MODERN EDUCATION SOCIETY'S

NOWROSJEE WADIA COLLEGE

(AUTONOMOUS)

NAAC Accredited A^+ with CGPA 3.51

Affiliated to the

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B. Sc. Degree Program in Physics

(Faculty of Science & Technology)

B. Sc. (Physics)

National Education Policy (NEP) Syllabus

To be implemented from Academic Year 2023-2024

B. Sc. (Physics)

3. PREAMBLE FOR THE SYLLABUS:

The syllabus has been prepared on a participatory manner, after discussion with number of faculty members in the Physics subject and after referring an existing syllabi.

In compliance with the directives from the University Grants Commission (UGC), under the autonomous status of the college, the syllabus for Physics at the undergraduate level is revised and reframed as per the National Educational Policy (NEP – 2020) curriculum framework. Nowrosjee Wadia College has decided to change the syllabi for the B.Sc. degree from June 2023 – 24 academic year, as the college has already shifted to the autonomous status from the academic year 2022 – 2023. The present syllabus is prepared by the Board of Studies in Physics, Nowrosjee Wadia College, considering the present relevance.

Considering the curricular reforms as instrumental for desired learning outcomes, department of Physics has made a rigorous attempt to revise the curriculum of undergraduate and postgraduate programmes in alignment with National Education Policy-2020 and UGC Quality Mandate for Higher Education Institutions-2021.

The process of revamping the curriculum started with the series of discussions conducted by the college authorities to orient the teachers about the key features of the Policy, enable them to revise the curriculum in sync with the NEP-2020 policy. Proper orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to incorporate the vital aspects of the Policy in the revised curriculum.

The learning outcome-based curriculum for a degree in B.Sc. (Physics) is designed to provide comprehensive foundation in the subject and to help students to develop ability to continue with further studies and research in physics. The present syllabus is prepared by the Board of Studies in Physics, Nowrosjee Wadia College, taking in to consideration the present relevance and application of the various branches of Physics. While preparing this syllabus the U.G.C. model curriculum (LOCF) and existing syllabus given by Savitribai Phule Pune University is followed.

4. OBJECTIVES:

The curriculum will be taught through formal lectures with the aid of power-point presentations, audio and video tools and other teaching aids can be used as and whenever required. Emphasis will be inclined towards laboratory work for giving hands on experience to students. Students will be encouraged to accomplish semester long project in their own institute as well as in reputed institutes of National level. Aims of the Programme are as follows-

- Provide the students with a broad spectrum of Physics Courses.
- Emphasize the role of Physics in other disciplines such as (Chemical Sciences, Mathematical Sciences, Life Sciences and their applied areas)
- Develop the ability of the students to deal with physical models and formulas mathematically.
- Strengthen the student knowledge of Physics and its applications in real world.
- Provide the student with mathematical and computational tools and models to be used in solving problems.
- Equip the students with different practical, intellectual and transferable skills.
- Improve the student's inter disciplinary skills.
- To train students in skills related to research, experiments, education, industry and market.
- To familiarize with the recent scientific and technological developments.
- To enrich knowledge through problem solving, hands on activities, study visits, research projects, etc.
- To become compatible students for research and developments in fundamental science.
- To help students to build-up a progressive and successful career in Physics and allied areas.

5. Program Outcome (PO):

The Department of Physics has outlined following 09 PO's and 10 Program Specific Outcomes (PSOs). The course syllabi and the overall curriculum have been designed to achieve these outcomes:

Program Outcome (PO)	Short title	Description: A Graduate student in Physics will be able to:
PO1	Basic Knowledge	Capable of delivering basic disciplinary knowledge gained during the programme.
PO2	In-depth Knowledge	Capable of describing advanced knowledge gained during the programme.
PO3	Critical thinking and Problem Solving abilities	Capable of analysing the results critically and applying acquired knowledge to solve the problems.
PO4	Creativity and innovation	Capable to identify, formulate, investigate and analyse the scientific problems and innovatively to design solutions to real life problems.
PO5	Research aptitude	Ability to develop a research aptitude and apply knowledge to find the solution of research problems in the concerned fields.
PO6	Holistic and multidisciplinary	Ability to gain knowledge with the holistic and multidisciplinary approach across the fields.
PO7	Skills enhancement	Learn specific sets of disciplinary or multidisciplinary skills and advanced techniques and apply them.
PO8	Ethical thinking and Social awareness	Inculcate the professional and ethical attitude and ability to relate with social problems.
PO9	lifelong learning skills	Ability to learn lifelong learning skills which are important to provide better carrier opportunities and improve quality of life.

6. PROGRAM SPECIFIC OUTCOMES (PSO):

After successful completion of Bachelor's Science degree in Physics, the student will be able to:

PSO	Short title	Description
PSO1	Fundamental Concepts	The students will acquire a scientific knowledge of the fundamental principles of Physics through study of Classical Mechanics, Electromagnetic Theory, Optics, Heat and Thermodynamics, Statistical Mechanics, Solid State Physics, Modern Physics, Quantum Mechanics and other areas of Physics
PSO2	Experimental Skills	Students should learn how to design and conduct an experiment and understand the basic physics behind it.
PSO3	Locomotive skills	Students will develop the proficiency in the handling of laboratory instruments
PSO4	Computational Techniques	The students will acquire a fair amount of computational skill using open source software packages such as Python, Numpy, Scipy, Matplotlib, SciLab etc. in both Linux and Windows platform.
PSO5	Statistical Techniques	The students will learn use of appropriate computational techniques and apply them for experimental data analysis and solving theoretical problems.
PSO6	Experimental skills	The students will learn to work independently as well as a group during laboratory sessions, projects and student seminars.
PSO7	Research attitude	Students develop aptitude of doing research through undertaking small projects and research centre visit.
PSO8	Societal Applications	Students will realize and develop an understanding of the impact of Physics on society and apply conceptual understanding of the physics in real life.
PSO9	Ethics	The student will acquainted with the recent development in the subject through of scientific literature and ethical issues related to physics.
PSO10	Communication skills	The students will learn effective communication skill to present their knowledge of physics from basic concepts to specific advanced areas in the form of preparation of laboratory note book, project work, seminar presentation, poster presentation, etc.

7. ELIGIBILITY:

- Higher secondary school certificate (10+2) (Science) or its equivalent examination with English.
- Whenever and wherever, the guidelines directed from SPPU, Pune will be followed.

8. TEACHING SCHEME:

- The course is of 3 years i.e. 6 semesters full time under graduate course.
- The course follows the NEP (National Educational Policy 2020) pattern as per Government of Maharashtra G.R(s) as follows:

सांकेतांक २०२३०४२०१९२५२६६९०८

शासन निर्णय क्रमांक: एनईपी-२०२२/प्र.क्र.०९/विशि-३ शिकाना, दिनांक २० एप्रिल, २०२३

- 4 Credits Theory Course = 60 Hours (60 Lectures)
- 2 Credits Theory Courses = 30 Hours (30 Lectures)
- 2 Credits Practical Course = 60 Hours (4 Hours/Week/Batch)

9. ABBREVIATIONS:

OE: Open Elective
AEC: Ability Enhancement Course
VEC: Value Education Courses
CC: Co-Curricular Courses
IKS: Indian Knowledge System
OJT: On Job Training
FP: Field Project
VS: Vocational Skill Courses
CEP: Community Engagement Project
T – Theory
P - Practical
CE - Continuous Evaluation
SEE – Semester End Examination
F.Y. – First Year
S.Y. – Second Year
T.Y. – Third Year.

