Vivekanand Education Society's

College of Arts, Science and Commerce

(Autonomous)

Sindhi Society, Chembur, Mumbai, Maharashtra – 400 071.

Accredited by NAAC "A Grade" in 3rd Cycle - 2017
Best College Award – Urban Area, University of Mumbai (2012-13)
Recipient of FIST Grant (DST) and STAR College Grant (DBT)

Affiliated to the

University of Mumbai

Syllabus for

Program: B.Sc. (Physics)

(Program code: VESUSPH)

As per Choice Based Credit System (CBCS)
with effect from Academic Year 2022 - 2023

Program Outcomes (PO):

Upon completion of B.Sc Programme, the graduates will have:

PO1	The required analytical skills to apply appropriate scientific principles and methodologies to solve real world problems.
PO2	The ability to design, carry out experiments and analyze results by accounting uncertainties in different quantities measured using various scientific instruments.
PO3	The ability to communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
PO4	Understanding of the need for scientific solutions to problems of the environment and society, keeping in mind their sustainable development.
PO5	Imbibed ethical, moral and social values in personal and social life leading to a cultured and civilized personality.

Program Specific Outcomes (PSO)

On completion of B.Sc. Physics program, learners will be enriched with knowledge and be able to

PSO1	Understand applications of physics concepts in different areas.
PSO2	Establish linkages between different areas of physics and other interdisciplinary science subjects.
PSO3	Demonstrate competence in problem solving skills in different areas of Physics namely Classical Mechanics, Quantum Mechanics, Modern Physics, Electrodynamics, Optics, Thermodynamics, Crystallography and Materials Science.
PSO4	Use analytical skills using appropriate physical principles and methodologies to solve a wide range of problems.
PSO5	Design and carry out experiments by using appropriate scientific instruments.

F.Y.B.Sc. (PHYSICS)

(SEMESTER I)

Course Code	Title	Credits & Lectures per Semester	Lectures per Week
VESUSPH101	**Mechanics and Thermodynamics**	**02**	**03**
	Unit I: Newton's laws, Basic fluid dynamics	**15 Lectures**	
	Unit II: Introduction to thermodynamics	**15 Lectures**	
	Unit III: SHM (Composition of parallel and Perpendicular SHM) and waves	**15 Lectures**	
VESUSPH102	**Optics and Material Science**	**02**	**03**
	Unit I: Geometric optics (thin lens) Combination of lenses	**15 Lectures**	
	Unit II: Laser and Fiber optics, Acoustics	**15 Lectures**	
	Unit III: Introduction to Materials Science	**15 Lectures**	
VESUSPHP101	**Practical I**	**02**	**06**

F.Y.B.Sc. PHYSICS

(SEMESTER II)

Course Code	Title	Credits & Lectures per Semester	Lectures per Week
VESUSPH201	**Electricity and Electronics**	**02**	**03**
	Unit I : AC circuits	**15 Lectures**	
	Unit II: Circuit theorems	**15 Lectures**	
	Unit III: Basic electronics	**15 Lectures**	
VESUSPH202	**Modern Physics**	**02**	**03**
	Unit I: Introduction to Quantum Physics	**15 Lectures**	
	Unit II: Nuclear structure and Radioactivity	**15 Lectures**	
	Unit III: Interaction of charged particle with matter and Nuclear reactions	**15 Lectures**	
VESUSPHP201	**Practical II**	**02**	**06**

Detailed Syllabus: Unit wise / Module wise with number of lectures

Course title: Mechanics and Thermodynamics
Course code: VESUSPH101

Objective: To understand and develop competence in use of Basic of mechanics and Thermodynamics.

Learning Outcomes (LO):

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

LO1	Understand and apply Newton's laws in describing the motion of simple systems.
LO2	Apply the free body diagrams to analyze the forces on the object.
LO3	Use the concepts of friction and the concepts of work and energy, fluid mechanics and be able to perform calculations using them.
LO4	Understand the concepts of oscillations and waves.
LO5	Demonstrate quantitative problem-solving skills in all the topics covered
LO6	Analyze resultant of parallel and perpendicular SHMs
LO7	Understand and apply zeroth law and first of thermodynamics in different situations.
LO8	Understand and differentiate different processes of Thermodynamics and calculate work done.

