CALICUT UNIVERSITY – FOUR-YEAR UNDER GRADUATE PROGRAMME (CU-FYUGP)

BSc PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**SEMICONDUCTOR PHYSICS AND ELECTRONICS**				
Type of Course	**Minor (SET III: SEMICONDUCTOR PHYSICS)**				
Semester	**I**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1.Basic understanding of physics and mathematics, including algebra and calculus. 2.Familiarity with fundamental concepts in electricity and magnetism.				
Course Summary	This course covers fundamental concepts in electronics, focusing on both theoretical understanding and practical applications. The syllabus includes topics such as atomic models, semiconductor physics, diode and transistor circuits, voltage stabilization, amplifiers, and digital electronics. The course aims to equip students with the necessary knowledge and skills to analyze, design, and troubleshoot electronic circuits.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Master the energy band structure of semiconductors, differentiate between intrinsic and extrinsic semiconductors, grasp majority and minority carrier concepts, and proficiently analyse pn junctions.	U	F	Instructor-created exams / Quiz
CO2	Analyse diode rectifiers and filtering circuits, understand transistor basics and various configurations and load line analyse	U & An	C	Practical Assignment / Observation of Practical Skills
CO3	Gain insight into voltage stabilisation using Zener diodes. Design and understand the working of CE amplifiers. Get introduced to operational amplifiers.	U, Ap & C	P	Seminar Presentation / Group Tutorial Work
CO4	Understand Boolean algebra basics, the functioning of OR, AND, NOT gates, and the fundamental theorems. Master truth tables, symbolic representation, universal gates, XOR gates and adder circuits.	U & Ap	C	Instructor-created exams / Home Assignments
CO6	Practical session will help in understanding the working of pn junction diode, transistors. Will comprehend the working of logic gates in digital electronics	Ap & C	M	One Minute Reflection Writing assignments

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)

- Factual Knowledge (F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks 70
I		**Semiconductor Physics**	**8**	**12**
	1	Bohr's atomic model and energy levels, Energy bands and classification of solids, silicon	2	
	2	Semiconductors and the influence of temperature	1	
	3	Intrinsic and extrinsic semiconductors, n type and p type, majority and minority carriers	2	
	4	pn junction and its properties	2	
	5	Biasing of junction	1	
		Sections 4.1 - 4.6 of chapter 4, sections 5.1 - 5.20 of chapter 5, Book 1		
II		**Analog Electronics**	**16**	**25**
	6	Diode as rectifiers- half wave and full wave- Efficiency and ripple factor calculations	6	
	7	Filter circuits	2	
	8	Introduction to transistor and its action	2	
	9	Transistor configurations- CE in detail (CB and CC as comparison with CE)	3	
	10	Load line analysis and operating point	2	
	11	Testing of transistor	1	
		Sections: 6.2,6.3, 6.6-6.21 (excluding 6.16) of chapter 6, sections 8.1-8.22, (Excluding 8.11) (Derivation of expression of Ic may be avoided in CE, CB and CC), 8.27 of chapter 8, Book 1		

III		**Voltage stabiliser and amplifier**	**13**	**21**
	12	Zener diode, voltage stabilisation, equivalent circuit of zener diode, zener diode as voltage stabilizer.	3	
	13	Faithful amplification, transistor biasing, inherent variations in transistor parameters, stabilization, voltage divider bias method	3	
	14	Designing of transistor biasing circuits, Mid - point biasing	1	
	15	CE amplifier – circuit, working, phase reversal, frequency response, voltage gain.	3	
	16	Operational amplifier: basic operation, inverting and noninverting modes, voltage follower.	2	
	17	Summing amplifier, applications of summing amplifiers	1	
		Sections: 6.24-6.28 of chapter 6, 9.1-9.5, 9.12, 9.14-9.15 of chapter 9, 10.1-10.5 of chapter 10, 11.3-11.4, of chapter 11, 25.15- 25.17, 25.22-25.24, 25.26, 25.27, 25.32 - 25.33 of chapter 25, Book 1		
IV		**Digital Electronic**	**8**	**12**
	18	Basic logic gates	3	
	19	Combination gates and XOR gates	1	
	20	Boolean Algebra and Boolean theorems	2	
	21	De Morgan's theorems	1	
	22	Electronic adder circuits	1	
		Sections: 26.11-26.17, 26.20-26.22, 26.32 of chapter 26, Book 1		
V		**PRACTICALS**	**30**	
		Conduct any 5 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 6th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course.		