10.B.Sc. Physics Course Structure

First Year - Semester 1

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 2)	Major Paper 1 (Theory)	Mechanics and Properties of Matter	2	2
	Major Paper 2 (Theory)	Physics Principles and Applications	2	2
	Major Paper (Practical)	Physics Practical - I	4	2
Major Electives				
Minor				
OE (2 + 2)		Introduction to Astronomy	2	4
		Renewable Energy Sources - I	2	
VSC (2)	Major Specific Practical I	Basic Python Programming -I	4	2
SEC (2)	Skill Paper 1 (Theory)	Basic Circuits and Network Analysis	2	2
AEC(2),	English Theory	English Communication I	2	2
VEC (2)	EVS Theory	Environment Science I	2	2
IKS (2)	Major Specific Theory	Indian Space Missions	2	2
CC (2)	CC-I Course	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2	2

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

First Year - Semester 2

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 2)	Major Paper 3 (Theory)	Heat and Thermodynamics	2	4
	Major Paper 4 (Theory)	Electricity and Magnetism	2	
	Major Paper (Practical)	Physics Practical -II	4	2
Major Electives				
Minor	Minor Paper I (Theory)	Bio-Physics	2	2
OE (2 + 2)	OE (Theory)	Medical Physics	2	4
		Renewable Energy Sources-II	2	
VSC (2)	Major Specific Practical II	Basic Python Programming -II	4	2
SEC (2)	Skill Paper 1I (Theory)	Introduction to SciLab Programming language	2	2
AEC(2),	English Theory	English Communication II	2	2
VEC (2)	EVS Theory	Environment Science II	2	2
IKS (2)				
CC (2)	CC-II Course	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2	2

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

Second Year - Semester 3

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 4)	Major Core Paper 5 (Theory)	Optics	2	4
	Major Core Paper 6 (Theory)	Electronics	2	
	Major (Practical) on Major Core Paper 5	Physics Practical -III	4	4
	Major (Practical) on Major Core Paper 6	Physics Practical -IV	4	
Major Electives				
Minor (4)	Minor Paper II (Theory)	Applied Physics	2	4
	Minor (Practical) On Minor Paper II	Physics Lab-I	4	
OE (2)	Theory	Physics in daily life	2	2
VSC (2)	Major Specific Practical III	Opto-Electronics	4	2
SEC (2)				
AEC(2)	MIL	MIL-I (Hindi) / MIL-I (Marathi)	2	2
VEC (2)				
IKS (2)				
FP/CEP (2)	FP –I		6	2
CC(2)	CC III	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2	2

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

Second Year - Semester 4

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 4)	Major Core Paper 7 (Theory)	Mathematical Methods in Physics -I	2	4
	Major Core Paper 8 (Theory)	Oscillations, wave and Sound	2	
	Major (Practical) on Major Core Paper 7	Physics Practical -V	4	4
	Major (Practical) on Major Core Paper 8	Physics Practical -VI	4	
Major Electives				
Minor (4)	Minor Paper III (Theory)	Statistical Methods in Physics	2	4
	Minor (Practical) on Minor paper III	Physics Lab-II	4	
OE (2)	Theory	Inside the minds of brilliant physicists OR Eminent Physicists of 21st Century	2	2
VSC (2)				
SEC (2)	Skill Paper III (Theory)	Basics of Drone Technology & Applications	4	2
AEC(2),	MIL	MIL-II (Hindi) / MIL-II (Marathi)	2	2
VEC (2)				
IKS (2)				
CEP(2)	CEP –I		6	2
CC(2)	CC-4	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2	2

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

Third Year - Semester 5

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 4 + 2)	Major Core Paper 9 (Theory)	Classical Mechanics	2	2
	Major Core Paper 10 (Theory)	Atoms and Molecular Physics	2	2
	Major Paper 11 (Theory)	Classical Electrodynamics	2	2
	Major (Practical)	Physics Practical -VII	4	2
	Major (Practical)	Physics Practical -VIII	4	2
Major Electives	Elective I (Theory)	Acoustics -I	2	4
	Elective I (Practical)	Practical - Acoustics	4	
	OR			
	Elective II (Theory)	Materials Sciences-I	2	
	Elective II (Practical)	Practical - Materials Sciences	4	
Minor (4)	Minor Paper IV (Theory)	Geo-Physics	2	4
	Minor (Practical) On Minor Paper IV	Physics Lab-III	4	
OE (2)				
VSC (2)	Major Specific Practical IV	Hands on practical on Photovoltaic Technology OR Electrical Vehicles	4	2
SEC (2)				
AEC(2),				
VEC (2)				
IKS (2)				
FP / CEP(2)	FP –II/CEP II		6	2

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

Third Year - Semester 6

Course Type	Course	Course / Paper Title	Hours/Week	Credit
Major Mandatory (4 + 4 + 2)	Major Core Paper 12 (Theory)	Quantum Mechanics	2	2
	Major Core Paper 13 (Theory)	Thermodynamics and Statistical Mechanics	2	2
	Major Paper 14 (Theory)	Solid State Physics	2	2
	Major (Practical)	Physics Practical -IX	4	2
	Major (Practical)	Physics Practical -X	4	2
Major Electives	Elective III (Theory)	Acoustics -II	2	4
	Elective III (Practical)	Practical - Acoustics	4	
	OR			
	Elective IV (Theory)	Laser Technology	2	
	Elective IV (Practical)	Practical - Laser Technology	4	
Minor (4)	Minor Paper V (Theory)	Elements of Material Science	2	4
	Minor (Practical) On Minor Paper V	Physics Lab-IV	4	
OE (2)				
VSC (2)				
SEC (2)				
AEC(2),				
VEC (2)				
IKS (2)				
FP / CEP(2)				
OJT(4)	OJT	On Job Training	12	4

OE: Open Elective, AEC: Ability Enhancement Course, VEC: Value Education Courses, CC: Co-Curricular Courses, IKS: Indian Knowledge System, OJT: On Job Training, FP: Field Project, VSC: Vocational Skill Courses, CEP: Community Engagement Project.

******Courses mentioned in grey shaded rows are not offered from Physics subject.***

11. Semester wise courses (PHYSICS) with credits & evaluation scheme Sem- I

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Mechanics and Properties of Matter	2		15	35	50
Major Mandatory		Physics Principles and Applications	2		15	35	50
Major Mandatory		Physics Practical -I		2	15	35	50
OE		Introduction to Astronomy	2		15	35	50
		Renewable Energy Sources-I	2		15	35	50
VSC		Basic Python Programming -I		2	15	35	50
SEC		Basic Circuits and Network Analysis	2		15	35	50
IKS		Indian Space Missions	2		15	35	50

Semester II

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Heat and Thermodynamics	2		15	35	50
Major Mandatory		Electricity and Magnetism	2		15	35	50
Major Mandatory		Physics Practical -II		2	15	35	50
Minor		Bio-Physics	2		15	35	50
OE		1) Medical Physics	2		15	35	50
OE		2) Renewable Energy Sources-II	2		15	35	50
VSC		Basic Python Programming -II		2	15	35	50
SEC		Introduction to SciLab Programming language	2		15	35	50

Semester III

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Optics	2		15	35	50
Major Mandatory		Electronics	2		15	35	50
Major Mandatory		Physics Practical -III		2	15	35	50
Major Mandatory		Physics Practical -IV		2	15	35	50
Minor (T)		Applied Physics	2		15	35	50
		Physics Lab-I		2	15	35	50
OE		3) Physics in daily life	2		15	35	50
VSC		Opto-Electronics		2	15	35	50
FP				2	15	35	50

Semester IV

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Mathematical Methods in Physics -I	2		15	35	50
Major Mandatory		Oscillations, wave and Sound	2		15	35	50
Major Mandatory		Physics Practical -V		2	15	35	50
Major Mandatory		Physics Practical -VI		2	15	35	50
Minor (T)		Statistical Methods in Physics	2		15	35	50
Minor (P)		Physics Lab-II		2	15	35	50
OE		4) Inside the minds of brilliant physicists 5) Eminent Physicists of 21st Century	2		15	35	50
SEC		Basics of Drone Technology & Applications	2		15	35	50

