Department of Physics
Date: 05/04/2023

To,
The Principal,
Tuljaram Chaturchand College of
Arts, Science & Commerce, Baramati

With ref notice no 456 dated 18/03/2023, we have arranged Physics BoS meeting on Saturday 8th April 2023 at 12.00 pm in the department of Physics in off-line as well as online mode.

This is for your kind information.

Head,
Department of Physics

Anekant Education Society's

Tuljaram Chaturchand College

of Arts, Science and Commerce, Baramati

(Autonomous Status)

(Affiliated to Savitribai Phule Pune University, Pune)

BOS Meeting Notice

The meeting of all the members of **Board of Studies in Physics** is arranged on **Saturday, 08/04/2023 at 12.00 p.m.** in the Department of Physics offline as well with online-mode. All the members are requested to attend and actively participate in the meeting.

AGENDA

1. Reading and confirmation of minutes of previous BOS meeting
2. To discuss and finalize syllabus for S.Y.B. Sc First semester
3. To discuss and finalise the syllabus for M. Sc. II first semester
4. Any other matter with the permission of the chairman.

Chairman
Board of Studies in Physics

Principal

Dr. AS Jagtap
13/4/

Anekant Education Society's

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MINUTES OF BOS MEETING

Meeting of Board of Studies in Physics was held on Saturday, 08/04/2023 at 12.00 p.m. in the Department of Physics offline as well with online-mode**. Chairman of BOS in Physics Prof. Dr. P.C. Pingale welcomed all the members present for the meeting. The meeting proceeded with the issues mentioned in the agenda.**

Following issues were discussed in the meeting and decisions were taken after the detailed discussion.

1. **To read and confirm the minutes of previous meeting.**
   The minutes of previous meeting were read and were unanimously confirmed by all the members.
2. **To design syllabus for S.Y.B.Sc. First semester class.**
   The syllabus of S.Y.B.Sc. First semester class designed by BOS members was discussed in meeting and finalized.
3. **To discuss and finalize the syllabus for M. Sc. II First semester**
   The members of BOS present for the meeting discussed and finalized the syllabus for M. Sc. II First semester
   Prof. Dr. K.R. Priolkar suggested reference book "Cryogenics And Measurement Of Properties Of Solids At Low Temperatures: S. Kasthurirengan R. Srinivasan, A.K. Raychaudhuri; Allied Publishers, 05-Apr-2008" for course Experimental Techniques in Physics
4. **Any other matter with the permission of the chairman.**
   All the subjects on the agenda were discussed in the meeting, so no issue was raised by any of BOS members.
5. **Students feedback on Syllabus were collected and appropriate suggestions were incorporated in the syllabus.**

Meeting was concluded with the vote of thanks by Dr. R.D. Mane.

Chairman
Board of Studies in Physics

Noted:

Coordinator
Internal Quality Assurance Cell
Tuljaram Chaturchand College of
Arts,Science and Commerce,
Baramati (Pune)-413102

IQAC Co-ordinator

Principal

Department of Physics

List of Physics BoS Members 2022-2025

Third Meeting 8th April 2023 at 12.00 pm

Sr. No.	Name	Designation	Signature
1	Prof. (Dr.) P. C. Pingale	Chainman BoS	
2	Prof. (Dr.) S. S. Veer	Member, Expert from SPPU, Pune	online.
3	Prof. (Dr.) K. Y. Rajpure	Member, Expert from Shivaji University, Kolhapur	—
4	Prof. (Dr.) K.R. Priolkar	Member, Expert from Goa University	
5	Mr. Subhash Zambare	Representative From Industry, Gaser Metacoat, Pune	online.
6	Mr. Swapnil Nardekar	Alumni and Research Scholar Jeju National University, South Korea	online.
7	Prof. (Dr.) A. E. Kalange	Member	
8	Dr. R. D. Mane	Member	
9	Dr. R. T. Sapkal	Member	
10	Dr. S. B. Kulkarni	Member	
11	Prof. (Dr.) S.H. Pawar	Member	—
12	Mr. S. B. Kakade	Member	
13	Dr. V. S. Mohite	Member	
14	Dr. S. J. Rajoba	Member	
15	Ms S E Bhosale	Member	
16	Dr. G. S. Lonkar	Member	
17	Mr.Mhaske .S.S	Member	
18	Mr.Malve .S.S	MSc-II	
19	Dhanashree Hole	TYBSc	
20	Adidtya Sorate	TYBSc	
21	Asmita Ghadge	MSc-II	