	Necessary theory of experiments can be given as Assignment/ Seminar.			
	1	**Study the V-I characteristics of diodes.** ● Characteristics of Ge/Si diodes, and LEDs. ● ExpEYES may be used. https://expeyes.in/experiments/electronics/diodeIV.html ● Optional: Plot and fit the experimental data with the diode equation in GeoGebra or any other application and calculate the value of the ideality factor of the PN junction.		
	2	**Study the characteristics of Zener diode and construct a voltage regulator.** ● Study the V-I characteristics of zener diode and hence determine the breakdown voltage. ● https://expeyes.in/experiments/electronics/zenerIV.html ● Construct a voltage regulator using a zener diode and determine the percentage of voltage regulation.		
	3	**Construction of the center tapped full wave rectifiers and regulated power supply.** ● Construct a center tapped full wave rectifier without filter and with a filter. ● Connections may be realized through soldering, to get an experience of soldering. ● Measure the AC and DC voltages using a multimeter and calculate the ripple factor without and with a filter. ● Observe the variation of the ripple factor with load resistance, when filter is used. ● Optional: Construct 5V/12V regulated power supply using 78XX IC.		
	4	**Transistor input, output & transfer characteristics in CE configuration.**		

		• Draw the static characteristics of the transistor in common emitter configuration and calculate input/output resistance and the current gain. • ExpEYES may be used https://expeyes.in/experiments/electronics/npn.html		
	5	**Construction of CE transistor amplifier and the study of frequency response** • Design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias. • Study the frequency response and find the bandwidth.		
	6	**Operational Amplifier –inverting, non inverting amplifier and voltage follower.** • Design inverting and non inverting amplifiers of different voltage gain. • Measure and verify the gain using CRO/ExpEYES. • Construct a voltage follower and verify that the gain is unity.		
	7	**Operational Amplifier- adder, subtractor** • Design arithmetic circuits(adder and subtractor) using OP AMP, with two input voltages and measure the result using multimeter/CRO/ExpEYES.		
	8	**Construction of basic gates using diodes (AND, OR) & transistor (NOT)** • Realize the logic AND and OR gates using diodes and NOT gate using a transistor and verify the truth table. Logic output can be checked using a multimeter or LED.		
	9	**Construct Half adder using universal gates and study the operation.** • Implement half adder using NAND/NOR gates and verify the truth table for each input/output combination.		
	10	**Verification of De-Morgan's Theorems using basic gates.**		

		• Realize the either side of the De-Morgan's Theorems using gates from appropriate ICs and verify the truth table for each input/output combination.		
	11	**Acceleration of a Freely Falling Body** • Use the smartphone acoustic stopwatch to determine the duration of a free fall. • Measure the time of flight of a steel ball for different heights and plot a graph of distance vs. time squared (s vs. t^2). Determine g from the graph. • Experiment 2 of Book 2. • Phyphox app may be used. https://phyphox.org/experiment/free-fall-2/ **OR** • Use ExpEyes kit, electromagnet, and contact sensor to determine the duration of a free fall. https://expeyes.in/experiments/mechanics/tof.html		
	12	**Verification of the Relation of Angular Velocity and Centrifugal Acceleration** • Use the smartphone gyroscope and the accelerometer. • Attach the smartphone to some rotating arrangements and record the data from the gyroscope and accelerometer. • Plot angular velocity Vs acceleration and verify the relation. • Experiment 18 of Book 2. • Phyphox app may be used. https://phyphox.org/experiment/centrifugal-acceleration/		
	13	**Analysis of Bouncing Balls to Determine Gravitational Acceleration and Coefficient of Restitution.** • After doing the experiment, the student should be able to understand the concept of inelastic collision.		