Semester V

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Classical Mechanics	2		15	35	50
Major Mandatory		Atoms and Molecular Physics	2		15	35	50
Major Mandatory		Classical Electrodynamics	2		15	35	50
Major Mandatory		Physics Practical -VII		2	15	35	50
Major Mandatory		Physics Practical -VIII		2	15	35	50
Major Elective		Acoustics -I	2		15	35	50
Major Elective		Practical - Acoustics		2	15	35	50
		OR					
Major Elective		Materials Sciences-I	2		15	35	50
Major Elective		Practical - Materials Sciences		2	15	35	50
Minor (T)		Geo-Physics	2		15	35	50
Minor (P)		Physics Lab-III		2	15	35	50
VSC		Hands on practical on Photovoltaic Technology. OR Electrical Vehicles		2	15	35	50
FP				2	15	35	50

Semester VI

Course Type	Course code	Course Title	Credits		Evaluation		
			T	P	CE	SEE	Total
Major Mandatory		Quantum Mechanics	2		15	35	50
Major Mandatory		Thermodynamics and Statistical Mechanics	2		15	35	50
Major Mandatory		Solid State Physics					
Major Mandatory		Physics Practical -IX		2	15	35	50
Major Mandatory		Physics Practical -X		2	15	35	50
Major Elective		Acoustics -II	2		15	35	50
Major Elective		Practical - Acoustics		2	15	35	50
		OR					
Major Elective		Laser Technology	2		15	35	50
Major Elective		Practical - Laser Technology		2	15	35	50
Minor (T)		Elements of Material Science	2		15	35	50
Minor (P)		Physics Lab-IV		2	15	35	50

12. Program Articulation Matrices:

B.Sc. Physics Degree (Three-year Degree Program)

Total Credits for the Program: **120 - 132**

Discipline/Subject: PHYSICS

Starting year of implementation: 2023-2024

Program Articulation Matrix for Core Courses (Major)

Semester	Title of the Course	Theory/Practical	Credits
I	Mechanics and Properties of Matter	Theory	2
	Physics Principles and Applications	Theory	2
	Physics Practical -I	Practical	2
II	Heat and Thermodynamics	Theory	2
	Electricity and Magnetism	Theory	2
	Physics Practical -II	Practical	2
III	Optics	Theory	2
	Electronics	Theory	2
	Physics Practical -III	Practical	2
	Physics Practical -IV	Practical	2
IV	Mathematical Methods in Physics -I	Theory	2
	Oscillations, wave and Sound	Theory	2
	Physics Practical -V	Practical	2
	Physics Practical -VI	Practical	2
V	Classical Mechanics	Theory	2
	Atoms and Molecular Physics	Theory	2
	Classical Electrodynamics	Theory	2
	Physics Practical -VII	Practical	2
	Physics Practical -VIII	Practical	2
VI	Quantum Mechanics	Theory	2
	Thermodynamics and Statistical Mechanics	Theory	2
	Solid State Physics	Theory	2
	Physics Practical -IX	Practical	2
	Physics Practical -X	Practical	2

Program Articulation Matrix for Discipline Specific Elective (DSC EL)

Semester	Title of the Course	Theory/Practical	Credits
V	Acoustics -I	Theory	2
	Practical - Acoustics	Practical	2
	OR		
	Materials Sciences-I	Theory	2
	Practical - Materials Sciences	Practical	2
VI	Acoustics -II	Theory	2
	Practical - Acoustics	Practical	2
	OR		
	Laser Technology	Theory	2
	Practical - Laser Technology	Practical	2

Program Articulation Matrix for Minor:

Semester	Title of the Course	Theory/Practical	Credits
II	Bio-Physics	Theory	2
III	Applied Physics	Theory	2
	Physics Lab-I	Practical	2
IV	Statistical Methods in Physics	Theory	2
	Physics Lab-II	Practical	2
V	Geo-Physics	Theory	2
	Physics Lab-III	Practical	2
VI	Elements of Material Science	Theory	2
	Physics Lab-IV	Practical	2

Program Articulation Matrix for Indian Knowledge System Courses (IKS)

Semester	Title of the Course	Theory/ Practical	Credits
I	Indian Space Missions	Theory	2

Program Articulation Matrix for Open Elective (OE)

(These will be offered by Science Faculty for Arts)

Semester	Title of the Course	Theory/ Practical	Credits
I	1. Introduction to Astronomy	Theory	2
	2. Renewable Energy Sources - I	Theory	2
II	3. Medical Physics	Theory	2
	4. Renewable Energy Sources-II	Theory	2
III	5. Physics in daily life	Theory	2
IV	6. Inside the minds of brilliant physicists OR 6. Eminent Physicists of 21st Century	Theory	2

Program Articulation Matrix for Vocational Courses (VSC)

Semester	Title of the Course	Theory/Practical	Credits
I	Basic Python Programming -I	Practical	2
II	Basic Python Programming -II	Practical	2
III	Opto-Electronics	Practical	2
V	Hands on practical on Photovoltaic Technology **OR** Electrical Vehicles	Practical	2

Program Articulation Matrix for Skill Enhancement Courses (SEC)

Semester	Title of the Course	Theory/Practical	Credits
I	Basic Circuits and Network Analysis	Theory	2
II	Introduction to SciLab Programming language	Theory	2
IV	Basics of Drone Technology & Applications	Theory	2

Program Articulation Matrix for Field Project Courses (FP)

Semester	Title of the Course	Theory/Practical	Credits
III		Practical	2
V		Practical	2

13. Syllabus in detail (Sem-I)

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
	Bachelor of Science in Physics	
	Major (Theory) Subject SEMESTER – I	
Year – 1st	**Name of Paper – Mechanics and Properties of Matter**	**Credits 2**
Semester-I		**Hours 30**

Course specific outcomes- In this course students will learn,

- Propose different ways to implement three Newton's laws and apply them in calculations of the motion of simple systems.
- Use the free body diagrams to analyse the forces on the object.
- Understand the concepts of friction and the concepts of elasticity, fluid mechanics and be able to perform calculations using them.
- Demonstrate quantitative problem-solving skills in all the topics covered.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Motion** 1.1 Inertia 1.2 Frame of reference: 1.3 Inertial and non-inertial frame of reference 1.4 Newton's Laws: 1.5 Newton's First, Second and third law of motion, Examples, Problems 1.6 Kinematic Equations: 1.7 Three equations, problems 1.8 Friction: 1.9 Friction as component of contact force, Kinetic friction, static friction, friction coefficient, Problems.	**7**
Unit 2-	**Work and Energy** 2.1 Kinetic energy, Problems 2.2 Potential energy: Definition, Change in P. E. in a rigid body motion, Gravitational P. E., P.E. of Compressed and Extended spring, Problems 2.3 Work and Work energy theorem: Calculation of work done, Problems 2.4 Conservative and non-conservative forces	**8**
Unit 3-	**Fluid Mechanics** 3.1 Fluids:	

	3.2 Pressure in fluid, Pascals law, Archimede's principal, 3.3 Pressure difference and Buoyant force in accelerating fluids, Problems 3.4 Flow of fluids: 3.5 Steady flow and turbulent flow 3.6 Viscosity: 3.7 Concept of viscous force, definition, Poiseullie's equation, Stokes law, Terminal velocity, Critical velocity, Reynold's number, Problems 3.8 Equation of continuity, Problems 3.9 Bernoulli's principal: Statement, Derivation, Applications, Problems	**7**
Unit 4-	**Properties of Matter** 4.1 Surface tension: Definition, Units, dimensions, Surface energy, Contact angle, Jaeger's method, Excess pressure in a drop, Capillary action, Application, Problems 4.2 Elasticity: Stress, strain, Hooke's law and moduli of elasticity, Young's modulus, bilk modulus, Modulus of rigidity, Work done during the longitudinal strain, volume strain and Shearing strain, Poisson's ratio, Relation between three elastic moduli, Applications, Problems	**8**
References	1. Fundamentals of Physics: D. Resinick, R. Halliday and J. Walker, 6th Edition, John Wiley and Sons. Inc. 2. Concept of Physics: Vol.1: H. C. Verma, Bharti Bhawan Publishers and Distributors. 3. Searl's and Zemansky's University Physics Mechanics: H. D. young and R. A. Freedman, Pearson. 4. Mechanics: D. S. Mathur, S. Chand and Company Ltd. 5. Elements of Properties of Matter: D. S. Mathur, S. Chand and Company Ltd.	
Learning outcomes	After completion of this course students will get to know- ➢ Basics of mechanics and related dynamics ➢ To understand Newton's laws of motion ➢ Different forces those exist in nature and their physical significance ➢ Conservation of energy and their dynamics ➢ Deep knowledge of physical quantities such as Elasticity, Viscosity and Surface Tension ➢ Capacity to investigate and analyse the daily problems related to mechanical movement.	

