

University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग (ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई - ४०० ०३२
टेलिफोन नं - ०२२ - ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७

दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने शैक्षणिक वर्ष २०२५-२६ पासून पदवी व पदव्युत्तर अभ्यासक्रम विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई - ४०० ०३२
२७ मे, २०२५


(डॉ. प्रसाद कारंडे)
कुलसचिव

Copy forwarded for information and necessary action to :-	
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7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
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To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
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AC – 28/03/2025
Item No.– 6.17 (N)

As Per NEP 2020

University of Mumbai



Syllabus for Major Vertical – 1 & 4 (Scheme – III)

Name of the Programme – B.Sc. (Physics)		
Faulty of Science		
Board of Studies in Physics		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in Physics
Semester	III & IV	
From the Academic Year	2025-26	

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.Sc. (Physics)
2	Exit Degree	U.G. Diploma in Physics
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R. SU-520 C(III) R. SU-520 D(III)	Attached herewith
6	Semesters	Sem. III & IV
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-

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

Sd/-

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

Sd/-

Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

Under Graduate Diploma in Physics
Credit Structure (Sem. III & IV)

R. SU-520 C(III)										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	2+2+2	Mathematical Methods for Physics, Electrodynamics,	--	2+2	SEC:2	AEC:2	FP: 2 CC: 2		UG Diploma 88
	R. SU-520 D(III)									
	IV	2+2+2	Introduction to Quantum Mechanics and Modern Physics, Advanced Electronics-I	--	2+2	VSC:2 Computer Maintenance	VEC:2	CEP: 2 CC: 2		
	Cum Cr.	12		--	8	4	4	4+4		
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Community Engagement Project, CC – Co-Curricular, RP – Research Project]

Preamble

1) Introduction

The revised syllabus in Physics, as per credit based system for the Second Year B.Sc. course Will be implemented from the academic year 2025 – 2026. This program is designed to provide a basic understanding of Physics. In addition to imparting knowledge, our academic program of theory and practical courses seeks to spark interest in physics.

2) Aims and Objectives

The aims and objectives of the B.Sc (Physics) course are designed to provide students with foundational understanding of the principles and applications of Physics. The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics. By emphasizing intellectual, practical, and professional growth, these broader educational goals and objectives complement more general educational objectives. To enrich knowledge through problem-solving, hands-on activities, study visits, projects etc

3) Learning Outcomes

The Semester III and IV will initiate a process to continuous learning and self-improvement of students and acquiring the following skills:

1. Mathematical physics gives introduction of basic concept of ordinary differential differentiation its types, Partial Differential Equations and its applications in physics and solve the problem on it.
2. Electrodynamics explains the phenomena associated with charged particles in motion and changing electric and magnetic fields and basic theorems and apply it in numerous problems.
4. Understanding of Quantum mechanics gives mathematical skills required to develop theory of quantum mechanics, postulates of quantum mechanics and to learn to apply them to solve quantum mechanical problems.
5. The analog and digital electronics gives introduction of basic concept of Transistor, operational amplifier and its applications.

2. Any other point (if any)

In addition to imparting knowledge, our academic program of theory and practical courses seeks to spark interest in physics.

Sem. - III

Vertical – 1 Major

Syllabus

B.Sc. (Physics)

(Semester- III)

Name of the Course: S.Y.B.Sc. Physics (SEM-III)
Paper I –MJ: 3: Mathematical Methods for Physics (2 Credits)

Sr. No.	Heading	Particulars
1.	Description 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 :	Major/Minor/Open Elective /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3.	Type :	Theory / Practical
4.	Credits :	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5.	Hours	30 Hours
6	Marks Allotted:	50 Marks
7.	<p>Course Objectives (CO): After successful completion of this course students will be able to:</p> <p>CO 1. Apply the knowledge of differential equations and solve problems using them. CO 2. Learn the first order and second order homogeneous and non- homogeneous differential equations with variable coefficients and constant coefficients. CO 3. Describe variable separable method and exact differentials equation, Linear Differential equation and Second-order homogeneous differential equations with constant coefficients. CO 4. Solve important partial differential equations in physics, method of separation of variables. Partial differential equations and its type CO 5. Understand applications of Partial Differential Equations in physics.</p>	
8.	<p>Course Outcomes (OC): After successful completion of this course</p> <p>OC 1. Students will acquire fundamental knowledge of ordinary differential equations and its types OC2. Students understand first order linear and Second-order homogeneous differential equations with constant coefficients and Problems depicting physical situations like LC, RL and LCR circuits. OC 3. Students understand important Partial differential equations in and its type (Parabolic, Hyperbolic and Elliptical) OC 4. Students Comprehend important applications of Partial Differential Equations. OC 5. Students understand problem solving skills in all the topics covered.</p>	

