4	Today's Communication Systems in India	6
Electronic mail, Social networking sites: Facebook, Linkedin, Instagram, Myspace, Twitter(X), Online chat, Video chatting, Internet telephony: Voice and Video, Internet- 2G, 3G, 4G, 5G, (In brief), IoT and Artificial Intelligence.		

Text / Reference Books:

1. Telecommunications: Indian 50 Years of Independence: 1947-97 Status, Growth and Development: A. V. Gokak, BR Publishing Corporation, 1998.
2. Electronic Communication systems, George Kennedy, Bernard Davis, McGraw Hill companies, 4th Edition, 2009.
3. Electronic Communication, Dennis Roddy, John Coolean, Pearson Education, 4th Edition, 2008.
4. Principles of Electronic Communication Systems, Louis E. Frenzel, McGraw-Hill Education; 3rd Edition, 2007.

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Title of The Course : Instrumentation and Measurement Systems								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Minor	**ELE-241-MN**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: After completing this course, students will be able to:

1. Explain the working of basic instrumentation systems.
2. Identify and use appropriate sensors for measuring physical quantities.
3. Understand signal processing techniques used in instrumentation.
4. Make use of various instruments.
5. Work with the filters, ADCs and DACs.
6. Design simple measurement systems.

Detailed Syllabus:

Unit 1	Fundamentals of Measurement	4
Definitions: Accuracy, Precision, Resolution, Sensitivity, Linearity, Types of errors: Gross, Systematic, Random, Static and dynamic characteristics of instruments, Calibration and standards		
Unit 2	**Instrumentation Systems**	**10**
Block diagram of an instrumentation system, Performance Characteristics, Concepts of Sensors and Transducers, Classification of sensors and actuators, Wheatstone bridge Temperature sensors: Thermocouples, RTD, Thermistors, Displacement and pressure sensors: LVDT, Strain gauges, Piezoelectric sensors, Optical and ultrasonic sensors		
Unit 3	**Measuring Instruments**	**8**
PMMC, Ammeter, Voltmeter, Multimeter, RPS, Wattmeter, Function generator, Oscilloscope (CRO), DSO (Block/ functional diagram, working principle, specifications and applications)		
Unit 4	**Signal Conditioning and Data Acquisition Systems**	**8**
Signal conditioning: Amplifiers (Instrumentation amplifier), Filters, ADC,DAC, Display systems: Digital display (7-segment, LCD), Basic block diagram of DAQ system, Case studies of instrumentation in industry and research		

Text / Reference Books:

1. Electronic Instrumentation by H. S. Kalsi, 4th Edition McGraw Hill 2019.
2. Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai and Co., 2023.
3. Introduction to Instrumentation and Measurements, R. B. Northrop, 3rd Edition, 2014.
4. Measurement Systems: Application and Design, E.O. Doebelin, 4th Edition, 1989.
5. Instrumentation for Engineers and Scientists, John Turner, Martyn Hill, Oxford University Press, 1st Edition, 1999.

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Title of the Course : Lab Course on Instrumentation and Measurement Systems								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Minor	**ELE-242-MNP**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

Course Outcomes: After completing this course, students will be able to:

1. Explain the working of basic instrumentation systems.
2. Identify and use appropriate sensors for measuring physical quantities.
3. Understand signal processing techniques used in instrumentation.
4. Operate lab instruments independently.
5. Make use of sensors to construct a measurement system.
6. Design and test simple measurement systems.

List of Experiments:

Experiments (Any 12 from 1 to 15) + Activity / Study tour report / Assignments / /Demonstration/ Virtual lab

1. Study of Multirange voltmeter.
2. Study of Function generator.
3. Study of CRO/ DSO.
4. Study of different types of power supply.
5. Use of Ammeter, Voltmeter and Wattmeter.
6. Use of LCR meter.
7. Measurement of Light Intensity using LDR.
8. Measurement of temperature using Thermistor.
9. Measurement of temperature using RTD.
10. Study of Thermocouple Characteristics.
11. Displacement Measurement using LVDT.
12. Measurement of Unknown Resistance using Wheatstone Bridge.
13. Use of strain gauge for force/pressure measurement.
14. Signal conditioning using op-amps.
15. Digital display interfacing with sensors.