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
	Bachelor of Science in Physics	
	Major (Theory) Subject SEMESTER – I	
Year – 1st **Semester-I**	**Name of Paper-Physics Principles and Applications**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- To introduce student to earlier development of modern physics.
- To introduce basic principle of LASER
- To make them aware of different bonding mechanism
- To introduce the spectrum of EM waves
- To introduce working principle of Solar cell.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Physics of Atoms** 1.1 Introduction to Atom: Atomic Models: Thomson's Atomic Model, Rutherford's Atomic Model, Bohr's Atomic Model 1.2 Classical planetary model of Hydrogen Atom 1.3 The Bohr Theory of the Hydrogen Atom 1.4 The Hydrogen Spectrum: Hydrogen like atoms. 1.5 Frank and Hertz Experiment 1.6 Problems.	**7**
Unit 2-	**Laser and Its Applications** 2.1 Introduction to LASERS 2.2 Basic Principle of Lasers: Three Processes 2.3 Characteristics of Lasers: brief explanation 2.4 Boltzmann Distribution Law 2.5 Population Inversion and pumping 2.6 Types of Lasers: Gas Laser: He-Ne Laser, Solid State Laser: Ruby Laser 2.7 Applications of Lasers 2.8 Problem	**8**
Unit 3-	**Physics of Molecules** 3.1 Introduction to Bonding 3.2 Forces Between Atoms	**7**

Unit 4-	3.3 Types of Bonding:- Ionic Bond, Covalent Bond, Vander Waal's Bond, Metallic Bond, Hydrogen Bond 3.4 Rotation energy levels of diatomic molecule 3.5 Vibration energy levels of a diatomic molecule 3.6 Problems. **Sources of Electromagnetic waves** 4.1 Introduction to Electromagnetic Waves: Historical Perspective 4.2 General properties of Electromagnetic radiations 4.3 Electromagnetic spectrum and its sources 4.4 Production of electromagnetic waves: Hertz Experiment 4.5 Plank's Hypothesis of Photons 4.6 Applications of various waves in electromagnetic spectrum	**8**
Unit 5-	**Introduction to Solar Cells** 5.1 Introduction to Basic working principle of Solar Cell 5.2 Diagram and graphical representation of I_m, V_m , I_{sc} , V_{oc} , FF , P_{in} ,P_{out} and Efficiency 5.3 Thin Film Solar Cells: Silicon Solar Cells –mono-crystalline, polycrystalline and Amorphous, Dye-Sensitized Solar Cells (DSSCs), Perovskite Solar Cells 5.4 Problems	**05**
References	1. Concepts of Modern Physics: A Beiser (6th ed., McGraw Hill, 2003 2. Modern Physics: Raymond A. Serway, Clement J. Moses, Curt A. Moyer 3. Sears and Zemansky's University Physics: H.D. Young R. A. Freedman, Sandin (11th Ed. Pearson Education) 4. LASERS: M. N. Avdhanulu, S. Chand Publications. 5. Solar Photovoltics Fundamentals, Technologies and Applications: Chetan Singh Solanki (3rd Ed. PHI).	
Learning outcomes	After completion of this course students will get to know- ➢ General structure of Atoms, spectrum of Hydrogen atom. ➢ Understand the fundamental working principle of LASER. ➢ Understand bonding mechanism and its different types. ➢ Understand working principle of solar cell, choice of material.	

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
Major/ (Physics Practical) Subject SEMESTER-I		
Year-Ist **Semester-**I	**Practical- Physics Practical-I**	**Credits 2** **Hours 60**

Course specific Objectives:- Practical Course in Physics will enable student to-

- Handle the apparatus carefully and cautiously to avoid any damage to the instrument.
- Know the limitations of measuring device and find its least count, error etc.
- Perform the experiment systematically and make precise observations.
- Interpret result and draw conclusions.
- To give hands on experience on modern physics related phenomena.

Sr. No.	COURSE CONTENT	Hours 60
1	Measurement of length using Vernier callipers.	
2	Measurement of diameter using Micrometer Screw Gauge.	
3	Measurement of diameter using Travelling Microscope.	
4	Determination of moment of inertia of a flywheel.	
5	Determination of divergence of LASER beam.	
6	To determine the wavelength of Laser light using Diffraction grating.	
7	Study of Modulus of rigidity of a wire using Torsional oscillations.	
8	Determination of coefficient of viscosity by Poiseuille's method.	
9	Determination of Young's modulus of material of flat spiral spring.	
10	Determination of modulus of rigidity of flat spiral spring.	
11	Study of surface tension by Jaeger's method.	
12	Determination of Young's modulus of material of a beam by method of bending.	
13	Measurement of Planck constant using LED.	
14	Determination of particle size using LASER beam.	
15	Study of I-V characteristics of solar cell.	

References	1. Advanced Practical Physics, Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publication 2. An Advanced Course in Practical Physics, D. Chattopadhyay, P.C. Rakshit, New Central Book Agency (P)Ltd 3. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited 4. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited 5. Advanced Practical Physics for students, B. L. Flint, H.T. Worsnop, 1971, Asia Pub. House. 6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. 7. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
Learning outcomes	On successful completion of this course student will be able to ➢ Use various types of measuring instruments used in physics laboratory. ➢ Skills to draw graph between two different physical quantities. ➢ Use of specific measurement instruments and experimental apparatuses used in the modern physics lab, including necessary precautions. ➢ How to present their experimental data in a laboratory report.

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE** **(AUTONOMOUS)**	**Academic Year 2023-2024**
Bachelor of Science in Physics		
OE (Theory) Subject SEMESTER – I		
Year – 1st **Semester-I**	**Name of Paper- Introduction to Astronomy**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- About our universe, its origin and its expansion.
- The sun, solar system, Planets, Star Clusters, Nebula, a galaxy and their observation from the earth.
- Indian astronomers and their work.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**The Universe** 1.1 Origin of the Universe 1.2 The early Universe 1.3 The Expanding Universe 1.4 The vast world of Galaxies	**7**
Unit 2-	**The Sun and Solar system** 2.1 The Sun and solar system 2.2 Introduction to the Planets and its movement 2.3 Stars- Origin, types, composition, characteristics, directions using stars, Black holes 2.4 Sky watch from the surface of earth	**8**
Unit 3-	**Earth and Moon** 3.1 Introduction to the Earth 3.2 The Moon 3.2 Effect of gravitation between the earth and moon 3.4 Satellites, it types and applications 3.5 Introduction to telescope	**7**
Unit 4-	**Indian Astronomers and their work** 4.1 Aryabhata 4.2 Subramanyam Chandrasekhar 4.3 Meghnad Saha 4.4 Jayant Naralikar 4.5 ISRO	**8**