Pingale
HoD Physics
8.4.23

Anekant Education Society's

Tuljaram Chaturchand College

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Board of Studies in Physics

Names of BOS

1. Prof. Dr. Pandurang Pingale – Chairman
2. Prof. Dr. Ashok Kalange – Member
3. Dr. Ravindra Mane – Member
4. Dr. Ramchandra Sapkal – Member
5. Dr. Sachin Kulkarni – Member
6. Prof. Dr. Shivaji Pawar- Member
7. Mr. Sandip Kakade – Member
8. Dr. Vijay Mohite – Member
9. Dr. Swapnil Rajoba – Member
10. Ms. Shubhangi Bhosale - Member
11. Prof. Dr. Shivaji Veer- Member (Expert from SPPU, Pune)
12. Prof. Dr. Keshav Rajpure – Member (Expert from other university)
13. Prof. Dr. Priolkar – Member (Expert from other university)
14. Mr. Subhash Zambare - Member (Representative from Industry)
15. Mr. Swapnil Nardekar – Member (Alumni and Research Scholar)

Anekant Education Society's

TULJARAM CHATURCHAND COLLEGE OF ARTS, SCIENCE AND COMMERCE, BARAMATI

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Faculty of Science

Department of Physics

Syllabus Submitted to Academic Council

For

B.Sc. in Physics

From Academic Year 2022-25

INDEX

Preamble:

Physics is concerned with the study of the universe from the smallest to the largest scale: it is about unraveling its complexities to discover the way it is and how it works. Discoveries in physics have formed the foundation of countless technological advances and play an important role in many scientific areas. Many techniques used in medical imaging, nanotechnology, and quantum computing are derived from physics instrumentation. Even the World Wide Web was a spin-off from the information processing and communications requirements of high-energy particle physics. The contributions of physics to solving global problems such as energy production, environmental protection, global warming, and public health are essential and have an enormous impact on our society.

The systematic and planned curricula from the first year to the third year shall motivate and encourage the students for pursuing higher studies in Physics and for becoming an entrepreneur.

Objectives:

- To provide in-depth knowledge of scientific and technological aspects of Physics
- To familiarize with current and recent scientific and technological developments
- To enrich knowledge through problem-solving, hands-on activities, study visits, projects etc.
- To train students in skills related to research, education, industry, and market.
- To create a foundation for research and development in Physics
- To develop analytical abilities toward real-world problems
- To help students build up a progressive and successful career in Physics.

Eligibility:

1. First Year B.Sc.: Higher Secondary School Certificate (10+2) Science stream or its equivalent Examination as per the University of Pune eligibility norms.
2. Second Year B.Sc.: Keeping terms of First Year of B.Sc. with Physics as one of the subjects. Other students if they fulfil the conditions approved by the equivalence Committee of Faculty of Science of the University of Pune are also eligible.
3. Third Year B.Sc.: Student shall pass all First Year B.Sc. courses and satisfactorily keeping terms of Second Year of B. Sc. with Physics as one of the subjects.

Admissions will be given as per the selection procedure/policies adopted by the Tuljaram Chaturchand College, in accordance with conditions laid down by the Academic Council of

Anekant Education Society's, Tuljaram Chaturchand College, Baramati, Reservation and relaxation will be as per the Government rules for minority institution.

Proposed Structure of B.Sc. degree in physics and syllabus for Second year (Sem-III) degree in Physics as follows:

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F.Y., S.Y., T.Y.B. Sc. [Physics] Structure

2022-2025

Class	Semester	Paper-I	Paper-II	Paper-III
F.Y.B.Sc.	I	Mechanics & Properties of Matter	Electromagnetics	Practical-I
	II	Heat and Thermodynamics	Physics Principles and Applications	Practical-II
S.Y.B.Sc.	III	Mathematical Methods of Physics-I	Electronics-I/ Instrumentation	Practical-I
	IV	Oscillations, waves, and Sound	Optics	Practical-II

