AC – 28/03/2025
Item No. – 6.3 (N) (6ab) Sem. III & IV

As Per NEP 2020

University of Mumbai

Syllabus for Minor Vertical 2 (Scheme-I)		
Faculty of Science and Technology		
Board of Studies in Physics		
Second Year Programme in Minor (Physics)		
Semester	III & IV	
Title of Paper	Sem.	Total Credits 4
I) Digital Electronics	III	2
II) Applied Optics		2
Title of Paper		Credits
I) Applied Electronics	IV	2
II) Electrical Instruments		2
From the Academic Year		2025-26

Sem. - III

Syllabus
B.Sc. (Physics)
(Sem.- III)

Title of Paper: Digital Electronics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
4	**Credit**:	**2 credits** (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Know the concept of IC logic families **2)** Learn the basics of Number systems. **3)** Understand the basics of Boolean functions & logic Gates **4)** Learn the basics of combinational logic circuits.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course students will be able to: **1)** Understand the concept of digital logic system. **2)** Get knowledge of Number systems. **3)** Know the idea of Boolean functions & logic Gates **4)** Understand and explain the different flip-flops and timing circuit.	

9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Number System and Logic Gates (15 Lectures)	
	1. Number system and codes: Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421-2421), Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation. **2.** Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex NOR and their truth tables), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem.	
	Module 2: Unit-II: Combinational Logic Circuits (15 Lectures)	
	The Half adder, the full adder, subtractor circuit. Multiplexer demultiplexer, decoder. Flip flop and Timing circuit: set-reset laches, D-flipflop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T- flipflop.	
10	**Reference Books:** **1)** Digital Fundamentals by T. L. Floyd, Pearson International Publications, Ninth Edition, 2000 **2)** Electronics Principles by Malvino and Leach, Mc. Graw Hill, Third edition. 2000 **3)** Modern Digital Electronics by R P Jain, Tata McGraw-Hill Education, 2003. **4)** Fundamental of Digital Circuits by A. Anand kumar	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	
	Unit - I (15 Marks)	Q.1 A) Attempt any Two 10 Marks i) Theory ii) Theory iii) Theory iv) Theory

		B) Attempt any One i) Problem / Theory ii) Problem	05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two i) Theory ii) Theory iii) Theory iv) Theory B) Attempt any One i) Problem / Theory ii) Problem	10 Marks 05 Marks

Syllabus
B.Sc. (Physics)
(Sem.- III)

Title of Paper: Applied Optics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
4	**Credit**:	**2 credits** (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Understand the principles of thin and thick lenses, including the Lens Maker's Equation, Newton's lens equation, and magnification (both lateral and longitudinal). **2)** Analyze the behavior of lenses in co-axial systems, considering equivalent focal lengths and cardinal points. **3)** Explore the properties of thick lenses, including their cardinal points, with a focus on practical examples. **4)** Investigate aberrations such as spherical aberration and chromatic aberration, emphasizing conditions for achromatic aberration. **5)** Apply knowledge of optical systems to real-world scenarios, including oil immersion objectives in high-power microscopes, telescope objectives, and camera lenses.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Solve problems related to lens behaviour, cardinal points, and focal lengths. **2)** Identify and correct aberrations in optical systems. **3)** Analyze and interpret interference phenomena, including thin film interference, fringes in wedge-shaped films, and Newton's rings. **4)** Operate a Michelson's interferometer and apply it for wavelength measurement and other practical purposes. **5)** Demonstrate understanding of Fabry-Perot interferometers and etalons, particularly in qualitative contexts.	

9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Lens and Aberration **(15 Lectures)**	
	1. Thin & thick Lens, Lens Maker's Equation (Review), Newton's lens equation, magnification-lateral, Longitudinal and angular. Equivalent focal length of two thin lenses, cardinal points of co-axial system of two thin lenses, Thick lens, cardinal points of thick lens, Ramsden and Huygens eyepiece. **2. Aberration:** Spherical Aberration, Reduction of Spherical Aberration, Chromatic aberration and condition for achromatic aberration, oil immersion objective of high power microscope, achromatism of telescope objective and camera lens. (Emphasis must be placed on explaining examples from day-to-day life and solving more Problems)	
	Module 2: Unit-II: Interference **(15 Lectures)**	
	1. Interference, Interference in thin films, Fringes in Wedge shaped films, Newton's Rings (Reflective) **2. Michelson's Interferometer:** Principle & Working, Applications: Measurement of Wavelength, Determination of difference in the wavelength of two waves, Thickness of Thin transparent film, Determination of RI of gases, Standardization of Metre scale. Fabry Perot Interferometer and etalon (qualitative) (Emphasis must be placed on understanding applications based on interference and solving more Problems)	
10	**Reference Books:** **1)** N. Subramanyam , Brijlal, and M N Avadhanulu , A Textbook of Optics, 25th revised ed.(2012) S. Chand (Main Reference) **2)** Ashok Kumar, D R Gulati, H R Gulati, Fundamentals of Optics, 2018, R Chand & Co. (Further Reading) **3)** Devraj Singh, Fundamentals of Optics, 2nd edition (2015), PHI (Further Reading)	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play,	**Evaluation:** through Exam at the End of the Semester / Term.

	creative writing, assignment etc. (at least 3)		
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**		
	Unit - I (15 Marks)	Q.1 A) Attempt any Two v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any One iii) Problem / Theory iv) Problem	10 Marks 05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any One iii) Problem / Theory iv) Problem	10 Marks 05 Marks

Sem. - IV

Syllabus
B.Sc. (Physics)
(Sem.- IV)