References	1. A Cosmic Adventure Author: Jayant Naralikar translation by Mangala Naralikar, Rajhans Prakashan 2. COSMOS: Documentaries by Carl Sagan 3. Reading materials provided by teachers
Learning outcomes	After completion of this course students will get to know- ➢ Where we are in the universe? ➢ How does the sky look? ➢ The information of all planets and its motion in the solar system. ➢ The stars, celestial objects and telescopes to see them. ➢ Indian astronomers, their work and Indian institute

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in PHYSICS		
OE (Theory) Subject SEMESTER – I		
Year – 1st **Semester-I**	**Name of Paper- Renewable Energy Sources-I**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- To understand the need of renewable energy sources.
- The necessity of harnessing solar energy in the form of photo-thermal and photovoltaic applications.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**An Introduction to Energy Sources** 1.1 Energy: Definition, Classifications of energy sources 1.2 Conventional and non-conventional energy sources 1.3 Sun: The source of energy 1.4 Solar radiations outside earth atmosphere 1.5 Solar radiation at the earth surface	**10**
Unit 2-	**Photo-thermal Applications** 2.1 Solar cooker 2.2 Solar water heater 2.3 Flat plate collector 2.4 Solar distillation 2.5 Solar green houses	**10**
Unit 3-	**Photovoltaic systems** 3.1 Solar Energy-Key features, its importance 3.2 Merits & demerits of solar energy 3.3 Applications of solar energy 3.4 Solar cell 3.5 Types of Solar Cell	**10**
References	1. Non-conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi. 2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc. Graw Hill Ltd, New Delhi. 3. Solar Energy Utilizations**,** G. D. RAI (5th edition), Khanna Publishers, Delhi.	

	4. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer 5. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press. 6. Battery Systems Engineering by C. D. Rahn and C. Wang, Wiley Pub. 7. Electrochemical Energy Storage for Renewable sources and grid balancing by P. T. Moseley and J. Garche, Elsevier Science. 8. Solar Photovoltaic Technology and Systems by C S Solanki
Learning outcomes	Upon completion of the Introduction to Renewable Energy Systems course, the student should be able to: ➢ Identify various sources of renewable energy ➢ Examine each of the principal renewable energy sources in terms of physical principles, its cost and environmental impact, and its future prospects. ➢ Describe the potential applications of renewable energy. ➢ Discuss the major environmental factors associated with energy production, distribution and consumption.

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024

Bachelor of Science in Physics

VSC Practical Course SEMESTER – I

Year: Ist	Name of Paper: Basic Python Programming-I	Credits 2
Semester: I		Hours 30

Course specific outcomes- In this course students will learn,

- Understanding the basics of Python programming along with the development of the logic that lies within
- Writing the Python codes independently for the numerical/arithmetical/complex mathematical operations on the given data sets
- Generating the ability to transfer the Physics equations into codes for better understating of the important variables and scientific parameters present in that equations
- Understanding and using of the different loops, data types and functions in the Python coding and applying them to find solutions to the Physics problems
- Defining own Python functions for arguments and operations on the given data sets.

Sr. No.	COURSE CONTENT / SYLLABUS	Lectures
1	1. Step by step installation of Python's latest version (3.11) from online Python Installer (or Pydroid 3 app on the smart phone)	
2	2. Installation of the IDE (Jupyter/Spyder/PyCharm) on the personal computer or in the smart phone	
3	3. Writing of Physics Equations in Python Programming: 3.1. Newton's Laws of Motion 3.2. Laws of Thermodynamics 3.3. Bohr's Postulates from Atomic Model	
4	4. Basic mathematic and arithmetic operations in Python Programming: 4.1. Addition, Subtraction, Multiplication, Division, Modulo-division, Exponent, Truncation 4.2. Logical operators and Comparison operators.	
5	5. As per the concepts from the atomic models, calculate: 5.1. The fraction of volume occupied by a proton (V_p) within the volume of that nucleus (V_N) 5.2. The fraction of volume occupied by that nucleus (V_N) within the volume occupied by that atom (V_A) 5.3. In order to visualise above fraction in the real world, consider the nucleus to be 1 *foot* and calculate the size of the atoms in *feet* or *km.*	
6	6. Error analysis calculations: Values of length (l), breadth (b), and height (h) of a glass block readings are given. Also been provided standard readings of the same glass	

	block by the manufacturing company. Then using Python programming, find the % error in readings for: 6.1. 7Average length (l_A) 6.2. Average breadth (b_A) 6.3. Average height (h_A) 6.4. Average volume of the glass block (AV_g) 6.5. Standard Deviation (σ_s) for each of the above
7	7. Conversion of units: By writing a Python code convert the following values as per the suggested units: 7.1. Consider the weight 10,000 *mg*, convert this value into μ*gm gm* and *kg* as output value 7.2. The wavelength of the sodium lamp is 5890 A^0. Convert this wavelength into *nm*, *mm*, *cm*, and *m* 7.3. Convert input temperature value from Fahrenheit scale to the Degree Celsius scale.
8	8. Conversion of clock hour time: By using a Python code, convert any given time in seconds into the following format: 8.1. Hour(s), Minute(s), Second(s) 8.2. Hr : Min : Sec
9	9. Understand the range of electromagnetic radiations: Using the conditionals and looping in the Python programming, create a Python code to differentiate different wavelength/frequency dependent electromagnetic range that should include: 9.1. γ-rays 9.2. X-rays 9.3. Ultra-Violet 9.4. Visible 9.5. NIR-IR-FIR 9.6. Microwaves 9.7. Radio waves
10	10. Using the conditionals and looping in the Python programming, create a Python code to calculate the wavelength (λ) of the electromagnetic radiations in the visible range where the energy (E) of that radiation is used as input value (from 2 eV to 2.75 eV). The output of wavelength (λ) value should accompany with the colour of the radiation such as: Violet, Indigo, Blue, Cyan, Green, Yellow, Orange, Red.
11	11. Using the conditional statements in the Python programming, create a Python code to determine the given flow of a fluid is laminar or turbulent as a function of Reynold's Number (R)
12	12. Using the conditional statements in the Python programming, create a Python code to differentiate whether the material is hydrophobic or hydrophilic in nature as a function of contact angle (Θ)

13	13. Using iteration methods and looping in the Python programming, calculate the pressure at different depth levels below sea surface using P_2-$P_1 = h\rho g$
14	14. As a function of input principal quantum number (n), calculate: 14.1. Radius of Bohr's orbit (r_n) 14.2. Velocity (v_n) of that orbiting electron 14.3. Energy (E_n) of the electron
15	15. Distinguish the standard emission series of a hydrogen atom (take value of n up to 8 and value of p up to 5) as function of output wavelength (λ). Discuss comparatively: 15.1. Name the standard emission series (from Lyman to Pfund) as a function of output wavelength (λ) 15.2. The origin of H_α, H_β, H_γ and H_δ lines in Balmer series
References	1. Python Programming: Using Problem Solving Approach. By Reema Thareja (1st Edition) 2. Let Us Python By Aditya Kanetkar (3rd Edition) 3. Learning To Program With Python by Richard Halterman (Online Book) 4. Python The Ultimate Beginner's Guide by Andrew Johansen (Online Book) 5. Learn Python Pro (Mobile App) 6. Python X (Mobile App) 7. Pydroid 3 (Mobile App)
Learning Outcomes	On completion of the course, students will be able to : ➢ Write codes, syntax and fame the program ➢ Correlate the physics problem with statements in language. ➢ Combine two programs together to form loops ➢ Remove errors and debug them. ➢ Can analyse the output generated by the computer

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
	Bachelor of Science in Physics	
	SEC (Theory) Subject SEMESTER – I	
Year – 1st	**Name of Paper- Basic Circuit Theory and Network Analysis**	**Credits 2**
Semester- I		**Hours 30**

Course Objectives: In this course students will learn,

- To get knowledge about shorts and open in a circuit.
- To get basic understanding of circuit analysis.
- To study circuit theorems and laws to simplify the electrical circuits.
- To design and analyse the circuits using Resistors, Voltage sources and Current sources.