T.Y.B.Sc.		**Sem-I**	**Sem-II**
	1	Mathematical Methods of Physics-II	Electrodynamics
	2	Solid State Physics	Quantum Mechanics
	3	Classical Mechanics	Thermodynamics and Statistical Physics
	4	Atomic and Molecular Physics	Nuclear Physics
	5	Computational Physics with Python	Electronics II/ Advanced Electronics
	6	Elective-I (Select anyone) i) Elements of Material Science ii) Renewable Energy Sources iii) Physics and Technology of sensors. iv) Biophysics	Elective-II (Select anyone) i) Physics of Nanomaterials ii) Astronomy and Astrophysics iii) Medical Electronics iv) Microcontroller
	7	Practical -I	Practical –IV
	8	Practical -II	Practical -V
	9	Practical -III	Project

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Course Structure for S.Y.B.Sc. Physics 2022-2025

Semester	Paper Code	Title of Paper	No. of Credits
I	USPH231	Mathematical Methods of Physics-I	3
	USPH232	Electronics/Instrumentation	3
	USPH233	Practical-I	3
II	USPH241	Oscillations, waves, and Sound	3
	USPH242	Optics	3
	USPH243	Practical-II	3

SYLLABUS (CBCS) FOR S.Y.B.Sc. PHYSICS (W.E.F. June 2023)

Academic Year 2023-2024

S.Y.B.Sc. PHYSICS (Semester- III)

USPH 231: Mathematical Methods of Physics-I

Credit: 3 **No. of lectures: 48**

Learning Objectives:

- To impart knowledge about various mathematical tools employed to study physics problems.
- To introduce students to the methods of mathematical physics.
- To develop the required mathematical skills to solve problems in quantum mechanics, electrodynamics, and other fields of theoretical physics.

Learning Outcomes:

After the completion of this course, students will be able to:

- Understand the complex algebra useful in Physics courses.
- Understand the concept of Curl and Divergence.
- Understand the concept of partial differentiation.
- Understand the role of partial differential equations in Physics.
- Understand vector algebra useful in Mathematics and Physics
- Understand the singular points of the differential equation.

UNIT 1: Complex Numbers (12)

1.1 Introduction to complex numbers.

1.2 Rectangular, polar, and exponential forms of complex numbers.

1.3 Argand diagram, Algebra of complex numbers using Argand diagram.

1.4 De-Moivre's Theorem (statement only)

1.5 Powers, roots and log of complex numbers.

1.6 Trigonometric, hyperbolic, and exponential functions.

1.7 Applications of complex numbers to determine velocity and acceleration in curved motion.

1.8 Problems.

UNIT 2: Vector Algebra (04)

2.1 Introduction to scalars, vectors, dot product and cross product.

2.2 Scalar triple product and its geometrical interpretation.

2.3 Vector triple product and its proof.

2.4 Problems.

UNIT 3: Vector Analysis **(16)**

3.1 Scalar and vector fields.

3.2 Differentiation of vectors with respect to scalar.

3.3 Vector differential operator and Laplacian operator.

3.4 Gradient of scalar field and its physical significance.

3.5 Divergence of scalar field and its physical significance.

3.6 Curl of vector field.

3.7 Vector integrals: Line, surface and volume integral with their examples.

3.8 Statements of Gauss-Divergence theorem and Stoke's theorem.

3.9 Different vector identities.

3.10 Problems.

UNIT 4: Partial Differentiation and Differential Equation **(16)**

4.1 Definition of partial differentiation.

4.2 Successive differentiation.

4.3 Total differentiation.

4.4 Exact differential.

4.5 Chain rule.

4.6 Theorems of differentiation.

4.7 Change of variables from Cartesian to polar co-ordinates.

4.8 Implicit and explicit functions.

4.9 Conditions for maxima and minima (without proof).

4.10 Degree, order, linearity and homogeneity of differential equation.

4.11 Concept of Singular points. Example of singular points ($x = 0$, $x = x_0$ and $x = \infty$) of differential equation.

