Progressive Education Society's

Modern College of Arts, Science and Commerce (*Autonomous*), Shivajinagar, Pune 5

(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework and Syllabus

For

F. Y. B. Sc. (Physics)

Choice Based Credit System (CBCS) Syllabus under National Education Policy 2020 (NEP-2020)

To be implemented from Academic Year 2024-2025

Level: 4.5 (First Year) **Sem: I**

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	ESE	Total
Subject 1 T (2) + (T/P) (2) or T (4)	24ScPhyU1101	Mechanics and Properties of Matter	2		2		20	30	50
	24ScPhyU1102	Lab Course on General Physics I		2		4	20	30	50
Subject 2 T (2) + (T/P) (2) or T (4)	24Sc***U1201	<<Subject 2 Theory>>	2		2		20	30	50
	24Sc***U1202	<<Subject 2 Practical>>		2		4	20	30	50
Subject 3 T (2) + (T/P) (2) or T (4)	24Sc***U1301	<<Subject 3 Theory>>	2		2		20	30	50
	24Sc***U1302	<<Subject 3 Practical>>		2		4	20	30	50
IKS T (2)	24CpCopU1901	Generic IKS	2		2		20	30	50
GE/ OE (T/P) (2)	24ScPhyU1401	Renewable Energy: Global Scenario	2		2		20	30	50
SEC (P) (2)	24ScPhyU1601	Lab Course on Basic Instrumentation Skills		2		4	20	30	50
AEC T (2)	24CpCopU1701 / 24CpCopU1702	MIL-I (Hindi) / MIL-I (Marathi)	2		2		20	30	50
VEC T (2)	24CpCopU1801	Environmental Science	2		2		20	30	50
Total			14	08	14	16			550

Level: 4.5 (First Year) **Sem: II**

Course Type	Course Code	Course Title	Credits		Teaching Scheme Hr/Week		Evaluation Scheme and Max Marks		
			TH	PR	TH	PR	CE	ESE	Total
Subject 1 T (2) + T/P (2) or T (4)	24ScPhyU2101	Electricity and Magnetism	2		2		20	30	50
	24ScPhyU2102	Lab Course on General Physics II		2		4	20	30	50
Subject 2 T (2) + P (2)	24Sc***U2201	<<Subject 2 Theory>>	2		2		20	30	50
	24Sc***U2202	<<Subject 2 Practical>>		2		4	20	30	50
Subject 3 T (2) + P (2)	24Sc***U2301	<<Subject 3 Theory>>	2		2		20	30	50
	24Sc***U2302	<<Subject 3 Practical>>		2		4	20	30	50
GE/OE (T/P) (2)	24ScPhyU2401	Conventional and Non-conventional Energy Sources	2		2		20	30	50
SEC P (2)	24ScPhyU2601	Lab Course on Computational Physics Skills I		2		4	20	30	50
AEC T (2)	24CpCopU2703	English Communication Skills I	2		2		20	30	50
VEC T (2)	24CpCopU2801	Democracy, Election and Governance	2		2		20	30	50
CC (2)	24CpCopU2001/ 24CpCopU2011 /	Physical Education / Cultural Activities / NSS /	2		2		20	30	50

	24CpCopU2021 / 24CpCopU2031 / 24CpCopU2041 / 24CpCopU2051 / 24CpCopU2061 / 24CpCopU2071	NCC / Fine Arts / Applied Arts / Visual Arts / Performing Arts							
Total			14	08	14	16			550

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First Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU1101

Course Name: Mechanics and Properties of Matter

Teaching Scheme: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of Motion, work and Energy, Fluid Mechanics, Properties of Matter

Course Objectives:

- To Study and. Demonstrate an understanding of Newton's laws and applying them in calculations of the motion of simple systems.
- Use the free body diagrams to analyze the forces on the object.
- Understand the concepts of energy, work, power, the concepts of conservation of energy and be able to perform calculations using them.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Define Newton's laws and apply them in calculations of the motion of simple systems.	1
CO 2	Summarize the Applications of Mechanics	2
CO 3	Apply Newton's Law in real life problems.	3
CO 4	Explain the free body diagrams to analyze the forces on the object.	4
CO 5	Evaluate different dynamics and static physical quantities for a given situation	5
CO 6	Solve the problems related to concepts of energy, work, power, the concepts of conservation of energy and being able to perform calculations using them.	6