Sr. No.	COURSE CONTENT / SYLLABUS	Hours
Unit 1	**Series-Parallel Networks.** 1.1 Ohm's Law. 1.2 Voltage Divider Circuits. 1.3 Current Divider Circuits. 1.4 Analysing Series Parallel Circuits. 1.5 Problems. 1.6 Demonstration/ Hands-on.	
Unit 2	**Kirchhoff's Laws** 2.1 Kirchhoff's Current law. 2.2 Kirchhoff's Voltage Law. 2.3 Network analysis using KCL and KVL. 2.4 Mesh Analysis. 2.5 Nodal Analysis. 2.6 Problems. 2.7 Demonstration/ Hands-on.	**14**
Unit 3	**Thevenin's and Norton's Theorems** 3.1 Thevenin's Theorem. 3.2 Proof of the theorem. 3.3 Norton's Theorem. 3.4 Proof of the theorem. 3.5 Problems.	**16**

Unit 4	3.6 Demonstration/ Hands-on. **Superposition and Maximum Power Transfer Theorems** 4.1 Superposition Theorem. 4.2 Proof of the theorem. 4.3 Maximum Power Transfer Theorem. 4.4 Proof of the theorem. 4.5 Problems. 4.6 Demonstration/ Hands-on.	
References	1. Principles of Electronics, V. K. Mehta, S. Chand Publication. 2. Essentials of Circuit Analysis, Robert L. Boylestad, Pearson Education. 3. Fundamentals of Electric Circuits, Alexander and M. Sadiku, McGrow Hill. 4. Electronics Principles, Malvino, 7th Edition, Tata McGrow Hill.	
Learning outcomes	On successful completion of this course the students will be able to ➢ Analyse the series and parallel circuits. ➢ Understand shorts and open in a circuit. ➢ Design circuits using resistors, Voltage Sources and Current Sources. ➢ Apply the Network Theorems to simplify the electronic circuits.	

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
Indian Knowledge System (Theory) Subject SEMESTER – I		
Year – 1st	**Name of Paper – Indian Space Mission**	**Credits 2**
Semester-I		**Hours 30**

Course specific outcomes- In this course students will learn,

- About Space mission, its origin and its expansion.
- To understand Fundamental principles governing ascent mission design.
- To provide exposure to basic concept of Spacecraft orbital mechanics.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Space Mission** 1.1 Introduction 1.2 History of the Indian Space Program 1.3 Current Status of Space Programmes 1.4 Space Mission Configuration.	**6**
Unit 2-	**Fundamental principles** 2.1 Role of launch vehicles and Spacecraft 2.2 Ascent mission objectives, Mathematical models 2.3 Effect of drag and gravity on mission performance 2.4 Parts of launch vehicle and spacecraft.	**8**
Unit 3-	**Concept of orbit** 3.1 Introduction 3.2 Two body problem and Kepler's laws 3.3 Orbital parameters and orbit from initial condition 3.4 Types of orbits.	**8**
Unit 4-	**Major Mission and achievements of ISRO** 4.1 Chandrayaan- 1, 2 & 3 4.2 Gaganyaan 4.3 Shukrayaan – I 4.4 GSAT-14	**8**

References	1. Thompson, 'Introduction to Space Dynamics', Dover Publications, New York, 2. 1986. 3. Hale, 'Introduction to Space Flight', Prentice Hall, 1994. 4. Wiesel, 'Spaceflight Dynamics', McGraw-Hill, 1997. 5. Curtis, 'Orbital Mechanics for Engineering Students', 2nd Ed., Elsevier, 2010. 6. Walter, 'Astronautics: The Physics of Space Flight', Wiley-VCH, 2012.
Learning outcomes	After completion of this course students will get to - ➢ Understand the scientific goals of space mission and related instrumentation. ➢ Understand of challenges and risk facing current and future mission.

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
Major (Theory) Subject SEMESTER – II		
Year – 1st **Semester-II**	**Name of Paper – Heat and Thermodynamics**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- To be able to state the First Law and to define heat, work, thermal efficiency and the difference between various forms of energy.
- To understand the role of internal energy, enthalpy, entropy, and heat absorbed, work done etc…
- To be able to learn the different thermodynamic processes like isothermal, adiabatic, and isochoric.
- To learn the ideal heat engine, petrol and diesel engine. On the same note one can learn the refrigeration cycle.
- To understand the different temperature scale and thermometers and their applications.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Fundamentals of Thermodynamics** 1.1 Introduction- Kinetic theory of gases- assumptions. 1.2 Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Indicator diagram, Intrinsic and extrinsic properties, Problems. 1.3 Thermal equilibrium, Zeroth law of thermodynamics 1.4 Thermodynamic processes: Adiabatic and Isothermal changes, Indicator diagram, Work done during isothermal change, Work done during adiabatic change, Problems. 1.5 Internal energy, Internal energy as state function, First law of thermodynamics, Problems. 1.6 Heat capacity and specific heat capacity, Problems. 1.7 Reversible and Irreversible changes.	**8**
Unit 2-	**Applied Thermodynamics** 2.1 Conversion of heat into work and it's converse, 2.2 Second law of thermodynamics, Concept of entropy and physical significance, Temperature - entropy diagram, T-dS equations, 2.3 Clausius - Clapeyron latent heat equations, Problems.	**7**
Unit 3-	**Heat Transfer Mechanisms** 3.1 Carnot's cycle and Carnot's heat engine and its efficiency, Problems	**7**

Unit 4-	3.2 Heat Engines: Otto cycle & its efficiency, Diesel cycle & its efficiency, Problems **Low temperature Physics** 4.1 Concept of heat & temperature, Temperature scales & interconversions, Problems 4.2 Methods for producing low temperature-Joule Thomson porous plug experiments 4.3 Refrigerators: General principle and coefficient of performance of refrigerator, Air Conditioning: Principle and its applications, Problems. 4.4 Thermometry - Principle of Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, bimetallic thermometers, Platinum resistance thermometer, Thermocouple.	**8**
References	1. Concept of Physics: H. C. Verma, Bharati Bhavan Publisher. 2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd. 3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7 th Edition, Mc-Graw Hill International Edition. 4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House. 5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta. 6. Instrumentation: Devices & Systems, Rangan, Mani, and Sarma.	
Learning outcomes	After completion of this course students will get to know- ➢ Describe the basic concepts of like, system and surrounding, closed, open and isolated systems, extensive and intensive variables. ➢ Formulate the zeroth, first and second law of thermodynamics. ➢ Find the work done under isothermal and adiabatic processes. ➢ Relate the Carnot cycle, Otto cycle and Diesel cycle with real life.	

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
Major (Theory) Subject SEMESTER – II		
Year – 1st **Semester-II**	**Name of Paper – Electricity and Magnetism**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- It gives an opportunity for the students to learn about one of the fundamental interactions of electricity and magnetism.
- To introduce students to dielectric material.
- To introduce magnetic materials and their properties.