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Title of the Course : Fundamentals of Information Technology

Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
OE	**OE-201-ELS**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: On completion of the course, student will be able to:

1. Understand the basic components of computer systems and how they function.
2. Gain proficiency in using key software tools (word processors, spreadsheets, presentation tools, and basic graphic design tools).
3. Understand the significance of data management, digital archives, and academic research tools.
4. Learn basic principles of digital communication and online collaboration.
5. Develop an awareness of cyber security and ethical issues related to the use of information technology.
6. Be able to conduct effective online research and manage digital content relevant to their field of study.

Detailed Syllabus:

Unit 1	**Basics of Computer Software**	**8**
Introduction to computer softwares: System software and Application software, Study of Office Automation Tools: Word, Excel and Powerpoint, Antivirus packages.		
Unit 2	**IT in Education and E-Governance**	**12**
IT: Education, Banking, Healthcare, Governance and Government Digital Platforms (DigiLocker, UMANG etc.), Meeting platforms: Google meet, Zoom and Microsoft Teams, Online education tools: MOOCs platform, LMS platform etc.		
Unit 3	**Emerging Trends**	**6**
Introduction to AI, IoT and Cloud Computing, Use of Social media apps, Basics of Data Science and Machine learning.		
Unit 4	**IT and Society**	**4**
Ethics in IT: Digital rights and responsibilities, Cyber security basics, Cyber security in Social Media, Mobile devices and Smart Home devices.		

Text / Reference books:

1. Textbook of Information Technology, S. K. Bansal, APH Publishing Corporation, December 2004.
2. Fundamentals of Information systems, Ralph M. Stair and George W. Reynolds, 7th Edition, Boston, 2013.
3. Information Technology: Theory and Practice, Pradeep K. Sinha and Priti Sinha, PHI, 2016.
4. Introduction to Information Technology, V. Rajaraman, 3rd Edition, PHI learning Pvt, Ltd., 2018.

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Title of the Course : **Linear Integrated Circuits**								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-251-MJ**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

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

1. Understand the practical design aspects while using Op-amps.
2. Design and analyze basic application circuits using Linear ICs.
3. Learn the specifications Voltage Regulator IC.
4. Gain knowledge of the pin configuration, internal working, and typical applications of positive and negative voltage regulators.
5. Describe and evaluate the performance parameters of the LM565.
6. Understand and apply the concept of FSK demodulation using PLL.

Course Contents:

Unit 1	**Application Circuits using Opamp**	**4**
Precision half wave and full wave rectifiers, Peak detectors, sample and hold circuits.		
Unit 2	**Applications of Linear ICs**	**8**
Voltage comparators using op-amp as well as comparator IC (LM311), design of inverting and non-inverting Schmitt trigger, ON-OFF controller using comparator Astable and mono stable multivibrators using op-amp. Function generator using XR-2206.		
Unit 3	**Voltage Regulators**	**12**
Concept of Unregulated and regulated power supplies, Block diagram of regulated power supply, load regulation and line regulation with examples, Linear Regulators: Fixed three terminal regulators ICs-78XX, 79XX; Adjustable Three terminal regulators ICs LM317, LM337, LM723- Block diagram, working, Examples based on regulation formula of each regulator IC.		
Unit 4	**Phase Locked Loop**	**6**
IC LM565, operating principle, block diagram, PLL characteristics, applications of PLL such as frequency multiplier and FSK demodulator.		

Text / Reference Books:

1. George Clayton and Steve Winder, "Operational Amplifiers," 5th Edition Newnes An Imprint of Elsevier
2. Sergio Franco, "Design With operational Amplifiers and analog integrated circuits," TMH
3. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits," 4th Edition PHI
4. R.F. Coughlin, F.F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits," Prentice Hall.

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Title of the Course : Microcontroller Programming and Applications								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-252-MJ**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

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

1. Understand the fundamentals of microcontrollers and differentiate between microcontrollers and embedded processors.
2. Comprehend the architecture, features, and pin configuration of the AVR microcontroller and Arduino.
3. Develop basic Arduino programs using C/C++ and implement control structures, operators, and statements.
4. Implement interfacing of Arduino with various input/output devices such as LEDs, buzzers, sensors, and motors.