Course Contents

Unit 1	Units, Physical Quantities, and Vectors	3 Lectures
	• Standards and Units • Using and Converting Units • Vectors and Vector Addition • Components of Vectors • Unit Vectors • Products of Vectors	
Unit 2	Motion Along a Straight Line	3 Lectures
	• Displacement, Time, and Average Velocity • Instantaneous Velocity • Average and Instantaneous Acceleration • Motion with Constant Acceleration • Freely Falling Objects • Velocity and Position by Integration	
Unit 3	Motion in Two or Three Dimensions	4 Lectures
	• Position and Velocity Vectors • The Acceleration Vector • Projectile Motion • Motion in a Circle	
Unit 4	Newton's Laws of Motion	3 Lectures
	• Force and Interactions • Newton's First Law • Newton's Second Law • Mass and Weight • Newton's Third Law • Free-Body Diagrams	
Unit 5	Applying Newton's Laws	4 Lectures
	• Using Newton's First Law: Particles in Equilibrium • Using Newton's Second Law: Dynamics of Particles • Friction Forces • Dynamics of Circular Motion • The Fundamental Forces of Nature	
Unit 6	Work and Kinetic Energy	3 Lectures
	• Work • Kinetic Energy and the Work–Energy Theorem • Work and Energy with Varying Forces • Power	
Unit 7	Potential Energy and Energy Conservation	3 Lectures
	• Gravitational Potential Energy • Elastic Potential Energy • Conservative and Nonconservative Forces	

	• Force and Potential Energy • Energy Diagrams	
Unit 8	Momentum Impulse and Collision	3 Lectures
	• Momentum and Impulse • Conservation of Momentum • Momentum Conservation and Collisions • Elastic Collisions • Center of Mass • Rocket Propulsion	
Unit 9	Rotation of Rigid Bodies	4 Lectures
	• Angular Velocity and Acceleration • Rotation with Constant Angular Acceleration • Relating Linear and Angular Kinematics • Energy in Rotational Motion • Parallel-Axis Theorem • Moment-of-Inertia Calculations • Torque • Torque and Angular Acceleration for a Rigid Body • Rigid-Body Rotation About a Moving Axis • Work and Power in Rotational Motion • Angular Momentum • Conservation of Angular Momentum	

References:

- University Physics with Modern Physics; Young and Freedman (15th Edition); Pearson
- Halliday & Resnick Fundamentals of Physics; Jearl Walker; Wiley
- Concepts of Physics (Volume I); H. C. Verma;

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First Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU1102 Course Name: Lab Course on General Physics I

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic Science Instruments /Apparatus

Course Objectives:

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain	2

	quantitative results.	
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory equipment, tools, and materials.	4
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		(15)
	1. Measurements using Vernier calliper. 2. Measurements using Micrometer screw gauge. 3. Measurements using Travelling Microscope 4. Measurements using Spectrometer 5. M. I. of flywheel 6. Flat spiral spring 7. Study of Digital Multimeter 8. ‘g’ by simple pendulum 9. Surface Tension by Capillary Rise Method 10. Coefficient of Viscosity by Stokes Method 11. Virtual Lab based on Mechanics 12. Virtual Lab based on Mechanics	

	13. Virtual Lab based on Mechanics 14. Activity and Demonstrations 15. Study Tour	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
8. https://phet.colorado.edu
9. https://vlab.amrita.edu/

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First Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU1401 Course Name: Renewable Energy: Global Scenario

Teaching Scheme: 2 Hours/ Week **Credit: 02**

Examination Scheme: CIA: 20 Marks **End-Sem: 30 Marks**

Course Prerequisites:

- Familiarization of basic knowledge of Renewable Energy

Course Objectives:

1. To create awareness among the students about the different types of non-conventional energy resources and emphasize its importance
2. Apply the concept and use of knowledge of the renewable energy sources course to real-life problems.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Understand different types of storage technologies	1
CO 2	Design a thermal storage system	2
CO 3	Identify the basic principles of electricity generation from wind energy systems and photovoltaic systems.	3
CO 4	Differentiate between generation of electricity from fossil fuels and renewable resources	4
CO 5	Review the present energy scenario and the need for energy storage	5

CO 6	Solve problems related to wind energy systems and PV systems.	6

Course Contents

Unit 1	Introduction to Energy	15
	Introduction to Energy: Definition and units of energy, Forms of energy, Conservation of energy, Conventional energy sources, Role of energy in economic development and social transformation. Global Energy Scenario: Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, impact of exponential rise in energy usage on global economy.	
Unit 2	Indian Energy Scenario	15
	Indian Energy Scenario: Energy resources available in India, urban and rural energy consumption, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features, National Green Tribunal (NGT) act, NGT activities.	

References:

1. Non -Conventional Energy Resources, third edition by B. H. Khan, Mc Graw Hil Education Pvt. Ltd
2. Silicon solar cells: advanced principles and practice. Sydney, M. Green, Bridge Printery, 1995.
3. Third Generation Photovoltaics. Berlin, Germany, M. Green, Springer-Verlag, 2003.
4. Crystalline silicon solar cells: advanced surface passivation and analysis, Aberle A. G., Sydney, Centre for Photovoltaic Engineering, UNSW, 1999.
5. The physics of solar cells, J. Nelson, Imperial college press, 2006.
6. G. D.Rai,-"Non Conventional Energy Sources", Khanna publisher, New Delhi

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First Year of B.Sc.
(2024 Course under NEP 2020)
Course Code: 24ScPhyU1601 Course Name: Lab course on Basic Instrumentation Skills

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic Science Instruments /Apparatus

Course Objectives:

5. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
6. To learn the usage of electrical systems for various measurements.
7. Apply the analytical techniques and graphical analysis to the experimental data.
8. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory	4

	equipment, tools, and materials.	
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

		15
	1. Units and Dimensions in physics experiments. 2. Measurements and Error analysis in Physics 3. Study of Digital Multimeter 4. Study of CRO 5. Study of Signal Generator 6. Study of Potential divider circuit 7. Study of Voltmeter. 8. Study of Ammeter. 9. Study of Bread Board 10. Study of Transformer 11. Study of lenses 12. Study of Power Supply 13. Study of different types of sensors 14. Study of Telescope 15. Demonstration	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
5. Fundamental of Physics, Halliday and Resnick
6. Fundamental of Optics, Francis Jenkins, Harvey White
7. B. Sc. Practical Physics, C.L.Arora
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First Year of B.Sc.
(2024 Course under NEP 2020)
Course Code: 24ScPhyU2101 Course Name: Electricity and Magnetism

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic concepts of calculus

Course Objectives:

- To Study Basics of Electrostatics and Magnetostatics in Vacuum and in Dielectric Media
- To enrich knowledge of Electricity and Magnetism through problem solving

Course Outcomes:

On completion of the course, student will be able to–

CO No.	Course Outcomes (COs)	Bloom's Cognitive Level
CO1	Define the fundamental laws of electrostatics and magnetostaticsincluding Coulomb's law, Gauss's law, Biot-Savart's Law and Amperes law.	1
CO2	Explain the physical significance of Electric field, Electric Potential and Magnetic field.	2
CO3	Apply the Coulomb's law and Gauss' law to uniform charge distribution to calculate electric field and electric potential at a point	3
CO4	Analyze the behavior of dielectric material in uniform electric field	4
CO5	Evaluate the magnetic field due to current carrying elements by using Biot-Savart's Law and Amperes law	5
CO6	Develop mathematical models to solve the problem based on Electromagntostatics.	6

Course Contents

Unit 1	Electric Charge and Electric Field	6
	• Electric Charge • Conductors, Insulators, and Induced	