		• Measure the time interval between successive bounces using a digital acoustic stopwatch and hence calculate g and coefficient of restitution • Experiment 12 of Book 2 • Phyphox app may be used. https://phyphox.org/experiment/inelastic-collision/		
	14	**Analysis of Air Resistance and Terminal Speed to Determine the Drag Coefficient.** • Record the motion of a light weight paper cup and analyse it with Tracker tool (https://physlets.org/tracker/). • Plot acceleration, velocity, and position with time. • Repeat the experiment with different mass (by simply stacking the paper cups) • Determine the Drag Coefficient • Experiment 27 of Book 2. • https://www.youtube.com/watch?v=iujzK3uH1Yc		
	15	**Projectile Motion: Energy Conservation** • Analyse the motion of the tossing ball/ projectile in the Tracker tool. • Plot time Vs the x-and y-components of velocity and acceleration. • Also plot the kinetic energy, potential energy (build data using define tool) and total energy. • https://www.youtube.com/watch?v=x0AWRLvgB28 • https://www.youtube.com/watch?v=i07HeUWo8xc		

Books and References:

1. V K Mehta and Rohit Mehta -Principles of electronics (Book 1)
2. Smartphones as Mobile Minilabs in Physics(Edn. 1) by Jochen Kuhn & Patrik Vogt, Springer, (Book 2)
3. https://phyphox.org/
4. https://physlets.org/tracker/
5. 3. Digital principles and applications - Leach and Malvino (Tata McGraw Hill)
6. Electronic Principles by Malvino - (Tata McGraw Hill)
7. Digital Computer Fundamentals (Thomas. C. Bartee)

8. Physics of Semiconductor Devices- Second Edition – Dilip K Roy – Universities Press
9. Digital Fundamentals –Thomas L Floyd – Pearson Education
10. The Art of Electronics-Paul Herowitz & Winfield Hill

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PS O6	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7
CO 1	3	2	3	0	2	1	3	1	1	0	2	3	0
CO 2	2	1	1	1	2	1	2	2	2	1	2	3	0
CO 3	2	3	2	1	1	2	2	3	2	1	2	3	0
CO 4	0	2	1	0	0	0	1	1	1	0	2	3	0
CO 5	1	1	2	0	2	2	2	2	3	1	3	3	0
CO 6	2	2	1	0	2	2	2	2	2	1	3	3	0

Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- InternalTheory/Practical Exam
- Assignments /Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory/ Practical Exam	Assignm ent /Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	

CALICUT UNIVERSITY – FOUR-YEAR UNDER GRADUATE PROGRAMME (CU-FYUGP)

B.Sc. PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**FUNDAMENTALS OF OPTICS**				
Type of Course	**Minor (SET III: SEMICONDUCTOR PHYSICS)**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basics of Physics and Chemistry (Plus Two Level)				
Course Summary	This syllabus explores how light behaves, from reflection and bending to creating specific light sources and transmitting them through thin cables.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Analyze the principles of reflection and refraction, applying them to explain image formation by mirrors and lenses.	An	C	Instructor-created exams / Quiz/ Practical Assignment

CO2	Describe the phenomenon of wave interference and diffraction, and solve problems using concepts like the double-slit experiment.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Explain the concept of polarization and its applications, including the use of polarizers and analyzers.	U	C	Instructor-created exams / Quiz/ Practical Assignment
CO4	Describe the operating principles of lasers, including stimulated emission and population inversion, and identify different laser types.	U	C	Instructor-created exams / Home Assignments
CO5	Explain the concept of total internal reflection and apply it to understand light propagation through optical fibers.	Ap	F	Seminar Presentation / Group Tutorial Work
CO6	Able to explain the advantages and applications of optical fibers in communication and sensing.	U	C	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Reflection and Refraction**		**10**	**15**
	1	Reflection at plane Mirrors, Reflection at spherical mirror: Basic terms, paraxial rays and paraxial approximation, sign convention, spherical mirror equation, Focal point and focal length	3	
	2	Spherical mirror equation applied to concave mirror, Conjugate points, extended object, lateral magnification, convex mirror and plane mirror	3	
	3	Refraction at spherical surfaces, Gaussian relation	2	

	4	Lens equation, Lens maker's equation.	2	
	Section 3.3, 3.4, 3.12, 4.8 - 4.10 of chapter 3 and chapter 4 of Book 1			
II	**Wave optics**		**19**	**25**
	5	Interference, Young double slit experiment	2	
	6	Coherence and conditions for interference	1	
	7	Interference in thin parallel films	2	
	8	Interference in wedge shaped film, Angle of wedge and thickness of spacer, Colour of thin films	2	
	9	Newton's rings: determination of wavelength of light	2	
	10	Diffraction: Difference between diffraction and interference, Fresnel and Fraunhoffer type diffraction	1	
	11	Fraunhoffer diffraction at a single slit, double slit (Calculus method is excluded), Plane diffraction grating.	3	
	12	Polarization: Types of polarization, Brewster's law, Production of plane polarized light	2	
	13	Polarizer and analyser, Malu's law, Double refraction	2	
	14	Optical activity and specific rotation	2	
	Section 14.4 – 14.7,15.2, 15.5, 15.6 (upto 15.6.7), 17.6 - 17.7, 18.1, 18.2, 18.4, 18.7, 20.1, 20.2, 20.5, 20.6, 20.8 - 20.11, 20.27 - 20.29, Book 1			
III	**Lasers**		**8**	**15**
	15	Lasers, Thermal equilibrium, Absorption of a Photon, Spontaneous emission, Stimulated emission, Population inversion	2	