9.	Unit I:Differential Equations (15 Lectures)
	Introduction, Ordinary differential equations: first order homogeneous and non-homogeneous differential equations with variable coefficients, Second-order non homogeneous equations with constant coefficients, Variable separable method, exact differentials equation, General first order Linear Differential equation and Second-order homogeneous differential equations with constant coefficients. Problems depicting physical situations like LC, RL and LCR circuits.
10.	Unit II: Partial Differential Equations: (15 Lectures)
	Introduction,some important partial differential equations in physics, method of separation of variables. Partial differential equations and its type (Parabolic, Hyperbolic and Elliptical), Applications of Partial Differential Equations: 1. Modeling of a vibrating stretched string. 2. The two-dimensional heat flow equation. 3. Solution of the wave equation and Helmholtz's equation.
11.	References: 1.Introduction to Partial Differential Equations – K Sankara Rao 2. Mathematical Physics, Sathya Prakash, Sultan Chand, 6 th edition (2014) Additional References: 3.Mathematical Physics, B.D. Gupta-Vikas Publishing House, 4 th Edition (2006) 4. Mathematical Methods in Physical Science – Mary and Boas. 5. Mathematical Physics, H.K. Dass, S. Chand & Co., Eighth edition (2018) 6. Mechanics and mathematical methods by R Murugesan, S Chand.

Name of the Course: S.Y.B.Sc. SEM-III
Paper II: MJ 4: Electrodynamics-I (2 Credits)

1.	<p>Course Objectives (CO): After successful completion of this course students will be able to:</p> <p>CO 1.ExplainCoulomb'slaw,Line, surface, volume integrals, Fundamental theorms of Gradientand able to solve problems using them.</p> <p>CO 2. Learn the Dirac Delta function,electric field, Divergence of E and Curl of E.</p> <p>CO 3. Understand potential, Poisson's equation and Laplace's equation</p> <p>CO 4. Describe Properties of 2D and 3D Laplace equation, First & Second Uniqueness theorem, BiotSavart law and its application.</p>
2.	<p>Course outcomes(OC):After successful completion of this course</p> <p>OC 1.students understand basic concept Fundamental theorems of Gradient and able to solve problems using them.</p> <p>OC 2. Students Comprehend the Dirac Delta function, electric field, Divergence of E and Curl of E and able to solve problems using them.</p> <p>OC 3. Understand potential, Poisson's equation and Laplace's equation</p> <p>OC 4. Students understand concept of Electrostatics and Magnetostatics and develops the problem solving skills</p> <p>OC5. Student develop quantitative problem-solving skills in all the topics covered</p>
3.	<p>Unit I: Electrodynamics and Vector calculus: (15 lectures)</p>
	<p>Coulomb's law, Line integrals (electric potential), surface integrals (Gauss Law), volume integrals (Electrostatics energy), Fundamental theorems of Gradient, Introduction to Dirac Delta function (1-D only), Electric Field due to point charge, Divergence of E and Curl of E.</p>
4.	<p>Unit II Electromagnetism (15 lectures)</p>
	<p>Comments on potential, Poisson's equation and Laplace's equation. Solution and properties of 1D Laplace equation with problem. Properties of 2D and 3D Laplace equation (without proof). First & Second Uniqueness theorem, Biot-Savart Law, magnetic field due to a straight conductor, magnetic field along the axis of a circular current-carrying coil,magnetic field due to solenoid.</p>
5.	<p>References:</p> <p>1. Introduction to Electrodynamics : David J. Griffiths (4th Ed) Prentice Hall of India.</p> <p>Additional References:</p> <p>2. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat. Narosa Publishing House.</p> <p>3. Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH).</p>

	4. Electricity and Magnetism: Navina Wadhvani (PHI – 2010).	
6.	Internal Continuous Assessment: 40% (20 marks) Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	Semester End Examination: 60% (30 marks) paper pattern attached
Format of Question Paper: 30 Marks		
Duration: ONE Hour		
Unit –I (15Marks)	Q:1 A) Attempt any Two (5 Marks each) i)Theory ii)Theory iii)Theory iv) Theory B) Attempt any One 05 Marks i)Theory/ Problem ii)Problem	10Marks
Unit -II (15Marks)	Q:2 A) Attempt any Two (5 Marks each) i)Theory ii)Theory iii)Theory iv)Theory B) Attempt any One 05 Marks i)Theory/Problem ii)Problem	10Marks