4.12 Problems.

Reference Books:

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir

2. Mathematical Physics by B. D. Gupta

3. Mathematical Physics by Rajput and Gupta

4. Mathematical Methods in Physical Science by Mary and Boas

5. Vector analysis by Spiegel and Murrey

6. Mathematical Methods for Physicists by Arfke and Weber, 5th Edition, Academic Press.

7. Engineering Mathematics by H.K.Dass, S.Chand publication.

S.Y.B.Sc. PHYSICS (Semester- III)

USPH 232 (A): Electronics

Credit: 3 **No. of lectures: 48**

Learning Objectives:

- To impart knowledge about various laws of electrical circuits employed to study physics.
- To introduce students to properties and working of different components
- To develop knowledge of designing of logical circuits

Learning outcomes:

On successful completion of this course, the students will be able to

1. Apply laws of electrical circuits to different circuits.
2. Understand the properties and working of transistors.
3. Understand the functions of operational amplifiers.
4. Design circuits using transistors and operational amplifiers.
5. Understand Boolean algebra and logic circuits.

UNIT-1: NETWORK THEOREMS **[12]**

1.1 Kirchhoff's laws (revision)

1.2 Voltage and Current divider circuits

1.3 Thevenin's theorem

1.4 Norton's theorem

1.5 Super-position theorem

1.6 Maximum power transfer theorem

1.7 Problems.

UNIT-2: TRANSISTORS **[12]**

2.1 Bipolar junction transistors, n-p-n and p-n-p Transistors

2.2 Transistor biasing

2.3 CB, CC, CE configurations and their Characteristics- Active, saturation and cut-off regions.

2.4 Current gains α, β, γ and their relationships.

2.5 DC operating point and AC and DC Load line, Q-Point.

2.6 Problems

UNIT-3: OPERATIONAL AMPLIFIERS **[12]**

3.1 Operational Amplifier

3.2 Characteristics of an Ideal and Practical Op-Amp (IC 741),

3.3 Concept of Virtual ground.

3.4 Applications of Op-Amps: Inverting and Non-inverting Amplifiers, Adder, Subtractor, Differentiator, Integrator,

3.5 Problems

UNIT-4: DIGITAL ELECTRONICS [12]

4.1 Binary Number System.

4.2 Decimal to Binary and Binary to Decimal Conversion,

4.3 Octal Numbers,

4.4 Hexadecimal Numbers,

4.5 ASCII code, Excess-3 code, Gray Code.

4.6 Basic Gates- AND, OR, and NOT Gates. XOR and XNOR Gates

4.7 NAND and NOR Gates as Universal Gates. De Morgan's Theorems.

4.8 Boolean Laws. Simplification of Logic Circuit using Boolean Algebra.

4.9 Problems

REFERENCE BOOKS:

1. Electronics Principles, Malvino, 8th Edition Tata Mc-Graw Hills.
2. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi.
3. Op Amp and Linear integrated circuits, Ramakant Gaikwad, Prentice Hall of India Pub.
4. Integrated Circuts, K.R. Botkar, Khanna Publications, New Delhi
5. Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub

S.Y.B.Sc. PHYSICS (Semester- III)

USPH 232 (B): Instrumentation

Credit: 3 **No. of lectures: 48**

(For the students who have been offered Electronic Science at F. Y. B. Sc.)

Learning outcomes: -

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

1. Understand the principles and functions of different instruments.
2. Use different instruments for the measurement of various parameters.
3. Design experiments using sensors.

UNIT 1: FUNDAMENTALS OF MEASUREMENT (14)

1.1 Aims of measurement [Ref 1, Pages: 1-2]

1.2 Functional elements of typical measurement system (block diagram and its explanation) [Ref 1, Pages: 6-8]

1.3 Standard measurements and types of calibration methods [Ref 1, Pages: 19-27]

1.4 Static characteristics (accuracy, precision, sensitivity, linearity, repeatability, reproducibility, drift, hysteresis, resolution) [Ref 1, Pages: 29-33]

1.5 Dynamic characteristics: concepts of zero, first and second order systems, examples of first-order resistance thermometer and thermal element, examples of second order: U- tube manometer [Ref 1, Pages: 81-106]

1.6 Errors in measurement. (Definition and types)

1.7 Problems.

UNIT 2: TRANSDUCERS (14)

2.1 Measurement of displacement: variable resistance, inductance and capacitance methods. Variable capacitance transducers [Ref 1, Pages: 815-825]