Unit no.	**Details of topics**	**No of lectures**
1	**Newton's laws, Basic fluid dynamics** 1) Newton's first, second and third laws of motion, applications with and without friction, Inertial and non-inertial frames of reference, pseudo forces **RH 5.1-5.9; HCV 5.5, 6.1-6.4** 2) Work, work done by the gravitational force, work done by a spring force, work done by a general variable force, kinetic energy, potential energy, conservation of energy, power **RH 7.1-7.9, 8.2, 8.7-8.8** 3) Pascal's Principle, equation of continuity, Bernoulli's equation, applications of Bernoulli's equation, streamline and turbulent flow, lines of flow in airfoil, Poiseuille's equation. **RH 14.6, 14.9-14.10**	15 Lectures

2	**Intro to thermodynamics** 1) Behavior of real gases and real gas equation, Van der Waal equation 2)Thermodynamic Systems, Zeroth law of thermodynamics, Concept of Heat, The first law, Non Adiabatic process and Heat as a path function, Internal energy, Heat Capacity and specific heat, Applications of first law to simple processes, general relations from the first law, Indicator diagrams, Work done during isothermal and adiabatic processes. **BS : 2.1 - 2.13, 4.1 - 4.14**	15 Lectures
3	**SHM (composition of parallel and Perpendicular SHM) and Waves** 1) Displacement, velocity and acceleration in SHM, Energy of a simple harmonic oscillator, Simple Harmonic Oscillations in an Electrical System. **HJP pp1-12** 2) Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (i) equal frequencies and (ii) different frequencies (Beats). **HJP pp12-14** 3) Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **HJP pp15, 16, 19** 4) Transverse waves on string, Travelling and standing waves on a string. Normal modes of a string, Wave equation and its general solution. **HJP pp108-112, 124-125**	15 Lectures

References:

RH: Fundamental of Physics (extended) by Halliday, Resnick and Walker; John Wiley and Sons.
HCV: Concepts of Physics – (Part–I) by H. C. Verma; Bharati Bhawan Publishers
BS : Brijlal, Subramanyam and Hemne, Heat Thermodynamics and Statistical Physics, S Chand, Revised, Multi-coloured, 2007 Ed.
HJP: The Physics of Vibrations and Waves by H. J. Pain; John Wiley and Sons.

Additional references:

The Physics of Waves and Oscillations, N.K. Bajaj; Tata McGraw Hill.
Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
An introduction to mechanics: D. Kleppner, R.J. Kolenkow, McGraw- Hill
Heat and Thermodynamics: M.W. Zemansky, Richard Dittman, McGraw-Hill

Course title: Optics and Material Science
Course code: VESUSPH102

Objective: To understand concepts of thin lenses, laser and its application. To develop understanding in classification, selection and applications of materials.

Learning Outcomes (LO):

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

LO1	Understand the concept of light refraction through thin lens, Lens combination.
LO2	understand the basics of Aberrations and how to remove it and its applications.
LO3	Understand importance of reverberation, acoustics and ways to improve
LO4	Understand properties of LASER, principle and applications
LO5	Understand different types optical fibre and its use in communication applications
LO6	Understand role of materials in different applications and optimized properties required
LO7	Differentiate uses of materials based on their properties
LO8	Understand various types and application of conducting, Dielectric, magnetic materials
LO9	Demonstrate problem solving abilities in topics of the course

Unit no.	**Details of topics**	**No of lectures**
1	1) Geometrical Optics: Lens Maker's Formula (Review, exclude derivation), Newton's lens equation, magnification-lateral, longitudinal and angular. Refraction through lenses, Thin lens, Power, Lens combination. **BS: 4.9 to 4.12, 4.15- 4.17** 2) Aberrations: Spherical Aberration, Reduction of Spherical Aberration Chromatic Aberration, Condition for Achromatism. **BS: 9.1 to 9.5, 9.5.1, 9.6 (exclude 9.6.1) 9.10, 9.11, 9.12, 9.13(1) (2)** 3) Ramsden and Huygens eyepiece. BS: 10.10, 10.11.	15 Lectures