Semester III
PHYSICS PRACTICAL COURSE –USPHP3

Total Credit: 02 (60 Hours)

Passing standards for Practical:

Total Credit: 02 (60 Hours)

Total Marks: 50

- a) **40% Internal Continuous assessment: 20 Marks**
- b) **60% External Semester End Examination: 30 marks**

Note: Individual Passing in Internal and External Examination

Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
- While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation, and result.
- Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Understand & practice the skills while performing experiments.
 2. Understand the use of apparatus and their use without fear & hesitation.
 3. Correlate the physics theory concepts to practical application.
 4. Understand the concept of errors and their estimation.
- **Short Skill experiment (Minimum Four Experiment) will be conducted, for example**
 - a. To find least count of different types of optical instruments
 - b. To calculate and measure values of passive components

- c. To find percentage tolerance of different types of passive components
- d. To demonstrate an experiment and explain principles of Physics
- e. To prepare chart for and explain the devices /components used for experiments.
- f. Execute a short experiment which will showcase either innovation and / or different methods to the satisfaction of teacher in-charge of practical.
- g. Any other skill experiment related to syllabus

Note: Teacher should follow the above guidelines to conduct skill experiment

Internal Continuous practical Evaluation pattern for 20 Marks

Sr. No.	Activity	Total 20 Marks
1	One skill experiment	10 Marks
2	viva -voce	05 Marks
3	Overall performance	05 Marks

Semester end Examination (30 Marks)

- For practical examinations, the learner will be examined in one experiment.
- Experiment will be of two hours' duration.
- A Minimum **TEN** experiment must perform and reported in journal.
- Evaluation in viva voce will be based on regular experiments.
- A learner will be allowed to appear for the semester end practical examination only if

he/she submits a certified journal of Physics with a certificate that the learner has completed the practical course of Physics Semester III as per the minimum requirements.

Note: Minimum **TEN** experiments should be completed and reported in the journal. **Certified Journal is a must**, to be eligible to appear for the semester end practical examination.

- **Semester end Practical Examination Evaluation pattern (30 Marks)**
- **Duration of the practical examination: 2 Hours**

Sr. No.	Activity	Total 30 Marks
1	One experiment	20 Marks
2	Certified Journal	05 Marks
3	Viva-Voce	05 Marks

Scheme III SEMESTER III

List of Experiments:

1. To determine modulus of rigidity η using Flat spiral spring
 2. To determine wavelength of light using cylindrical obstacle
 3. Determination of Dispersive power of prism using spectrometer
 4. To determine Young's modulus Y using Flat spiral spring
 5. Determination of acceleration due to gravity g using Kater's pendulum
 6. Log Decrement using Simple pendulum
 7. Figure of merit of a mirror galvanometer
 8. Determination of R.I. of liquid by laser
 9. LCR series resonance
 10. LCR Parallel resonance
 11. Thevenin's Theorem: To verify the theorems for DC circuits
 12. Norton's Theorem: To verify the theorems for DC circuits
 13. Passive (RC) low pass filter
 14. Passive (RC) High pass Filter
 15. Passive (RC) Band pass
1. **Semester End Practical Examination: Scheme of Examination:**

There will be internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of this semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc. Physics as per the minimum requirement. The duration of the practical examination will be two hours. There will be one experiment through which the candidate will be examined in practical. The questions on slips for the same should be framed in such a way that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

References:

1. Advanced course in Practical Physics D. Chattopadhyaya, P. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B. Sc. PRACTICAL Physics – Harnam Singh S. Chand & Co. Ltd. 2001
3. B. Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand and Co. Ltd.

Additional References:

4. A testbook of advanced practical PHYSICS _SAMIR K Umar Ghosh, New Central Book Agency (3rd edition)
5. Practical Physics CL Squires (3rd Edition) Cambridge University
6. University Practical Physics – DC Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint.

SEC

Semester III

Physics (Skill Enhancement Course) - 2 credits, (60 Hours)

Course code: USPHSEC2

Title: - Battery and Inverter Testing and Maintenance

Battery and Inverter Testing and Maintenance Practical Course

This course is designed for learners to get exposure with various aspects of battery and inverter, their usage through practical and hands-on mode.

Passing standards for SEUSPHSEC2 Practical:

Total Credit: 02 (60 Hours)

Total Marks: 50

c) 40% Internal Continuous assessment: 20 Marks

d) 60% External Semester End Examination: 30 marks

Note: Individual Passing in Internal and External Examination

Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
- While evaluating practical, weightage should be given to circuit/block diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning Outcomes:

On successful completion of this course students will be able to:

1. understand of the various types of batteries, their construction, and materials used in

their design.