2.2 Measurement of force: Load cell, cantilever beam

2.3 Measurement of temperature: I) Scales of temperature (Kelvin, Celsius, Fahrenheit etc.)

II) Methods of temperature measurement:

a. Non-electrical method – liquid filled thermometer, bimetallic thermometer.
b. Electrical method – Platinum resistance thermometer
c. Thermistor – PTC and NTC with characteristics

2.4 Problems [Ref 1, Pages: 739-758, 788-793].

UNIT 3: MEASUREMENT OF PRESSURE (08)

3.1 Unit of pressure, concept of vacuum, absolute gauge, and differential pressure

3.2 Elastic transducer – diaphragm, corrugated diaphragm, bellows, Bourdon tube

3.3 Electric type - LVDT, strain gauge

3.4 Problems.

UNIT 4: ANALOG SIGNAL CONDITIONING (12)

4.1 Steps involved in Signal Conditioning, impedance matching.

4.2 OP-AMP circuit used in instrumentation –precision rectifier, comparator, logarithmic amplifier, current to voltage and voltage to current converters

4.3 Instrumentation amplifier (Three OP-AMP configuration) [Ref 1, Pages: 873-903]

4.4 Active Filters-Low pass, High pass filter (First order) [Ref 1, Pages: 913- 918]

4.5 Problems.

REFERENCE BOOK:

1. A course in Electrical and Electronic Instrumentation [19th edition, 2012]- A. K. Sawhney (Dhanpat Rai & Co. Pvt. Ltd., New Delhi)
2. Instrumentation devices and systems- Rangan, Sarma, Mani [Tata McGraw Hill]
3. Instrumentation Measurement and Analysis – Nakra, Choudhari [Tata McGraw Hill]
4. Electronics Instrumentation – H. S. Kalsi [Tata McGraw Hill]
5. Sensor and Transducers – Patrabnis [PHI]
6. Fundamental of Industrial Instrumentation- Alok Barua [Wiley India]
7. Instrumentation, measurement and systems-Nakra and Chaudhary.

S.Y.B.Sc. PHYSICS (Semester- III)

USPH 233: Practical-I

Credit: 3 **No. of Practicals 10**

Learning Objectives:

1. To develop analytical abilities toward real-world problems
2. To familiarize with current and recent scientific and technological developments
3. To enrich knowledge through problem-solving, hands-on activities, study visits, projects etc

Learning Outcomes:

After successfully completing this laboratory course, the students will be able to do the following:

1. Acquire technical and manipulative skills in using laboratory equipment, tools and materials.
2. Demonstrate an ability to collect data through observation and/or experimentation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and theories gained by experiencing and visualizing them as authentic phenomena.
5. Acquire the complementary skills of collaborative learning and teamwork in laboratory settings.

List of Experiments: (Students must perform Any 8 Experiments)

1. Circuit Theorems (Thevenin's, Norton's and Maximum power transfer theorem)
2. Transistor characteristics (CE configuration)
3. *Thermal conductivity of rubber tube*
4. OPAMP as inverting and noninverting amplifier
5. Study of logic gates (using IC) and verification of De Morgan's theorem
6. Use of CRO (AC/DC voltage measurement, frequency measurement)
7. Measurement of displacement (linear and angular) using potentiometer/variable inductor
8. *Measurement of force using load cell.*

9. *Measurement of pressure using elastic diaphragm (in variable Capacitor/Bourdon Tube)*
10. OPAMP as an adder and subtractor
11. Platinum Resistance Thermometer
12. Integrator and differentiator using IC 741
13. Characteristics of Thermistor
14. Study of Thermocouple
15. *Study of thermal conductivity by Lee's method*
16. *Phase shift Oscillator using IC 741*

Additional Activities

1. Demonstrations (Any one demonstrations equivalent to two experiments)

1. Biprism
2. LASER
3. Telescope

2. Computer aided demonstrations using computer simulations or animations (Any one demonstrations equivalent to two experiments)

1. Thevenin's Theorem and Norton's Theorem
2. Newton's law of Cooling
3. Lee's Disc Apparatus
4. Thermo Couple- Seeback effect

3. Student Involvement (Any one equivalent to two experiments)

1. Mini Projects

Group of 4 students should carry out mini project with the report.

OR

2. Industrial Visit /Study Tour / Field Visit

- Students must perform at least two additional activities out of three activities in addition to eight experiments mentioned above. Total Laboratory work with additional activities should be equivalent to TEN experiments.