5. Design and develop simple IoT-based applications and real-world projects using Arduino and external modules.
6. Integrate and program modules to build interactive embedded systems and IoT prototypes.

Course Contents:

Unit 1	**Introduction to Microcontroller**	**6**
Introduction to microcontrollers, difference in microcontroller and embedded processor. Harvard and Von-Neumann architectures, Microcontroller for Embedded Systems, Criteria for choosing a microcontroller. List of Microcontrollers, Introduction to AVR Microcontroller, AVR Features. General Block diagram of AVR Microcontroller.		
Unit 2	**Introduction to Arduino and Programming Basics**	**12**
Introduction to Arduino: Features of Arduino, Microcontrollers used in Arduino, Architecture, Pin configuration, Concept of digital and analog ports. Arduino Programming Basics: Basics of C/C++ for Arduino Programming, Data Types, Variables, Arrays, Operators (arithmetic, logical, relational, modulo and assignment) Statements: if-else and switch-case, Control structures: while and for Loop.		
Unit 3	**Arduino Programming and Interfacing**	**8**
Functions: setup(), loop(), analogRead(), and digitalRead() functions. Serial Port Communication. Arduino Uno Interfacing: LED blinking, buzzer, Push button, LDR, relay, Bluetooth module, LCD and LM35. Controlling Motors (DC and Servo)**.**		
Unit 4	**Arduino Applications**	**4**
Intensity control of LED with Pulse Width Modulation using analogWrite(), Home Automation Using Arduino, Distance measurement using ultrasonic sensor, Internet of Things (IoT) with Arduino and Wi-Fi Module (ESP8266).		

Text / Reference Books:

1. The AVR microcontroller and embedded systems using Assembly and C, Muhamad ali Mazidi, Sarmad Naimi, Sepehr Naimi, PHI publications
2. Programming Arduino, Getting Started with Sketches 2ND edition, Simon Monk, McGraw-Hill Education. https://agsci.colostate.edu/wp-content/uploads/sites/95/2020/03/Programming-Arduino.pdf
3. Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury. https://api.pageplace.de/preview/DT0400.9781351669542_A31858991/preview-9781351669542_A31858991.pdf
4. Arduino Documentation, https://docs.arduino.cc/

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Title of the Course : Practical Course-IV								
Year: II					**Semester: IV**			
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	**Allotted Marks**		
		Theory	Practical			CIE	ESE	**Total**
Major	**ELS-253-MJP**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

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

1. Design and build half-wave and full-wave precision rectifiers using Op-Amps for high-precision signal

rectification.
2. Design, build, and test fixed and adjustable voltage regulators (e.g., IC 78XX, 79XX, LM317, LM337, LM723).
3. Explain how a PLL locks onto an input frequency and generates a stable output at a multiple of the input.
4. Interfacing various input/output devices such as push buttons, sensors, LED and Buzzer with Arduino.
5. Interface DC motor, Servo motor and steeper motor with Arduino.
6. Explain how IoT systems collect, transmit, and visualize real-time sensor data over the internet.

Total Experiments:
Experiments (Any 12 from Group A and B) + Activity / Study tour report / Assignments /Demonstration / Virtual lab
Group A: List of Practicals based on Linear Integrated Circuits (Any 6)

1. Design, build and test half-wave and full-wave precision rectifier.
2. Design, build and test peak detector.
3. Design, build and test sample and hold circuits.
4. Design, build and test voltage comparator using Op-Amp (LM741/LM311).
5. Design, build and test inverting/non-inverting Schmitt trigger.
6. Design, build and test ON-OFF controller using comparator.
7. Design, build and test Astable/ Monostable multivibrator using op-amp.
8. Design, build and test function generator using XR-2206**.**
9. Design, build and test fixed linear voltage regulator using IC 78XX /79XX.
10. Design, build and test adjustable voltage regulators using LM317/LM337.
11. Design, build and test voltage regulators using LM723.
12. To study PLL and measure lock range and capture range of PLL using LM565.
13. Design, build and test frequency multiplier using PLL LM565.