Title of Paper: Applied Electronics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
4	**Credit**:	**2 credits** (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** To analyze and synthesize circuits and to become familiar with the propagation of signals through transmission lines. **2)** To illustrate the fundamentals of basic communication system. **3)** To analyze the circuits in time and frequency domain **4)** To study network functions, inter relationship among various circuit parameters. **5)** Investigate tuning circuit behavior, Q-value and bandwidth. **6)** Learn about direct and indirect coupled circuits and filters. **7)** Understand the importance of basic sensors and transducers used in day to day life.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Through test, laboratory exercises and home assignment, students will be able to apply their knowledge in solving simple circuits. **2)** Understand the basic components and types of communication systems. **3)** Students will be able to evaluate the time and frequency response which is useful in understanding behavior of electronic circuits and control system. **4)** Design and analyze resonance in series and parallel LCR circuits. **5)** Calculate the Q-value and bandwidth of tuning circuits. **6)** Analyze the use of a variety of transducers used in electronic industry.	
9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Electronic Communication Circuits (15 Lectures)	

	Tuning Circuits and Filters: Resonance in series and parallel LCR circuits – Operating characteristic of a tuning circuit – Q value – Bandwidth – Tuning circuit in radio receivers – Double tuned transformers – direct and indirect coupled circuits – coefficient of coupling – filters: low pass filter-high pass filter– band pass filter-band stop filter. **Modulation**: Basic concepts of wave propagation. Amplitude Modulation (AM), Frequency and Phase modulation (FM & PM)	
	Module 2: Unit-II: Sensors and Transducers **(15 Lectures)**	
	Basics of sensors and transducers: Active and passive transducers, characteristics and selection criteria of transducers, working principle of Eddy current sensors. Pizoelectric transducers, photoelectric and photo voltaic sensors, capacitive sensors. **Displacement and pressure**: Potentiometers, pressure gauges, Linear Variable Differential Transformers (LVDT) for measurement of pressure and displacement, strain gauges. **Temperature transducers**: Resistance Temperature Detectors (RTD), thermistors, and thermocouples, their ranges and applications.	
10	**Reference Books:** **1.** M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000 **2.** Electronic Instrumentation (2 Ed.) H.S. Kalsi, TMH (2006). **3.** K V V Murty and M S Kamth, "Basic Circuit Analysis", Jaico Publishing house, London **4.** W. Cooper and A. Helfric, "Electronic Instrumentation and Measurement Techniques", PHI, 4th edition, 2009	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.

	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	
	Unit - I (15 Marks)	Q.1 A) Attempt any Two 10 Marks ix) Theory x) Theory xi) Theory xii) Theory B) Attempt any One 05 Marks v) Problem / Theory vi) Problem
	Unit – II (15 Marks)	Q.2 A) Attempt any Two 10 Marks ix) Theory x) Theory xi) Theory xii) Theory B) Attempt any One 05 Marks v) Problem / Theory vi) Problem

Syllabus
B.Sc. (Physics)
(Sem.- IV)

Title of Paper: Electrical Instruments

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
4	**Credit**:	**2 credits** (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Gain knowledge of measuring instruments used in Physics laboratory and Elecrical/ Electronic Industry. **2)** Explore principle of Cathode Ray Oscilloscope and its applications. **3)** To understand basic principles underlying electrical instruments and application in measurement of electronics parameters. **4)** To understand basic functions and principle of working of sensors and components used in Electronic Measurement.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Explore the working of basic measuring instrument like Cathode Ray Oscilloscope (CRO) / DSO, including principles of beam deflection. **2)** Students will learn measurement of physical parameters using various transducers and working of sensors. **3)** They will become familiar with basics of instruments and details of operation of measuring instruments and their applications.	
9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Principles of Measurement (15 Lectures)	
	Introduction to basic instruments: Components of generalized measurement system, applications of instrument systems, static and dynamic characteristics of instruments, concepts of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration **Errors in measurement**: Errors in measurement, classification of errors, remedies to eliminate errors	

	Module 2: Unit-II: Measuring Instruments - Oscilloscopes (15 Lectures)	
	Cathode ray oscilloscope: Block diagram based Study of CRO, specifications, controls, sweep modes, role of delay line, single- and dual-beam dual-trace CROs, chop and alternate modes, Measurement using oscilloscope: measurement of voltage, frequency, rise time, fall time and phase difference. Lissajous figures in detection of frequency and phase. Digital storage oscilloscope (DSO): Block diagram based study of DSO, study of features like roll, refresh, storage mode and sampling rate; applications of DSO	
10	**Reference Books:** **1.** W. Cooper and A. Helfric, "Electronic Instrumentation and Measurement Techniques", PHI, 4th edition, 2009 **2.** H. S. Kalsi, "Electronics Instrumentation", Tata Mcgraw Hill, 2nd Edition, 2009 **3.** H. Oliver and J. M. Cage, "Electronic Measurement and Instrumentation", McGraw Hill, 3rd edition, 2008 **4.** C. S. Rangan, G.R. Sarma, and V.S.V. Mani, "Instrumentation Devices and Systems", Tata McGraw Hill, 9th edition, 2007 **5.** T. S. Rathore, "Digital Measurement Techniques", Narosa Publishing House, New Delhi, 2nd Edition, 2003	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
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	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	

	Unit - I (15 Marks)	Q.1 A) Attempt any Two xiii) Theory xiv) Theory xv) Theory xvi) Theory B) Attempt any One vii) Problem / Theory viii) Problem	10 Marks 05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two xiii) Theory xiv) Theory xv) Theory xvi) Theory B) Attempt any One vii) Problem / Theory viii) Problem	10 Marks 05 Marks

Sd/- **Sd/-** **Sd/-**

Sign of the BOS Chairman
Dr. T.N. Ghorude
Board of Studies in Physics

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of the
Offg. Dean
Prof. Shivram S. Garje
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