	Charges ● Coulomb's Law ● Electric Field and Electric Forces ● Electric-Field Calculations (Line charge) ● Electric Field Lines ● Electric dipole ● Torque acting on dipole due to electric field	
Unit 2	Gauss's Law	4
	● Charge and Electric Flux ● Calculating Electric Flux ● Gauss's Law ● Applications of Gauss's Law (Spherical and cylindrical symmetry)	
Unit 3	Electric Potentials	4
	● Electric Potential Energy ● Electric Potential ● Calculating Electric Potential (Line charge and electric dipole))	
Unit 4	Capacitance and Dielectrics	8
	● Capacitors and Capacitance ● Capacitors in Series and Parallel ● Dielectrics ● Molecular Model of Induced Charge ● Gauss's Law in Dielectrics	
Unit 5	Magnetostatics	8
	● Magnetism ● Magnetic Field ● Magnetic Field Lines and Magnetic Flux ● Magnetic Field of a Moving Charge ● Magnetic Field of a Current Element ● Magnetic Field of a Straight Current-Carrying Conductor ● Ampere's Law ● Applications of Ampere's Law (solenoid and toroid)	

	• Magnetic Materials	

References:

1. Sear's and Zimansky's University Physics with Modern Physics, Young and Freedman
2. Fundamentals of Physics, Resnick and Halliday

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First Year of B.Sc.
(2024 Course under NEP 2020)
Course Code: 24ScPhyU2102 Course Name : Lab Course on General Physics II

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Prerequisite Courses:

- Familiarity with 10+2 level physics syllabus
- Familiarity with basic Science Instruments /Apparatus

Course Objectives:

- To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
- To learn the usage of electrical and optical systems for various measurements.
- Apply the analytical techniques and graphical analysis to the experimental data.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Course Outcomes:

On completion of the course, student should be able to–

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Find the various procedures and techniques for the experiments related to general physics.	1
CO 2	Generalize the mathematical concepts/equations to obtain quantitative results.	2
CO 3	Integrate the basic communication skills through working in groups in performing the laboratory experiments and by interpreting the result.	3
CO 4	Correlate the technical and evaluative skills using laboratory	4

	equipment, tools, and materials.	
CO 5	Test practical knowledge by applying the experimental methods to correlate with the Physics theory.	5
CO 6	Adapt the knowledge of mechanical, electrical and optical systems for various measurements.	6

Course Contents

	1. Verification of Kirchhoff's Current Law 2. Verification of Kirchhoff's Voltage Law 3. Vector diagrams of L - R circuit 4. Discharging of Capacitor. 5. Self-inductance using Maxwell's Bridge. 6. Characteristics of semiconductor diode 7. Frequency of AC mains 8. Plane Diffraction Grating 9. Equivalent resistance in series and parallel 10. Angle of Minimum deviation 11. Virtual Lab based on Electricity and Magnetism 12. Virtual Lab based on Electricity and Magnetism 13. Virtual Lab based on Electricity and Magnetism 14. Activity and Demonstrations 15. Study Tour	

References:

1. An Advanced course in Practical Physics, D. Chattopadhyay and P. C. Rakshit
2. Practical Physics, R.K.Shukla and Anchal Shrivastava
3. B. Sc. Practical Physics, Harnam Singh
4. University Physics with Modern Physics, Sears and Zemansky
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First Year of B.Sc.
(2024 Course under NEP 2020)
Course Code: 24ScPhyU2401 Course Name: Conventional and Non-conventional energy sources

Teaching Scheme: 2 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Course Prerequisites:

- Familiarization of basic knowledge of Non-conventional Energy Sources

Course Objectives:

1. To create awareness among the students about the different types of non-conventional energy resources and emphasize its importance
2. Apply the concept and use of knowledge of the renewable energy sources course to real-life problems.