2	1) Acoustics of buildings: Reverberation, Sabine's formula (without derivation) Absorption coefficient, Factors affecting acoustics of buildings, sound distribution in an auditorium **RM & KS: 5.9,5.12, 5.13, 5.14, 5.15** 2) Laser: Introduction, Principle of Laser, Properties of Laser, He-Ne Laser, Applications of lasers, Introduction to holography **SP: 9.1,9.2, 9.3,9.4,9.4.1,9.4.2, 9.4.3, 9.6,9.10** 3) Fibre optics: Principle of propagation of laser through fibre, Numerical aperture, Step index and graded index fibre Applications of fibre **SP: 13.3,13.3.1,13.3.2,13.3.3, 13.5,13.9**	15 Lectures
3	Materials Science 1) Overview : Classification and Selection of Materials, Semiconducting materials, Current trends and advances in materials, Smart materials, Nanostructured materials, Quantum dots, Spintronics **[KK Chapter 1, Article 3 to 9]** 2) Electrical properties: Review of Energy band diagram for materials, conductors, semiconductors, insulators, correlation between band structure, bonding and electrical conductivity in metals, semiconductors and insulators. Effect of temperature on conductivity. **[CMSE 17.1 to 17.7]** 3) Magnetic properties: origin of magnetism in solids, Dimagnetism, paramagnetism, ferromagnetism, anti-ferromagnetism, magnetic hysteresis **[CMSE Chapter 18]** 4) Dielectric properties : Introduction to dielectric, pyroelectric, piezoelectric, ferroelectric materials, qualitative discussion P-E hysteresis **[CMSE 17.22 to 17.25]**	15 Lectures

References:

BS : A TextBook of Optics, N. Subramaniyam and Brij Lal, S. Chand and Co. 22nd Ed. (1994)

RM & KS: Properties of matter and Acoustics by R.Murugeshan and K. Sivaprasath, pub. S. Chand & Company Ltd.

SP: Modern Physics Concepts and Applications by S.Puri, Pub. Narosa Publishing House

KK: Materials Science by S.L.Kakani and A.Kakani, First edition, Pub. New Age International (P) Ltd
CMSE: Callister's Materials Science and Engineering adopted by R. Balasubramaniam, Wiley India

Additional references:

Fundamental of Physics (extended) by Halliday, Resnick and Walker; John Wiley and Sons.
Fundamentals of Optics: F.A. Jenkins & H.E. White, McGraw- Hill
Electronic properties by Rolf Hummel
Materials Science and Engineering: A first course by V. Raghavan

Course title: Electricity and Electronics

Course code: VESUSPH201

Objective: To understand working of LR, CR and LCR circuits. To develop competence in use of circuit theorems and develop understanding in digital electronics.

Learning Outcomes (LO):

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

LO1	Understand working of LR, CR and LCR circuits
LO2	Analyze working of AC bridges and use it in different applications
LO3	Apply different circuit theorem in analysis of electrical circuits
LO4	Understand diode characteristics and relate it to applications
LO5	Understand basic digital electronics
LO6	Demonstrate problem solving abilities in the topics covered in the course
LO7	Understand Boolean algebra

Unit no.	**Details of topics**	**No of lectures**
1	1) Alternating current theory:(Concept of L, R, and C: Review) AC circuit containing pure R, pure L and pure C, Root-Mean- Square, Average Value over a Half Cycle, representation of sinusoids by complex numbers, Series L-R, C-R and LCR circuits. Resonance in LCR circuit (both series and parallel), Power in ac circuit. Q-factor. **CR - 15.2 to 15.11** 2) AC bridges: AC-bridges: General AC bridge, Maxwell, de-Sauty, Wien Bridge. **CR : 15.14**	15 Lectures
2	**Circuit theorems** 1) Ohm’s law, Kirchoff’s current law, Kirchoff’s voltage law 2) Constant Voltage Source, Constant Current Source, Conversion of Voltage Source into Current Source **VKM 1.9-1.11** 3) Thevenin’s theorem, Procedure for Finding Thevenin Equivalent Circuit, Norton’s theorem, Procedure for Finding Norton Equivalent Circuit, Maximum power transfer theorem **VKM 1.12-1.16**	15 Lectures
3	1) Diode characteristics (forward bias and reverse bias) **VKM: 5.18-5.19**	15 Lectures

	2) DC power supply: Half wave rectifier, full wave rectifier, bridge rectifier, efficiency, PIV and ripple factor of rectifiers **VKM: 6.6-6.15** 3) Digital electronics : logic gates, Demorgan's theorem **VKM: 26.10-26.17, 26.20-26.22**	

References:

CR : Electricity and Magnetism- D. Chattopadhaya and P. C. Rakshit
(4th Ed) Reprint – 2000) Books and Allied (P) Ltd.
VKM: Principles of Electronics by V K Mehta and R Mehta; S Chand & Co.