Group B: Microcontroller Programming and Applications (Any 6)

1. To study and understand Interfacing LED array to Arduino.
2. To Control an LED status using a push-button.
3. To switch ON/OFF an AC bulb or any high-voltage device using Arduino.
4. To study and understand Interfacing keyboard to Arduino.
5. To study and understand interfacing bluetooth to Arduino.
6. To study and understand Interfacing LM35 to Arduino.
7. Seven segments display interfacing.
8. Servo motor interfacing to Arduino.
9. LCD interfacing to Arduino .
10. Stepper motor interfacing (Clockwise and anticlockwise rotation).
11. DC motor interfacing (Clockwise and anticlockwise rotation).
12. Setting up ESP8266 Wi-Fi Module with Arduino for basic internet connectivity.
13. Send Sensor Data (LM35 or LDR) to Cloud (ThingSpeak/Adafruit IO).
    Control an LED via Web Server.
14. Send Data to Smartphone/PC Using HTTP.
15. To control home appliances from a smartphone or computer.

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Title of the Course : Circuit Simulation - II								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC	ELS-271-VSC	00	02	02	60	15	35	50

Course Outcomes: On completion of the course, student will be able to

1. Understand and implement basic digital output control using Arduino to turn devices ON and OFF.
2. Acquire and process analog and digital sensor data using Arduino to read and display sensor data.
3. Use conditional statements in Arduino programming to control output devices.
4. Establish serial communication between Arduino and external devices using a Bluetooth module

List of Experiments:

Experiments (Any 12) + Activity / Study tour report / Assignments / Demonstration /

Virtual lab: Any available simulation software can be used to conduct the following experiments.

1. LED interfacing to Arduino
2. LED array interfacing to Arduino
3. Traffic Light Controller
4. Turn ON/OFF an LED using a push button
5. Matrix Keypad interfacing to Arduino
6. Seven-Segment Display Interface
7. Temperature sensor LM35 interfacing to Arduino
8. LCD interfacing to Arduino
9. Digital Thermometer using LM35 and LCD
10. Measure distance using Ultrasonic sensor and display it on Serial Monitor or LCD
11. DC motor speed control using PWM
12. Servomotor interfacing to Arduino
13. Stepper motor interfacing to Arduino
14. Password based door locking system.
15. Smart Water Level Monitor and Controller

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Title of the Course : Community Engagement Project								
Year: II					Semester: IV			
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
CEP	**ELS-281-CEP**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

The guidelines for community engagement project will be given by the college. The student has to follow the guidelines given by the Savitribai Phule Pune University while completing community engagement project.

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Title of the Course : Communication Electronics								
Year: II					Semester: IV			
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Minor	**ELE-291-MN**	**02**	**00**	**02**	**30**	**15**	**35**	**50**

Course Outcomes: After completing this course, students will be able to:

1. Understand different blocks in communication systems, types of noise in communication systems and its different parameters.
2. Understand need of modulation, modulation process, amplitude modulation, frequency modulation and demodulation methods.
3. Describe the operation and applications of TDM and FDM in communication systems and identify their differences.
4. Apply the concept of sampling and the sampling theorem in digital communication.
5. Study the difference between digital Modulation techniques ASK, FSK, PSK as well as PCM and its applications.
6. Describe satellite orbits, transponders, uplink/downlink concepts, and applications of satellite communication in global connectivity.

Detailed Syllabus:

Unit 1	**Basics of Electronic Communication**	**5**
Introduction to communication- means and modes, Block diagram of an electronic communication system, Electromagnetic spectrum, Transmission Media, Concept of Noise, signal-to-noise (S/N) ratio, Bandwidth, Need of Modulation, Concept of Modulation.		
Unit 2	**Analog Modulation Techniques**	**12**
Amplitude Modulation: AM waveform, mathematical expression of AM, concept of sideband, Modulation index, Power Distribution. AM using transistor, AM Receiver: demodulator circuit using diode and super-heterodyne receiver, Block diagram of AM communication system.		

Frequency Modulation: FM waveform, frequency spectrum, bandwidth and modulation index, frequency deviation, FM Modulation using varactor diode, Block Diagram of FM communication system. Comparison of AM and FM.		
Unit 3	**Pulse Modulation Techniques**	**8**
Types Pulse modulation: concept and generation of PAM, PWM, PPM, Concept of Time Division Multiplexing(TDM) and Frequency Division Multiplexing(FDM). Digital Modulation Techniques: Advantages of digital communication system, Bit Rate, Baud Rate and Bandwidth. Serial and Parallel communication, Concept of Sampling, Sampling theorem, PCM, ASK, FSK, PSK.		
Unit 4	**Application of Communication System**	**5**
FM Broadcasting, TV Broadcasting, Satellite Communication, Mobile Communication, Concept of 2G, 3G, 4G, 5G, Internet.		