2. Equip students with the knowledge of testing methods to evaluate battery performance and lifespan.
3. Understand the fundamentals of inverters, including their design, working principles, and applications.
4. Design inverters for different applications with an understanding of power conversion principles and component selection
5. Understand & practice the skills while performing experiments.
6. Understand the use of apparatus and their use without fear & hesitation.
7. Correlate the physics theory concepts to practical application.
8. Troubleshoot common inverter and UPS faults using logical fault-finding methods and testing instruments.

Internal Continuous USPHSEC2practical Evaluation pattern for 20 Marks

Sr. No.	Activity	Total 20 Marks
1	Assignment or Test on practical skill experiment (Any one experiment from Group A or Group B)	10 Marks
2	viva -voce	05 Marks
3	Overall performance	05 Marks

- **Semester end Practical Examination Evaluation pattern for USPHSEC2 (30 Marks)**
- **Duration of the practical examination: 2 Hours**

Sr.No.	Activity	Total 30 Marks
1	One experiment from Group A or Group B	20 Marks
2	Certified Journal	05 Marks
3	Viva-Voce	05 Marks

Semester end Examination (30 Marks)

- For practical examinations, the learner will be examined in one experiment.
- Experiment will be of two hours duration.
- A Minimum **TEN** experiment (minimum **Five experiment** from Group A And Group B) must perform and reported in journal.
- Evaluation in viva voce will be based on regular experiments.
- A learner will be allowed to appear for the semester end practical examination

only if he/she submits a certified journal of Physics with a certificate that the

learner has completed the practical course of Physics Semester-III as per the minimum requirements.

1 Group A: Battery Testing and Maintenance

1. Study of specifications of Battery provided by the manufacturer (capacity, maximum charge voltage, maximum continuous current, discharge cut-off voltage, temperature range etc.)

2. Voltage, Capacity and Internal resistance Measurement of a Battery

Aim: To measure the voltage, capacity and internal resistance of a given battery using a Multimeter and electronic load.

Theory: The voltage of a battery indicates its electrical potential difference between the terminals. Capacity (measured in mAh or Ah) indicates how much charge a battery can store. Using a Multimeter, the open-circuit voltage (OCV) provides a quick health check of the battery. Using a load test, the internal resistance can be calculated using Ohm's law by measuring the voltage drop across a known load.

3. Verification of Ohm's Law Using a Battery and Resistors.

Aim: To verify Ohm's Law by measuring voltage and current through multiple resistors.

Theory: Ohm's Law states that $V = IR$, showing the relationship between voltage (V), current (I), and resistance (R). By connecting a battery to resistors and measuring voltage and current, Ohm's Law can be verified practically.

4. Series and Parallel Connection of Batteries & their effect on Voltage and Current

Aim: To study how connecting batteries in series and parallel affects voltage and current.

Theory: Connecting batteries in series increases voltage while keeping the current the same, whereas parallel connection increases current capacity while maintaining the same voltage. (For example, for parallel connection due to the difference in capacity between a battery, it may affect their discharge rates and lifespan. We recommend connecting batteries of the same type with matching voltage, capacity, and battery management systems.) Understanding these principles for designing battery packs to provide unified power source.

5. Measurement of Battery Terminal Voltage Under Load, No-Load Conditions and Testing Battery Performance under Load

Aim: Measurement of Battery Terminal Voltage Under Load, No-Load Conditions and Testing Battery Performance under Load

Theory: Comparing terminal voltage under load and no-load conditions highlights the effect of internal resistance (current should be beyond I_L max.). A significant voltage drop under load indicates higher internal resistance or a weak battery.

Under load conditions, a battery's terminal voltage typically drops. This practical evaluates the battery's ability to maintain voltage and supply current, demonstrating performance under real-world conditions.

6. Determining the Charging and Discharging Time of a Battery.

Aim: To measure how long a battery takes to charge and discharge under a specific load.

Theory: Charging and discharging times depend on the battery capacity and the applied current. Constant current and constant voltage (CCCV) methods influence how fast a battery charges, while discharge time reflects energy delivery efficiency.

7. Battery Self-Discharge Experiment.

Aim: To observe and measure the self-discharge of a battery by recording voltage at intervals 24 Hr. (Time interval depends on observer for e.g. 4 Hr, 8 Hr, 12 Hr, etc.)