	16	Components of Laser and lasing action	3	
	17	Ruby laser, Nd-YAG laser, Helium Neon laser, Carbon dioxide laser, semiconductor laser.	3	
	Sections 22.1, 22.3, 22.4, 22.7, 22.8, 22.9, 22.14, 22.15, Book 1			
IV	**Fiber Optics**		**8**	**15**
	18	Introduction, Optical fiber, Total internal reflection	2	
	19	Propagation of light through optical fiber	1	
	20	Critical angle, Acceptance angle, Numerical Aperture, Modes of propagation	2	
	21	Classification of optical fibers, Losses in optical fiber, Applications	2	
	22	Fiber optic communication systems, fiber optic sensors.	1	
	Sections 24.1 - 24.6, 24.8, 24.10, 24.11, 24.15, 24.20 - 24.21, 24.23 (24.23.1-24.23.2), Book 1			
V	**PRACTICALS**		**30**	
	Conduct any 6 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 7th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course. Necessary theory of experiments can be given as Assignment/ Seminar.			
	1	**Determine the refractive index of (a) given liquid and (b)the material of a lens, by forming a liquid lens.** ● Through this experiment the students are expected to get the concepts of image formation, combination of lenses and radius of curvature of the surface of lens.		

		• Determine the radius of curvature of the lens by Boy's method and hence calculate the refractive indices.		
	2	**Determine the focal length of the combination of two lenses separated by a distance.** • Determine the focal lengths, f1 and f2 of the two lenses using an illuminated cross-slit screen holder, nodal slide(for placing the lenses) and plane mirror arrangement. • Place the two lenses separated by a distance d, determine the focal length, F of the combination and verify the relation • $\frac{1}{F} = \frac{1}{f1} + \frac{1}{f2} - \frac{d}{f1f2}$. • The combination of the lenses in the eyepiece of the spectrometer/ travelling microscope may be used for the study. • https://www.youtube.com/watch?v=IOlEEtyNPBg • https://www.youtube.com/watch?v=tNo4Ipk74SU		
	3	**Determination of the dispersive power of a solid prism using a spectrometer.** • Find the angle of the prism and the angle of minimum deviation for prominent lines of the mercury spectrum using a spectrometer. • Calculate the refractive indices corresponding to the colors and find the dispersive power of the material of the prism for two pairs of wavelengths.		
	4	**Refractive indices of quartz prism using spectrometer.** • Determine the refractive indices of quartz for the ordinary and extraordinary rays of a sodium vapour lamp by arranging the quartz prism at minimum deviation position in the spectrometer. • Verify the polarizations of the ordinary and extraordinary rays using a polaroid.		

	5	**Determination of wavelengths of mercury spectrum using diffraction grating and spectrometer.** ● Arrange the grating at normal incidence. ● Standardize the grating using the green line of mercury and then find the wavelengths of other prominent lines of the spectrum.		
	6	**Newton's rings-determination of the wavelength of sodium light** ● Form of Newton's rings in the air-film in between a plano-convex lens and a glass plate using sodium-source. ● Determine the radius of curvature by Boy's method and determine the wavelength of the source. ● Optional: In experiment 5 and 6, record a short video of the interference pattern, calibrate the video using scale marked on the glass plate, analyse the video using Tracker tool. From the intensity profile get the locations of the dark rings and calculate the wavelength of the source/thickness of the sample https://physlets.org/tracker/. https://www.youtube.com/watch?v=UCCPkJpUQEw		
	7	**Air wedge-determination of the radius of a thin wire/human hair/thin foil.** ● Form interference fringes using sodium-source, in the air-film in between wedge formed by placing the given sample between the glass plates. ● Measure the positions of the successive dark bands using a travelling microscope and determine the angle of the wedge and thickness of the sample given.		
	8	**Single slit diffraction using laser - Determination of slit width.** ● The laser light diffracted from the narrow slit is allowed to fall on a screen and record the maxima or minima points in a paper.		