Additional references:

1. Foundation of Electricity and Magnetism by Basudev Ghosh; Books & Allied Ltd.
2. Electronic principles by Malvino and Bates; McGraw Hill

Course title: Modern Physics
Course code: VESUSPH202

Objective: To understand X-ray production, properties and its applications. To develop understanding in foundation of quantum mechanics, nuclear properties, radioactivity and interaction of wave and matter.

Learning Outcomes (LO):

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

LO1	Understand nuclear properties and nuclear behavior.
LO2	Understand the type of isotopes and their applications.
LO3	Demonstrate and understand the quantum mechanical concepts.
LO4	Demonstrate quantitative problem-solving skills in all the topics covered.
LO5	Understand working of gas filled radiation detector
LO6	Find Q value of equation and solution of Q equations
LO7	Differentiate various types of nuclear reactions

Unit no.	**Details of topics**	**No of lectures**
1	1) X-Rays production and properties. Continuous and characteristic X-Ray spectra, X-Ray Diffraction, Bragg's Law, Applications of X-Rays **AB 2.5-2.6** 2) Compton Effect, Pair production and annihilation, Photons and Gravity, Gravitational Red Shift **AB 2.7-2.9** 3) Origin of Quantum theory: Black body (definition), Black Body spectrum, Wien's displacement law **AB 2.2** 4) Matter waves: de Broglie hypothesis, Davisdon-Germer experiment, GP Thomson experiment, Phase and Group Velocities, Heisenberg uncertainty principle **AB 3.1, 3.4, 3.5, 3.7-3.9, R p474-477**	15 Lectures
2	1) Structure of Nuclei:Basic properties of nuclei, Composition, Charge, Size, Spin, density , Spin and Magnetic moment (Exclude Magnetic Energy, Larmor frequency for protons, Nuclear Magnetic Resonance) , Rutherford's experiment and estimation of nuclear size, Mass defect and	15 Lectures

	Binding energy, BE/A vs A plot and its interpretation, stability of nuclei (N Vs Z plot), Numerical problems **AB- 11.1,11.2,11.3,11.4, SBP- 4.1.2** 2) Radioactivity: Review : Properties of α, β, γ-rays and half-life (AB-12.1), Law of Radioactive decay , mean life (derivation required), statistical nature of radioactivity, , units of radioactivity, Radioactive growth and decay (successive disintegration ;A to B to C where C is the stable product) and equilibriums, Natural Radioactive series , Natural and artificial radioactivity, Problems. **SBP- 2.3, 2.4, 2.6 ,2.7, 2.8, 2.9** Determination of the age of the Earth , Carbon dating , **SBP - 2.12, 2.13** Radioisotopes and its Applications : (**DCT:2.13 Page No.86 and 87**) Additional : https://dae.gov.in/node/191 Radiation hazards (**AB:12.1 Page No. 422,423**)	
3	1) Interaction between particles and matter : **SBP- 1.1.1, 1.1.2** 2) Gas filled Radiation Detectors: Plot of variation of ionisation current with applied voltage Nuclear Physics: **SNG – Figure: 7.4**, Ionization chamber (qualitative), Nuclear Physics : **SNG – 7.3**(exclude mode of operation), Proportional counter ,GM counter, :**SBP- 1.I.3** (i, ii), Problems. 3) Nuclear Reactions: Introduction, Types of Reactions and Conservation Laws (mass, energy and charge). Concept of Compound and Direct Reaction, Q value equation and solution of the Q equation, Threshold energy from compound nucleus concept, problems. **SBP- 3.1, 3.2, 3.3, 3.4, 3.5**	15 Lectures

References:

1. **AB:** Concepts of Modern Physics by Arthur Beiser; McGraw Hill

2. **SBP:** Nuclear Physics An Introduction by S.B.Patel (New Age International Publishers - Second Edition)

3. **SNG:** Nuclear Physics by S.N.Ghoshal

4. **R:** Atomic Physics by J.B. Rajam; S Chand & Co.

Additional References :

Nuclear and Particle Physics- S.L Kakani and Shubhra Kakani(Viva Books)- 2^{nd} Edition(KK)

Nuclear Physics-D.C Tayal (Himalaya Publishing House)(5^{th} Edition)(DCT)

Perspectives of Modern Physics by Arthur Beiser; Tata McGraw Hill

Nuclear Physics by Irving Kaplan, Oxford Publishing

Besides reference books , Standard websites are expected to be referred

Lab courses consists of skill experiments, regular experiments and Demonstration experiments: Skills are conducted in the beginning of VESUSPHP101 and Demonstration experiments are conducted at the end of VESUSPHP201. Students will perform eight regular experiments in addition to Skills/Demonstration experiments.