Theory: Self-discharge (concept of leakage resistance) is the natural loss of charge when a battery is not in use. Factors like temperature, age, and battery chemistry affect this rate. Observing voltage drop over time without load gives insights into self-discharge characteristics.

8. Battery Inspection and Maintenance (Visual Inspection & Heavy Load Test)

Aim: To inspect a battery for physical damage and test its capacity under heavy load

Theory: Regular inspection of batteries can prevent failures. Visual inspection helps identify physical damage, leaks, or corrosion. Heavy load testing assesses the battery's capacity to deliver power under stress, indicating its health.

9. Effect of Temperature on Battery Voltage

Aim: To observe and measure how the voltage of a battery changes with temperature variation.

Theory: Temperature impacts battery performance. Higher temperatures increase chemical activity, raising voltage temporarily but may lead to degradation. Cold temperatures reduce voltage and capacity, demonstrating the importance of temperature management.

2. **Group B : Inverter Testing and Maintenance**

1. **Study of specifications of Inverter provided by the manufacturer** (DC Input voltage range, AC output voltage, continuous output power at different temperature, peak power etc.)

2. **Drawing the Block Diagram of an Inverter and Explaining Each Block**

Aim: To draw the block diagram of an inverter and describe the function of each block.

Theory: An inverter is an electronic device that converts DC (Direct Current) to AC (Alternating Current). The basic block diagram of an inverter includes:

DC Input Source, Oscillator Circuit, Driver Circuit, Power Stage (Switching Circuit), Output Filter.

3. **Demonstrate and explain the working of Inverter and its different parts and its functions (PWM card, charging card, driver card etc.)**

4. **Generating an Oscillator Signal Using a 555 Timer IC(Astable mode)**

Aim: To study a simple oscillator circuit using the 555 Timer IC and observe the square wave output on the oscilloscope.

5. **Making a Simple DC-AC Inverter Circuit**

Aim: To build a simple inverter circuit using a 555 Timer IC to convert DC to AC and observe the output.

6. **Simulating an Inverter Output Using a Square Wave Generator**

Aim: To simulate an inverter by connecting a square wave generator to a load and observe the AC-like output on the oscilloscope. (This practical demonstrates how square wave signals can simulate AC output. By connecting the output of a square wave generator to a load, students can visualize the AC characteristics on an oscilloscope, showing the basic principle of how inverters create AC from DC.)

7. **Analysis of Inverter Output Waveform Using an Oscilloscope**

Aim: To analyze the output waveform of an inverter (square/sine wave) using an oscilloscope. (When testing inverters, it is used to verify whether the output is a pure sine wave, modified sine wave, or square wave. Waveform shape impacts the efficiency and compatibility of the inverter with different types of loads.)

8. **Testing Transformer Primary & Secondary Voltages and Build a Simple Bridge Rectifier and Testing DC Output**

Aim: To measure Transformer Primary & Secondary Voltages and construct a bridge rectifier and measure the rectified DC voltage.

3

References:

1. Devid Linden – Handbook of Batteries Third ed. McGraw Hill (DLB)
2. Muhammad H. Rashid-Power Electronics Circuits, Devices and Applications 4th edition Pearson.

Additional Reference:

3. Xiaojun Tan-Battery Management System and its Application, Wiley (XTB)
4. Yan Bao-A Bi-Level Optimization Approach to Charging Load Regulation of Electric Vehicle Fast Charging Stations Based on a Battery Energy Storage System; MDPI (YBB)
5. Ersan Kabalci-Multilevel Inverters: Introduction and Emergent Topologies; Academic Press (EKM)
6. Thomas F. Schuber-Fundamentals of Electronics: Book 4 Oscillators and Advanced; Springer (TFE)
7. Tetsuo Suzuki-Basic Knowledge Regarding Uninterruptible Power Supply (UPS) (TSB)
8. K.C. Selvam- Design of Function Circuits with 555 Timer Integrated Circuit 1st Edition 2023 CRC Press

Sem. – IV

Syllabus

B.Sc. (Physics)

(Semester- IV)

Name of the Course: S.Y.B.Sc. SEM- IV - Paper I
MJ-5:Introduction to Quantum Mechanics and Modern Physics (2 Credits)