		• From the width of the central maxima or the position of minimum intensity points, calculate the slit width. • Verify the slit width using a traveling microscope. • Wavelength of laser can be found using diffraction grating of known N.		
	9	**Study the specific rotation of the sugar solution using a polarimeter.** • Determine the specific rotation corresponding to different concentrations of the sugar dissolved in water. • Draw a graph between rotation and concentrations and verify the linear relationship.		
	10	**Verification of Malus's law using polarizer, analyzer and photo detector** • Unpolarized light is allowed to pass through a polarizer and is observed through an analyzer. • Vary the angle between the axes of polarizer and analyzer and measure the intensity of the light (current output of the photodetector). • Plot $\theta - I$ and $cos^2\theta - I$ graphs and verify the Malus's law. • A flat computer monitor (or LCD TV screen) in plain white color can be used as the source of linear polarized light. • The ambient light sensor of the smartphone and the orientation sensor of the smartphone can be used to measure the illuminance and the angles respectively. • A small piece of polarizer (a square of about 1 cm side) from an old calculator's display was placed over the ambient light sensor as analyser. • https://arxiv.org/pdf/1607.02659		
	11	**Spectrometer-Determination of the Cauchy's constants of the given prism** • Find the angle of the prism, the minimum deviation angles of the prominent lines of the mercury spectrum and hence calculate the refractive indices for the colors. • Determine A and B from the $\mu - \frac{1}{\lambda^2}$ graph.		

	12	**Viscosity of a liquid - Falling Ball Viscometer** ● Drop a polished steel ball into a glass tube of a somewhat larger diameter containing the liquid. ● Record the time required for the ball to fall at constant velocity through a specified distance between reference marks. ● Use the Stoke's law for the sphere falling in a fluid under effect of gravity, to estimate the viscosity of the liquid.		
	13	**Surface tension of liquid - Capillary rise method** ● Clamp a clean capillary tube by dipping its lower end into the liquid in the beaker. ● Measure the rise of water in the tube using a traveling microscope. ● Also measure the radius of the capillary tube using the traveling microscope and estimate the surface tension of the liquid. ● Density of the liquid can be determined using Hare's apparatus of can be given		
	14	**Viscosity of a liquid - Poiseuille's Method** ● Fill the liquid in a vertically fixed burette with its lower end attached to a capillary tube, placed in horizontal position using a rubber tube. ● Note the time taken to reach each 10cc of water and the height of the corresponding marking. ● Also measure the radius of the capillary tube using the traveling microscope and estimate the viscosity of the liquid.		
	15	**Static torsion Rigidity modulus** ● Using Searle's static torsion apparatus, determine the rigidity modulus of the material of the rod.		

Books and References:

1) A Textbook of Optics by N. Subramanyam, Brij Lal, M N Avadhanulu, 25TH Edition (Book 1)
2) Optics by Ajoy Ghatak, Tata McGrow-Hill (Book 2)

3) Optics by Eugene Hecht, Addison-Wesley (Book 3)

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7
CO 1	3	2	2	1	2	0	3	1	1	0	2	1	0
CO 2	3	2	2	1	2	1	3	3	2	1	2	1	0
CO 3	3	2	3	2	2	1	3	2	2	1	2	1	0
CO 4	3	2	2	1	2	0	3	2	2	1	2	1	0
CO 5	2	3	2	1	2	1	3	2	2	1	3	1	0
CO 6	2	3	2	1	2	2	3	2	2	1	3	1	0

Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- InternalTheory/Practical Exam
- Assignments /Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory/ Practical Exam	Assignmen t /Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	

CALICUT UNIVERSITY – FOUR-YEAR UNDER GRADUATE PROGRAMME (CU-FYUGP)