Sr. No.	COURSE CONTENT / SYLLABUS	Lectures
Unit 1-	**Electrostatics** 1.1 Revision of Coulomb's Law: Statement Variation of force with distance 1.2 Superposition principle: Statement, Explanation with illustration 1.3 Electric Field due to point charge 1.4 Electric Field due to Continuous charge distribution: Line charge, Charged sphere, Surface charge 1.5 Electric potential due to point charge, system of charges 1.6 Gauss's Law in Electrostatics 1.7 Application of Gauss's Law – Cylindrical, Spherical and Planar symmetry 1.8 Comparison between Coulomb's Law and Gauss's Law 1.9 Problems.	**7**
Unit 2-	**Dielectrics** 2.1 Introduction to dielectric materials: Electric Dipole, Electric Dipole moment 2.2 Electric potential and intensity at any point due to dipole 2.3 Torque on a dipole placed in an electric field 2.4 Polar and non-polar molecules 2.5 Electric polarization of dielectric material 2.6 Gauss's Law in dielectric 2.7 Electric vectors and its relation 2.8 Effect of dielectric material on capacitance	**8**

	2.9 Problems	
Unit 3-	**Magnetostatics** 3.1 Revision of Biot-Savart's Law 3.2 Applications of Biot-Savart's Law: Long straight conductor, Circular coil 3.3 Ampere's Circuital Law (statement only) 3.4 Applications of Ampere's Circuital Law: Straight Current Carrying wire, Solenoid, and Toroid. 3.5 Gauss's Law for magnetism 3.6 Problems	**7**
Unit 4-	**Magnetic Properties of Materials** 4.1 Introduction to Magnetization 4.2 Types of Magnetic Materials: Diamagnetic, Paramagnetic, Ferromagnetic, and Antiferromagnetic. 4.3 Introduction to Bohr magneton 4.4 Magnetization (M) 4.5 Magnetic intensity(H) 4.6 Magnetic Induction (B) 4.7 Relation between B, H and M 4.8 Hysteresis and Hysteresis curve 4.9 Ferrite materials and its applications 4.10 Problems	**8**
References	1. Fundamentals of Physics: HallidayResnik and Walkar, 8th Edition. 2. Electromagnetics: B. B. Laud. 3. Concept of Physics : H.C. Verma 4. Electricity and Electronics: D.C.Tayal, Himalaya Publishing House, Mumbai. 5. Electricity and Magnetism: BrijLal, Subramanyan, RatanPrakashan (Revised edition, 1997). 6. Electricity and Magnetism: Khare, Shrivastav (Revised edition, 1997). 7. Introduction to Electrodynamics: D.G. Griffith	
Learning outcomes	After completion of this course students will get to know- ➢ Understand the concept of the electric force, electric field and electric potential for stationary charges. ➢ Understand dielectric phenomenon and effect electric field on dielectric ➢ Apply Gauss's law to variety of problems ➢ Understand Biot-Savart and Ampere's Circuital laws and its application in real world problems. ➢ Understand magnetic material and their properties.	

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in PHYSICS		
Major/ (Physics Practical) Subject SEMESTER-II		
Year- Ist	**Practical- Physics Practical-II**	**Credits 2**
Semester-II		**Hours 60**

Course specific Objectives:- Practical Course in Physics will enable student to-

- Handle the apparatus carefully and cautiously to avoid any damage to the instrument.
- Know the limitations of measuring device and find its least count, error etc.
- Perform the experiment systematically and make precise observations.
- Interpret result and draw conclusions.

Sr. No.	COURSE CONTENT	Hours 60
1	To use multimeter for measuring (a) Resistance (b) AC and DC voltage (c) Continuity in circuit.	
2	Determination of a frequency of AC mains.	
3	To determine the coefficient of thermal conductivity of a bad conductor by Lee's method.	
4	I-V characteristics of ohmic and non ohmic conductor.	
5	Determination of horizontal component of Earth's magnetic field.	
6	Study of temperature coefficient of thermister.	
7	Study of thermocouple.	
8	Study of specific heat of graphite.	
9	Study of charging and discharging of capacitor.	
10	Study of L-R circuit.	
11	Verification of Kirchhoff's current law.	
12	Verification of Kirchhoff's voltage law.	
13	Comparison of two capacitances by De Sauty's bridge.	
14	Conversion of a moving coil Galvanometer in to voltmeter.	
15	Use of MS-Excel for graph plotting.	

References	1. Advanced Practical Physics, Vol 1, B. Ghosh, K. G. Majumder, Sreedhar Publication 2. An Advanced Course in Practical Physics, D. Chattopadhyay, P.C. Rakshit, New Central Book Agency (P)Ltd. 3. B.Sc. Practical Physics, C.L. Arora, S Chand and Company Limited 4. Practical Physics, P.R. Sasi Kumar, PHI Learning Private Limited 5. Advanced Practical Physics for students, B. L. Flint, H.T. Worsnop, 1971, Asia Pub. House. 6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. 7. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
Learning outcomes	On successful completion of this course student will be able to ➢ Use various types of measuring instruments used in physics laboratory. ➢ Skills to draw graph between two different physical quantities. ➢ How to present their experimental data in a laboratory report.

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
Minor (Theory) Subject SEMESTER – II		
Year – 1st	**Name of Paper- Biophysics**	**Credits 2**
Semester- II		**Hours 30**

Course Objectives:

- The use of ideas and methods of Physics.
- To study and explain the structure of living organisms and mechanism of life process.
- To get understanding atomic and nuclear properties of the matter.

Sr. No.	COURSE CONTENT	Hours
Unit 1-	**Introduction** 1.1 Scope and definition of Biophysics. 1.2 Biophysics at macroscopic, microscopic level and at the molecular level.	**14**
Unit 2-	**Atomic structure** 2.1 Historical background 2.2 Bohr model, Significance of second and third postulate of Bohr's model. Derivation of radius and energy value. Quantization of energy levels. 2.3 Vector atom model. 2.4 Quantum numbers. Selection rules. Pauli's exclusion principle.	
Unit 3-	**Radioactivity** 3.1 Nucleus: Properties, Nuclear forces. 3.2 Nuclear models: liquid drop and shell model, radioactive nucleus. 3.3 Nuclear radiations and their properties - alpha, beta and gamma, 3.4 Half-life period,	**16**

	3.5 Physical and biological handling of alpha and beta emitting isotopes.	
Unit 4-	**Cell membrane** 4.1 Structure and functions of plasma membrane, 4.2 Diffusion basics. 4.3 Passive and active transport. Membrane potential, Nernst equation. 4.4 Electrical properties of cell: Passive- capacitance, resistance, and 4.5 Active properties. 4.6 Electrical model (equivalent) of cell membrane. 4.7 Depolarization, hyperpolarization of membrane (neuronal). Generation of action potential. 4.8 Biopotentials: types and measurement	
Unit 5-	**Biophysical properties** 5.1 Surface tension, adsorption, diffusion, osmosis, dialysis and colloids	
References	1. Biophysics, an introduction. 1st edition. (2002) Cotteril R. John Willey and Sons Ltd., USA 2. Biophysics. 1st edition (2002), Pattabhi V and Gautham N. Kluwer Academic Publisher, USA. 3. Textbook of optics and atomic physics, 8th edition (1989) P.P. Khandelwal, Himlaya Publishing House, India. 4. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata McGraw Hill, India. 5. Nuclear Physics: An Introduction. 2nd edition (2011). S. B. Patel. Anshan Publication, India.	
Learning outcomes	On successful completion of this course the students will be able to ➢ Examine biophysical scenarios using both a conceptual understanding of the core concepts of the Biology and Physics. ➢ Apply their Physics and Biophysics knowledge to analyse new biophysical situations. ➢ Analyse quantitatively the physical and chemical aspects of the functions of biological molecules, organisms and entities.	