Sr. No.	Heading	Particulars
1.	Description 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 :	Major/Minor/Open Elective /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3.	Type :	Theory / Practical
4.	Credits :	4 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5.	Hours	30 Hours
6	Marks Allotted:	50 Marks
	<p>Course Objectives (CO):After successful completion of this course students will be able to:</p> <p>CO1.Understand Blackbody Radiation, Planck’s Quantum Theory, Einstein’s Photoelectric Effect.</p> <p>CO 2. Comprehend Phase and Group Velocities, Diffraction of Particles,Wave Packet and able to solve problems on it.</p> <p>CO 3.Understand Schodinger’s Wave Equation, Heisenberg Uncertainty and problems.</p> <p>CO4. Explain Schrodinger’s 1D time dependent wave and time independent wave equation, Physical interpretation of wave function.</p> <p>CO5.Describe Operators in Quantum Mechanics, Eigen Function, Eigen Value, Expectation Values and able to solve problems on it.</p>	
	<p>Course Outcomes (OC):After successful completion of this course</p> <p>OC 1. Students understand Blackbody Radiation, Planck’s Quantum Theory. Einstein’s Photoelectric Effect and able to solve problems on it.</p> <p>OC2. Students will develop the knowledge of Einstein’s Photoelectric Effect, De-Broglie Hypothesis and able to solve problems on it.</p> <p>OC3. Students Comprehend the Schodinger’s Wave Equation, Heisenberg Uncertainty Principle.</p> <p>OC4. Understand Schrodinger’s 1D time dependent wave and time independent wave equation, Physical interpretation of wave function.</p> <p>OC5. Comprehend Operators in Quantum Mechanics, Eigen Function, Eigen Value, Expectation Values and able to solve problems on it.</p>	
1	Unit I: Modern Physics	(15 Lectures)
	Blackbody Radiation, Failure of Classical Physics to Explain Energy Distribution in the spectrum of a Black Body, Planck’s Quantum Theory, Einstein’s Explanation of	

	Photoelectric Effect, Wave- particle duality, De-Broglie Hypothesis for Matter Waves, Concept of Phase and Group Velocities, Diffraction of Particles, Interference of Electrons, Wave Packet, Problems.
2	Unit II: Quantum Mechanics (15 Lectures)
	Schrodinger's Wave Equation, Heisenberg Uncertainty Principle, Elementary proof of Heisenberg Uncertainty Relation, Elementary Proof of Uncertainty Relation between Energy and Time, Schrodinger's 1D time dependent wave equation, Schrodinger's 1D time independent wave equation, Physical interpretation of wave function, Operators in Quantum Mechanics, Eigen Function, Eigen Value, Expectation Values, Postulates of Quantum Mechanics, particle in box, Problems.
	<p>References:</p> <ol style="list-style-type: none"> 1. Elements of Quantum Mechanics, Kamal Singh, S.P. Singh, S.Chand Publishing, 2005. 2. Concepts of Modern Physics – A. Beiser (6th Ed.) Tata McGraw Hill. 3. Quantum Mechanics – S P Singh, M K Bagade, Kamal Singh, - S. Chand: 2004 Ed. <p>Additional References:</p> <ol style="list-style-type: none"> 4. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley. 5. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall. <p>Additional References:</p> <ol style="list-style-type: none"> 6. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan. 7. Quantum Mechanics. - By L. I. Schiff. 8. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub.

Name of the Course: S.Y.B.Sc. SEM-IV - Paper II (2 credits)

MJ 6: Advanced Electronics-I

1.	Course Objectives (CO): After successful completion of this course students will be able to: CO 1. Explain basics of transistor, its parameters, different configurations, biasing and its different methods of biasing. CO2. Understand basics of OPAMP, its different parameters, concept of feedback and applications. CO3. Understand basics of counters and registers its different types and registers
2	Course Outcome OC: After successful completion of this course: OC 1. Students gain the basic knowledge of digital electronics and its applications. OC2. Students Comprehend knowledge about amplification, Transistor Biasing its different methods and its parameters. OC3.Students Understand basics of OPAMP, its parameters, feedback concept and its applications. OC4. Students will acquire a fundamental understanding of Flip-Flops, counters and registers with its application.
1.	Unit I: Analog Electronics (15 Lectures)
	1.Transistor Biasing: (Review of transistor terminals, transistor action, the symbol of transistor, transistor as an amplifier, CB, CE, CC connections: only circuit diagrams and respective current amplification factor) Faithful amplification, Inherent Variations of Transistor Parameters, Essentials of a Transistor Biasing Circuit, Stability Factor, Base Resistor Method, Emitter Bias Circuit, Voltage Divider Bias Method. 2.Operational Amplifiers: Introduction, Block diagram, Schematic symbol of OPAMP, ideal characteristics of OP AMP, Frequency Response of an OPAMP, Bandwidth of an OPAMP, slew rate, Virtual ground concept, Voltage gain, OPAMP with Negative feedback, Inverting Amplifier, Input and output impedance of inverting amplifier, Non-Inverting Amplifier, Voltage Follower, Summing Amplifier.
2	Unit-II: Digital Electronics: (15 Lectures)
	1.Flip Flops: RS Flip-Flops (only NOR gate latch, NAND gate latch), Gated Flip-Flops,Edge-Triggered RS Flip-Flop, Edge-Triggered D Flip-Flop, Edge-Triggered J-K Flip-Flop, JK Master-slave Flip-Flops.