BSc PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**ELECTRONIC COMMUNICATION**				
Type of Course	**Minor (SET III: SEMICONDUCTOR PHYSICS)**				
Semester	**III**				
Academic Level	**200 – 299**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Fundamentals of EM wave characteristics and electronics				
Course Summary	This course explores the characteristics of the EM wave spectrum, various communication systems and there implementation.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Explain main parts and different types of electronic communication system. Define electromagnetic spectrum and its application in communication systems.	U & Ap	P	Instructor-created exams / Home Assignments
CO2	Calculate voltage gain, current gain, attenuation. Explain relation between Q, resonant frequency and bandwidth.	Ap	P	Instructor-created exams / Home Assignments
CO3	Explain the basic concepts of AM and FM. Compare AM and FM and calculate parameters such as modulation index, band width.	U & An	P	Instructor-created exams / Home Assignments
CO4	Explain the fundamental concepts in digital communication such as		C	Instructor-created exams / Home

	quantizing error, analog to digital conversion, sampling, PAM, PWM, PPM, difference between asynchronous and synchronous data transmission.	U		Assignments
CO5	Explain the reasons for the growing use of microwaves and millimetre waves in communications. Identify the microwave and millimetre-wave band segments and various microwave components used in this communication system.	U & An	P	Seminar Presentation / Group Tutorial Work
CO6	Design and construct various circuit elements useful in communication systems. Design experiments to identify different characteristics of electromagnetic spectrum.	Ap	P	Practical Assignment / Observation of Practical Skills / Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**INTRODUCTION TO COMMUNICATION SYSTEM**		**13**	**20**
	1	The significance of human communication, communication system, Types of communication systems.	2	
	2	Modulation and multiplexing, the electromagnetic spectrum	2	
	3	Bandwidth, survey of communication application	2	
	4	Gain, Tuned Circuits	3	
	5	Filters: Passive RC filters, Active filters (advantages, qualitative discussion on op-amp based active filters using circuit diagrams)	2	
	6	Fourier theory	2	
	Relevant topics of chapter 2 of Book 1; sections 1.1-1.7, 2.1, 2.2, 2.3 (selected topics), 2.4 of chapter 2 of Book 1			

II	**AMPLITUDE AND FREQUENCY MODULATION**		**12**	**18**
	7	AM modulation concepts, Modulation index and percentage of modulation	2	
	8	Sideband and frequency domain, pulse modulation	2	
	9	AM power, Single sideband modulation	2	
	10	Basic principles of frequency modulation, principles of phase modulation	2	
	11	Modulation index and side bands, Bessel functions	2	
	12	Frequency suppression effect of FM, AM versus FM	2	
	Relevant topics of chapter 3 and 5 of Book 1; Sections: 3.1 to 3.5, 5.1 to 5.5 of chapter 3 and chapter 5 of Book 1			
III	**DIGITAL COMMUNICATION**		**10**	**16**
	13	Digital transmission of data, serial and parallel transmission	2	
	14	Data conversion, Basic principles of data conversion, General discussion on DA converters and AD converters	2	
	15	Pulse modulation, pulse code modulation	2	
	16	Digital signal processing	2	
	17	Principles of digital transmission	2	
	Relevant topics of chapter 7 and 11 of Book 1; Sections: 7.1 to 7.5, 11.1, 11.2 of chapter 7 and chapter 11 of Book 1			
IV	**MICROMETRE AND MILLIMETRE COMMUNICATION**		**10**	**16**
	18	Microwave concepts, microwave frequencies and band, advantages and disadvantages of microwave transmission, microwave communication system.	2	
	19	Microwave lines and devices	2	
	20	Microwave semiconductor diode	2	
	21	Microwave tubes	2	

	22	Microwave antenna: Low frequency antenna, horn antenna, Microwave and millimetre wave applications	2	
	Relevant topics of chapter 16 of Book 1; Sections: 16.1 to 16.5, 16.7 of chapter 16 of Book 1			
V	**PRACTICALS**		**30**	
	Conduct any 6 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 7th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course. Necessary theory of experiments can be given as Assignment/ Seminar.			
	1	**Design and construct passive RC filters** ● Measure the frequency responses of low-pass and high-pass RC circuits and plot frequency response graphs (Bode plots) of the amplitude and the phase.		
	2	**Construct amplitude modulator circuit** ● Design and construct an amplitude modulator circuit. ● Study the response for suitable modulation depths.		
	3	**Construction of D/A converter** ● Construct a 4 bit D/A converter using R-2R ladder network. ● Plot a graph of analog output voltage versus binary number.		
	4	**Determine the numerical aperture (NA) of an optical fiber using a laser** ● Couple the light from the laser source onto one of the fiber ends and the light coming from the other end is allowed to fall on a screen(sheet having circular markings) placed perpendicular to the axis of the fiber. ● Measure the diameter of the laser beam on the screen and the distance between the screen and fiber output end and hence calculate the NA.		