Course Outcomes:

CO No	Course Outcomes (COs)	Bloom's Cognitive level
CO 1	Evaluation of the environmental effects of energy production and the relationship between energy generation and environment will be achieved	1
CO 2	Various types of environmental pollution and their effects will be explained	2
CO 3	Identify the basic principles of electricity generation from wind energy systems and photovoltaic systems.	3
CO 4	Differentiate between generation of electricity from fossil fuels and renewable resources	4
CO 5	Review the present energy scenario and the need for energy storage	5
CO 6	Solve problems related to wind energy systems and PV systems.	6

Course Contents

Unit 1	Energy Sources	15
	Classification of Energy Sources, Primary Energy Sources, Secondary Energy Sources, Statistical Review of Primary Energy Sources, Energy Consumption Pattern in India, Impact of Excessive Use of Fossil Fuels on Environment	
Unit 2	Non-Conventional/Renewable Energy Sources	15
	Features of Non-Conventional/Renewable Energy Sources, Statistical Review of Renewable Energy Sources, Benefits of Energy Conservation to a Nation, Energy Audit, Energy Management, Energy Strategy, Green energy, Clean energy, Green footprint, Carbon footprint etc.	

References:

1. Sukhatme S P, Solar Energy: principles of Thermal Collection and Storage, TataMcGrawHill.
2. Duffie J A, Beckman W A, Solar Engineering of Thermal Processes, Johnn Wiley.
3. Goswami D Y, Frank Kreith and Kreider J F, Principles of Solar Engineering, Taylor and Francis, USA.
4. Garg H P, Prakash S, Solar Energy: Fundamental and Application, Tata McGrowHill, New Delhi.
5. Kreith F, Kreider J F, Principles of Solar Engineering, McGrawHill.
6. Kreider J F, Kreith F, Solar Energy Handbook, McGrawHill.
7. Bent Sorensen, Renewable Energy, Academic press, New York.
8. Tiwari, G N, Solar Energy, Fundamentals Design, Modeling and Applications, Narosa, New Delhi

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First Year of B.Sc.

(2024 Course under NEP 2020)

Course Code: 24ScPhyU2601 Course Name: Lab Course on Computational Physics Skills I

Teaching Scheme: 4 Hours/Week **Credit: 02**

Examination Scheme: CIA : 20 Marks **End-Sem : 30 Marks**

Course Prerequisites:

- Completed first year course 24ScPhyU1101
- Basic understanding of Calculus

Course Objectives:

- To understand basic programming in Python using Numpy and Matplotlib
- To get familiar with Jupyter notebook, Colab
- To understand solving simple problems using Python programming

Course Outcomes:

	Course Outcomes (COs)	**Bloom's Cognitive level**
CO 1	Explain various problems using algorithm	1
CO 2	Compare Jupyter Notebook Vs Colab	2
CO 3	Apply programming techniques to solve simple physics problems	3
CO 4	Analyze the errors in Python program	4
CO 5	Determine algorithm to solve simple physics problems using Numpy and Matplotlib for plotting	5
CO 6	Solve a given problem based on Mechanics using Python program	6

Course Content

		15

	1. Introduction to Python script files 2. Introduction to Jupiter Notebook 3. Plotting one dimensional functions using Matplotlib 4. Displacement and velocity in motion with constant acceleration 5. Projectile Motion 6. Charging and Discharging of Capacitor 7. Motion of charged particle in external magnetic field 8. Ohm's law 9. Calculate Moment of Inertia of non-uniform disc 10. Random numbers generation using python 11. Plotting probability density function of random numbers generated using various methods 12. Plotting two dimensional functions using Matplotlib 13. Writing data files in Python 14. Study Tour Report 15. Assignments, Demonstration etc.	

References:

- Scientific Computation in Python (2nd Edition), Abhikit Kar Gupta, Techno World Publication
- Computational Physics: Problem Solving with Python, 4th Edition, Rubin H. Landau, Manuel J. Páez, Cristian C. Bordeianu, Wiley-VCH
- Introduction to Methods of Numerical Analysis, (5th Edition), S. S. Sastry, Prentice Hall India
- http://www.python.org
- https://numpy.org/7. https://phet.colorado.edu
- https://vlab.amrita.edu/