Text / Reference Books:

1. Communication Electronics :Principles and applications by Louis E Frenzel 3rd edition, TMH Publications
2. Electronics Communication Systems by Denis Roddy, John Coolen, PHI publication.
3. Kennedy, George & Davis, Bernard / "Electronic Communication Systems" / Tata
4. McGraw-Hill / 4th Ed.
5. Singh, R.P. & Sapre, S.D. / "Communication Systems: Analog & Digital" / Tata McGraw- Hill.

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Title of the Course : Lab Course on Communication Electronics								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
Minor	**ELE-292-MNP**	**00**	**02**	**02**	**60**	**15**	**35**	**50**

Course Outcomes: After completing this course, students will be able to:

1. Understand the design concepts of different types Analog Modulation Techniques
2. Understand the design concepts of different types Digital Modulation Techniques
3. Understand the design concepts of different types Pulse Modulation Techniques
4. Study of Various Applications of Communication System
5. Understand the principles of Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM)
6. Describe the block diagram and working of an AM and FM broadcasting system

List of Experiments:
Experiments (Any 12 from 1 to 17) + Activity / Study tour report / Assignments / /Demonstration / Virtual lab

1. Design, build and test Amplitude Modulator using transistor
2. Design, build and test FM generation using VCO/IC 8038/varactor diode
3. Study of Frequency Shift Keying (FSK) using XR 2206
4. Study of Amplitude Shift Keying (ASK)
5. Study of Binary Phase Shift Keying (BPSK)
6. Design, build and test Time division multiplexing
7. Design, build and test Frequency division multiplexing

8. Design, build and test Balance modulator and demodulator using IC 1408
9. Design, build and test PPM
10. Design, build and test PWM
11. Design, build and test PAM
12. Demonstration of PCM
13. Demonstration of FM Receiver
14. Demonstration of AM Receiver
15. Study of FM Broad Casting system
16. Study of TV Broadcasting System
17. Study of different types of antenna

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Title of the Course : Lab Course on Fundamentals of Information Technology								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
OE	**OE-251-ELS**	**02**	**00**	**02**	**60**	**15**	**35**	**50**

Course Outcomes: On completion of the course, student will be able to

1. Differentiate system and application software.
2. Efficiently use MS Office tools.
3. Understand the role and function of antivirus software.
4. Understand how IT is integrated into different sectors.
5. Use online platforms for education, governance, and collaboration.

List of Experiments: Experiments (Any 12) + Activity / Study tour report / Assignments / Demonstration / Virtual lab

1. Differentiate between system and application software.
2. Perform document creation, editing, and formatting using MS Word.
3. Perform data manipulation using MS Excel.
4. Perform data presentation design using MS PowerPoint.
5. Explore antivirus software for maintaining computer security.
6. Prepare a report or presentation on how Information Technology is applied in various sectors such as healthcare, education, banking, and governance.
7. Access and explore features of government digital platforms such as DigiLocker or UMANG.
8. Host a session on an online meeting platform (e.g., Zoom, Google Meet)
9. Explore educational platforms such as MOOCs (SWAYAM, Coursera) or LMS (Moodle).
10. Use an AI-based assistant like ChatGPT, Gemini, DeepSeek to perform tasks
11. Study of Internet of Things (IoT) technology.
12. Demonstrate how sensors (e.g., temperature, motion, ultrasonic) collect and transmit data using an IoT development board (Arduino or ESP8266).

13. Explore cloud computing by uploading, sharing, and collaborating on documents using Google Drive, OneDrive, or Dropbox.
14. Use Google Docs or Google Sheets online for collaborative editing and sharing of content.
15. Explore different social media apps (e.g., Facebook, Instagram, Twitter) and analyze their features, benefits, and digital safety practices.
16. Conduct a study or group discussion on how businesses use digital media (social media, email marketing, SEO, etc.) for marketing.