	5	**Attenuation and bandwidth of optical fibre** ● Determine the attenuation and bandwidth of the given optical fibre specimen		
	6	**Fourier analysis of the modes of vibration in a stretched string.** ● Record the sound produced by guitar string (or similar arrangement) using a microphone and analyze the spectrum by taking FFT. ● Audio Spectrum in the Pyphox, Audacity, ExpEYES or any other tools can be used to record the sound and to take FFT. ● Vary the length and tension of the string and analyze the harmonics. ● https://phyphox.org/experiment/audio-spectrum/ ● https://www.youtube.com/watch?v=bl7jf2myEvM ● https://expeyes.in/experiments/sound/beats.html		
	7	**Construct Half adder using universal gates and study the operation.** ● Implement half adder using NAND/NOR gates and verify the truth table for each input/output combination.		
	8	**Verification of De-Morgan's Theorems using basic gates.** ● Realize the either side of the De-Morgan's Theorems using gates from appropriate ICs and verify the truth table for each input/output combination.		
	9	**Construct and study the operations of the RS and JK Flip-Flops using IC's** ● Realize RS Flip-Flop using NAND gates and verify the truth table ● Realize JK Flip-Flop using NAND gates from appropriate ICs and verify the truth table		
	10	**Construction of the center tapped full wave rectifiers and regulated power supply.** ● Construct a center tapped full wave rectifier without filter and with a filter. ● Measure the AC and DC voltages using a multimeter and calculate the ripple factor without and with a filter.		

		• Observe the variation of the ripple factor with load resistance, when filter is used. • Construct 5V/12V regulated power supply using 78XX IC.		
	11	**Study the frequency response of common emitter(CE) transistor amplifier.** • Design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias. • Analyse the frequency response, draw the curve and find the bandwidth, without feedback.		
	12	**Construction of LC oscillator (Hartley or Colpitt's)** • Construct a LC oscillator (Hartley or Colpitt's) and measure the frequency using CRO/ExpEYES for different values of L and C. Compare with the theoretical values.		
	13	**Determination of Plank's constant using LEDs** • Observe the turn-on voltage, • V_0 of LEDs and calculate the value of h. Use at least 4 different colors of LED (with transparent casing) • Plot $\frac{1}{\lambda} - V_0$ graph using Python, fit a straight line to get the slope and estimate the value of h. • Calculate the %error. • Programmable voltage source of ExpEYES may be used to find the turn-on voltage.		
	14	**Analysis of Hydrogen spectra using the Tracker Video Analysis tool**. • Calibrate the video of the Hydrogen spectra in the Tracker tool using two laser wavelengths/lines of mercury spectra. • Plot the intensity profile, find the prominent wavelengths of the Balmer series and calculate the Rydberg's constant. • Estimate the %error. • Pre recorded video of the Hydrogen spectra can be used. • https://physlets.org/tracker/. • https://www.youtube.com/watch?v=UCCPkJpUQEw		

	15	**Black body spectrum of Sun -Estimation of surface temperature using the Tracker Video Analysis tool.** ● Calibrate the video of the solar spectra in the Tracker tool using two laser wavelengths/lines of mercury spectra. ● Plot wavelength vs intensity, get λ_{max} and using Wein's law calculate the surface temperature. ● Pre recorded video of the solar spectra can be used.		

Books and References:

1. Principles of electronic communication system, 4th Edition by Louis E. Frenzel (Book 1)
2. Electronic communication systems, 5th Edition by y George Kennedy, Brendan Davis, Srm Prasanna- Mc-Graw Hill(Book 2)
3. Electronic Communications System, 5th Edition by Wayne Tomasi, Pearson (Book 3)
4. Principles of Electronics, 11th edition by V.K. Mehta and Rohith Mehta, S Chand & Company (Book 4)

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	1	0	0	2	3	3	3	2	1	1	0
CO 2	3	2	1	0	0	2	3	3	3	2	1	1	0
CO 3	3	2	1	0	0	2	3	3	3	2	1	1	0
CO 4	3	2	1	0	0	2	3	3	3	2	1	1	0
CO 5	3	2	1	0	0	2	3	3	3	2	1	1	0
CO 6	3	2	2	0	0	3	3	3	3	2	1	1	0

Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Assignments
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Practical Skill Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6			✓	