Unit -II

(15Marks)

Q:1 A) Attempt any **Two** (5 Marks each)

10Marks

i)Theory

ii)Theory

iii)Theory

iv) Theory

B) Attempt any **One**

05 Marks

i)Theory/ Problem

ii) Problem

Semester IV

PHYSICS PRACTICAL COURSE –USPHP4 Credit: 02 (60 Hours)

Passing standards for practical:

Total Credit: 02 (60 Hours)

Total Marks: 50

40% Internal Continuous assessment: 20 Marks

60% External Semester End Examination: 30 marks

Note: Individual Passing in Internal and External Examination

Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
- While evaluating practical, weightage should be given to circuit/ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.

Internal Continuous assessment (20 Marks)

Short Skill experiment (Minimum Four Experiment) will be conducted, for example

- a. To find least count of different types of optical instruments
- b. To calculate and measure values of passive components

- c. To find percentage tolerance of different types of passive components
- d. To demonstrate an experiment and explain principles of Physics
- e. To prepare chart for and explain the devices /components used for experiments.
- f. Execute a short experiment which will showcase either innovation and / or different methods to the satisfaction of teacher in-charge of practical.
- g. Any other skill experiment related to syllabus

Note: Teacher should follow the above guidelines to conduct skill experiment

Internal Continuous practical assessment pattern (20 Marks)

Sr.No.	Activity	Total 20 Marks
1	One skill experiment	10 Marks
2	viva -voce	05 Marks
3	Overall performance	05 Marks

- **Semester end practical Examination (30 Marks)**

- For practical examinations, the learner will be examined in one experiment.
- Experiment will be of two hours' duration.
- A Minimum **TEN** experiments must be perform and reported in journal.
- Evaluation in viva voce will be based on regular experiments.
- A learner will be allowed to appear for the semester end practical examination only if he/she submits a certified journal of Physics with a certificate that the learner has completed the practical course of Physics Semester IV as per the minimum requirements.

- **Semester end Practical Examination Evaluation pattern (30 Marks)**

- **Duration of the practical examination: 2 Hours**

Sr.No.	Activity	Total 30 Marks
1	One experiment	20 Marks
2	Certified Journal	05 Marks
3	Viva-Voce	05 Marks

List of Experiments

1. Brewster's law: determination of μ
 2. G By shunting using Moving Coil Galvanometer
 3. Determination of Absolute capacitance using BG
 4. Determination of angle of diffraction using grating (1storder only)
 5. To determine wavelength of monochromatic light by using biprism.
 6. Optical lever: determination of μ
 7. I-V Characteristics of Solar cell with different intensity of light
 8. Verification of Stefans law (Electrical Method)
 9. J-K flip flop: Design and verify truth table of J-K flip flop (Using IC 7476 or IC 7473)
 10. OPAMP: Inverting amplifier with different gains
 11. OPAMP Non-inverting amplifier with different gains & Voltage Follower
 12. OPAMP as Integrator
 13. OPAMP as Differentiator
 14. MOD 5 & MOD 10 counter using IC7490 (BB)
 15. Shift registers (SISO and SIPO)
- ❖ Note: BB indicates that practical should be performed using breadboard(BB)

Semester End Practical Examination: Scheme of Examination:

There will be internal assessment for practical. A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of that semester of S.Y.B.Sc.Physics as per the minimum requirement. The duration of the practical examination will be two hours. There will be one experiment through which the candidate will be examined in practical. The questions on slips for the same should be framed in such away that candidate will be able to complete the task and should be evaluated for its skill and understanding of physics.

References:

1. Advanced course in Practical Physics D. Chattopadhyaya, P. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc. PRACTICAL Physics – Harnam Singh S. Chand & Co. Ltd. 2001
3. B.Sc. Practical Physics – C. L. Arora (1st Edition) - 2001 S. Chand and Co. Ltd.

Additional References:

4. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
5. Practical Physics C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D. C. Tayal. Himalaya Publication
7. Advance Practical Physics – Worsnop & Flint.