Course Name : Practical 1

Course code: VESUSPHP101

Objective: To get familiar with use of basic instruments in Physics and develop deep understanding of concepts in different concepts studied in theory

Learning Outcomes (LO):

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

LO1	Use instruments such as Vernier calliper, Screw gauge, multimeter confidently.
LO2	Demonstrate skills of calculating least count of instruments and use it appropriately.
LO3	Demonstrate careful conduct of Lab experiments.
LO4	Demonstrate appropriate use of multimeter in measuring various quantities

Skills Experiments:

1) Vernier calliper
2) Screw gauge
3) Use of Multimeter
4) Spectrometer
5) Travelling microscope
6) Scientific calculator
7) Graph plotting

Regular Experiments:

1) Study of Thermistor characteristics
2) Bifilar Pendulum
3) Angle of Prism using spectrometer
4) Refractive index measurement using spectrometer
5) Constant Volume Air Thermometer (CVAT)
6) Combination of lenses
7) Frequency of AC mains
8) Study of Zener characteristics
9) Study of NAND and NOR as a basic building blocks
10) Verification of Demorgan's theorem
11) Verification of basic thermodynamics laws using pressure/temperature sensors
12) Study Lissajous figure

Course Name : Practical 2
Course code: VESUSPHP201
Objective: To get familiar with use of basic instruments in Physics and develop deep understanding of concepts in different concepts studied in theory

Learning Outcomes (LO):

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

LO1	Demonstrate use of various scientific instruments confidently.
LO2	Demonstrate skills of calculating least count of instruments and use it appropriately and express results appropriately.
LO3	Demonstrate careful conduct of Lab experiments.

Regular experiments:

1) Study of Flywheel
2) Study of Bridge rectifier
3) Half wave and Full wave rectifier (study of input and output)
4) L-R circuit
5) C-R Circuit
6) LCR series resonance circuit
7) Thevenin's theorem
8) Nortorn's theorem
9) Maximum power transfer theorem
10) Torsional oscillations
11) Frank Hertz expt
12) Determination of g using position sensors
13) Determination of g using simple pendulum

Demonstration Practicals:

1) G-M counter
2) Conservation of angular momentum
3) Faraday's law
4) Laser divergence
5) Elastic collisions (Newton's laws)
6) Bernouli's theorem
7) Optical fiber Kit
8) L-figures
9) Use of CRO
10) Plotting of graph using excel, linear fitting

Modality of assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25% marks in the first part & by conducting the Semester End Examinations with 75% marks in the second part. Practical Examination will consist of End Sem examination.

Student will have to score 40% of marks in Internal assessment as well as End Sem examination to pass the course.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Internal Assessment: It is defined as the assessment of the learners on the basis of internal evaluation as envisaged in the Credit & Choice based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment : It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.

A. Theory - Internal assessment 25% **25 marks**

Sr No	Evaluation type	Marks
1.	Class Tests (multiple choice type)/ Assignments/Activity /Project/ Seminar presentation/ case study etc.	20
2.	Active participation in routine class activity Overall conduct as a responsible student, with respect to good behaviour, leadership qualities, interpersonal skills etc.	05

B. Theory - External examination - 75% **75 marks**

Semester End Theory Assessment
Duration - Each paper will be of 75 marks and shall be of 2.5 hours duration
There shall be question of 25 marks questions from each unit. There would be one question from each unit with sub questions with internal choices as given below.

Q	Solve any 5 questions out of following eight questions (5 marks each)	25 marks

C. Semester End Practical Assessment 100 marks

The evaluation of Practical papers will be on the based on performance of two experiments.

A	Two experiments /Lab activities	40+40 marks
B	Viva	10 marks
C	Journal	10 marks
	Total marks	**100 Marks**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Coordinator / In-charge of the department; failing which the student will not be allowed to appear for the practical examination.

Overall Examination and Marks Distribution Pattern

SEMESTER I

Course	Total Marks
VESUSPH101	100
VESUSPH102	100
VESUSPHP101	100

SEMESTER II

Course	Total Marks
VESUSPH201	100
VESUSPH202	100
VESUSPHP201	100