VSC

SEMESTER-IV
Physics (Vocational Skill Course) - 2 credits (60 Hours)

Physics (Vocational Skill Course)
Course code: USPHVSC2
Title: - Computer Maintenance

Practical Course

This course is designed for learners to get exposure with various aspects of Computer and its hardware, their usage through practical and hands-on mode.

Passing standards for practical:

Total Credit: 02 (60 Hours)

Total Marks: 50

- **40% Internal Continuous assessment: 20 Marks**
- **60% External Semester End Examination: 30 marks**

Note: Individual Passing In Internal and External Examination

Instructions:

- All the measurements and readings should be written with proper units in SI system only.
- After completing all the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination.
- While evaluating practical, weightage should be given to circuit/block diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result.
- Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result

Learning Outcomes:

On successful completion of this course students will be able to:

1. Understand of the different parts of the computer and its application.
2. Equip students with the knowledge of different processors, sockets, and ports, Memory (RAM & ROM).
3. Understand the fundamentals of HDD, SSD and Partitioning and Formatting
4. Understand Cooling solutions, different Input & Output Devices, printers.

5. Understand Networking Hardware Modems, Configuring Routers, switches, crimping LAN, Drive/file sharing and printer sharing.
6. Understand Installation of Virtual Machine and Basics commands of linux.
7. Troubleshoot the hardware of computers and diagnostics faults in the computer.

Internal ContinuousUSPHVSC2 practical Evaluation pattern for 20 Marks

Sr. No.	Activity	Total 20 Marks
1	Assignment or Test on practical skill experiment (Any one experiment)	10 Marks
2	viva -voce	05 Marks
3	Overall performance	05 Marks

- Semester end Practical Examination Evaluation pattern for USPHVSC2 (30 Marks)
- Duration of the practical examination: 2 Hours

Sr.No.	Activity	Total 30 Marks
1	One experiment	20 Marks
2	Certified Journal	05 Marks
3	Viva-Voce	05 Marks

Semester end Examination (30 Marks)

- For practical examinations, the learner will be examined in one experiment.
- Experiment will be of two hours' duration.
- A Minimum TEN experiment must perform and reported in journal.
- Evaluation in viva voce will be based on regular experiments.
- A learner will be allowed to appear for the semester end practical examination only if he/she submits a certified journal of Physics with a certificate that the learner has completed the practical course of Physics Semester IV as per the minimum requirements.

LIST OF EXPERIMENTS:

1. Demonstration of Computer (open computer), computer hardware, Overview of Computer components.
2. Demonstration of Internal Components of a Computer, Central Processing Unit (CPU) Functions, types, and performance factors (comparison of different processors), Motherboard
3. Explain and demonstrate sockets, and ports, Memory (RAM & ROM), Types, speeds, and capacities
4. Explain and demonstrate Storage Devices & Technologies, Hard Disk Drives (HDD) & Solid-State Drives (SSD), Partitioning and Formatting
5. Explain and Demonstrate Cooling solutions: Air cooling vs. Liquid cooling Heatsinks, Thermal paste, and fan management
6. Input & Output Devices, Keyboards, mice, scanners, webcams, Monitors, projectors, and display technologies (connections and working)
7. Printers (Inkjet, Laser, 3D printing), Audio devices and peripherals
8. Networking Hardware Modems, Network Interface Cards (NIC) and Ethernet cables, Wireless adapters and Bluetooth devices
9. Configuring Routers
10. Configuring Switches (Manageable and Unmanageable)
11. Colour code for crimping LAN (Cat 5/6/7) cable, Crimping LAN Cable
12. Implementation of Drive/file sharing and printer sharing.
13. Installation of Virtual Machine (e. VM Workstation, Oracle Virtual Box)
14. Installation of Operating System (RHEL/Windows) on Virtual Machine
15. Basics commands of linux (ls, cat, touch, chmod, ifconfig etc.)

References:

1. PC Organization by S. Chowdhury, Dhanpat Rai & Sons, Delhi
2. IBM PC Colons by Govinda Rajalu, Tata McGraw Hill Education Pvt Ltd, New Delhi
3. Text Book by Mark Minasi
4. Red Hat Enterprise Linux by Terry Colling

Additional References:

5. Computers by P. Norton
6. Troubleshooting and maintenance of Computers by S.P.S. Saini Vayu Education of India, New Delhi
7. Build a Computer from Scratch Author/s: Jeff Heaton, Publisher: Heaton Research, Inc., 2006

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-

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

Sd/-

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

Sd/-

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Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**