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE** **(AUTONOMOUS)**	**Academic Year 2023-2024**
Bachelor of Science in PHYSICS		
OE (Theory) Subject SEMESTER – II		
Year – 1st	**Name of Paper- Renewable Energy Sources-II**	**Credits 2**
Semester - II		**Hours 30**

Course specific outcomes- In this course students will learn,

- The emphasis on the fundamental of non-conventional energy sources (solar, wind, and biomass).
- Harnessing the energy through these sources using efficient technologies is expected to play an important role in serving as clean energy source for mankind. Thus, processes to harness energy are steadily gaining technical and economic importance worldwide. Therefore, it is necessary for energy planners/ users to know the facts as well as limitations of these technologies.
- This course aims at bringing the technological developments and research trends in the field of non-conventional energy sources with emphasis on engineering and design aspects.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Bioenergy and Biofuels** 1.1 Introduction to Bioenergy 1.2 Biogas plant: Floating gas holder and fixed dome type biogas plant, construction and working. 1.3 Factors affecting on bio-digestion (list of factors). 1.4 Comparative study of floating gas holder and fixed dome type biogas plant. 1.5 Working of downdraft gasifier. 1.6 Various methods to obtain energy from biomass. 1.7 Introduction to Biofuels. 1.8 Production of Biofuels (Jatropa and Sugar cane bagasse)	10
Unit 2-	**Wind Energy** 2.1 Introduction to wind energy. Principles and components of wind energy conversion system	10

	2.2 Classification of wind machines: Horizontal axial machine and vertical axial machine 2.3 Advantages and disadvantages of wind energy	
Unit 3-	**Other Energy Sources** 3.1 Introduction to tidal and geothermal energy 3.2 Tidal energy: methods of utilization of tidal energy 3.3 Advantages and disadvantages of tidal power generation 3.4 Geothermal energy: Geothermal sources and energy conversion 3.5 Advantages and disadvantages of geothermal energy	**10**
References	1. Non-conventional Energy Sources, G. D. RAI (4th edition), Khanna Publishers, Delhi. 2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc Graw Hill Ltd, New Delhi. 3. Solar Energy Utilization**,** G. D. RAI (5th edition), Khanna Publishers, Delhi. 4. Energy Management: W. R. Murphy, G. Mckay (Butterworths). 6. Efficient Use of Energy: I. G. C. Dryden (Butterworth Scientific) 7. Energy Economics - A. V. Desai (Wiley Eastern)	
Learning outcomes	At the end of this course students will get to know- ➢ Fundamentals of bioenergy and biofuels ➢ Working of biogas plants and energy conversion ➢ Wind energy, its energy storage and utilization ➢ Tidal energy and geothermal energy, its benefits and drawbacks	

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE** **(AUTONOMOUS)**	**Academic Year 2023-2024**
Bachelor of Science in Physics		
OE (Theory) Subject SEMESTER – II		
Year – 1st	**Name of Paper- Medical Physics**	**Credits 2**
Semester-II		**Hours 30**

Course specific outcomes- In this course students will learn,

- About basic terms related to medical physics.
- The various medical imaging techniques required for diagnosis.
- Applications of lasers in diagnosis.
- Indian astronomers and their work.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	**Physics in Medical Appliances** 1.1 Introduction 1.2 Thermometers 1.3 Stethoscope 1.4 Sphygmomanometer 1.5 Pulse oximeter 1.6 Electrocardiogram (ECG)	**10**
Unit 2-	**Medical Imaging Techniques** 2.1 Introduction: Interaction of radiation with matter 2.2 Magnetic Resonance Imaging (MRI) 2.3 X-ray imaging systems 2.4 Computerized tomography (CT) scan 2.5 Thermography 2.6 Optical imaging techniques	**10**
Unit 3-	**Laser in Medical Science** 3.1 Diagnosis 3.2 Therapy 3.3 Surgical applications	**10**
References	1. E. B. Podgorsak, Radiation Physics for Medical Physicists, 3rd Edition, Springer, 2016. 2. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science "An Introduction to Material in Medicine" Third Edition, 2013. 3. The Essential Physics for Medical Imaging–2 nd Edition–Jerrold T Bushberg, Lippincott Williams & Wilkins 2002.	

Learning outcomes	A student completing a major in Physics shall demonstrate the ability to: ➢ Demonstrate conceptual understanding of fundamental physics principles. ➢ Communicate physics reasoning in oral and in written form. ➢ Solve physics problems using qualitative and quantitative reasoning including sophisticated mathematical techniques. ➢ Conduct independent research or work successfully in a technical position.

	MODERN EDUCATION SOCIETY'S NOWROSJEE WADIA COLLEGE, PUNE (AUTONOMOUS)	Academic Year 2023-2024
Bachelor of Science in Physics		
VSC Practical Course for FYBSc		
Year: Ist **Semester: II**	**Name of Paper: Basic Python Programming-II**	**Credits 2** **Hours 30**

Course specific outcomes:

- Building on the basics of Python programming concepts and logic learned in the previous semester and develop further advancements
- Complete understanding of utilization of different external and in-built modules and related operations on given data sets
- Mastering of the basic data analysis and data representation in the field of Physics
- Understanding of data structures such as list, tuple and dictionary along with related operations as well as applications in Python coding to solve Physics related problems
- Understanding in-depth graph plotting methods and graphical representation methods in Python coding using various library functions

Sr. No.	COURSE CONTENT	Lectures
1	1. Introduction to modules and their detailed step by step installation in Python Programming	
2	2. Import Math Module for operation on numbers: 2.1. Trigonometric functions 2.2. Logarithmic functions 2.3. Mathematical functions 2.4. Arithmetic functions	
3	3. Import Random Module for: 3.1. Generation of random integers 3.2. Creating dice game 3.3. Generating random item from a given sample space and calculating its probability.	
4	4. Classification of the given list of materials on the basis of Magnetic Susceptibility (χ) in to first non-magnetic and magnetic categories and then in to different magnetic categories such as diamagnetic, paramagnetic, ferromagnetic etc.	
5	5. Data Structures: 5.1. Introduction to list, tuple, set, dictionary 5.2. Different operations on data structures 5.3. Applications of data structures in physics	
6	6. Import Matplotlib.pyplot Library for graphical representation of given data: 6.1. Introduction to plot() function 6.2. Introduction to pie() function	

	6.3. Introduction to bar() function
7	7. Plotting of the isothermal and adiabatic curves: 7.1. For isothermal PV=constant 7.2. For adiabatic PV^{γ}=constant.
8	8. Plotting of various mathematical functions using Matplotlib functions: 8.1. e^x plot 8.2. *log(x)* plot 8.3. $\|x\|^2$ plot.
9	9. To make a list/tuple of angles from 0^o to 360^o in steps of 15^o and plotting circle, ellipse, sine, cosine functions as output.
10	10. Addition or multiplication of two any general (mxn) matrices.
11	11. Calculations of intensity of electric field, electric potential, and columbic force for a given system of charge(s) and analysis of influence of each parameter.
12	12. Plotting of the charging/discharging curves for a given RC circuit and finding of the time constant for the same.
13	13. Calculation of the electric field due to an electric dipole system: 13.1. On its axial line 13.2. On its equatorial line
14	14. Calculation of the torque acting on an electric dipole placed in the externally applied uniform electric field
15	15. Calculation of the temperature coefficient of resistance for a given material system and plotting of the data sets.
References	1. Python Programming: Using Problem Solving Approach. By Reema Thareja (1st Edition) 2. Let Us Python By Aditya Kanetkar (3rd Edition) 3. Learning To Program With Python by Richard Halterman (Online Book) 4. Python The Ultimate Beginner's Guide by Andrew Johansen (Online Book) 5. Data Analytics using Python by Bharti Motwani 6. Learning with Python by Allen Downey.
Learning Outcomes	On completion of the course, students will be able to : ➢ Define their problem/task in python code and give it to computer. ➢ Plot any type of graphs using python graphical libraries. ➢ Can analyse the output and graphs generated by the computer. ➢ Could able to do simple scientific animation using pygame.

	MODERN EDUCATION SOCIETY'S **NOWROSJEE WADIA COLLEGE, PUNE** **(AUTONOMOUS)**	**Academic Year 2023-2024**
Bachelor of Science in Physics		
SEC (Theory) Subject SEMESTER – II		
Year – 1st **Semester-II**	**Name of Paper- Introduction to SciLab**	**Credits 2** **Hours 30**

Course specific outcomes- In this course students will learn,

- To analyse knowledge of physics and mathematics and transformed into a computer program.
- To provide a powerful computing environment for scientific applications.
- To introduce basic concepts of scientific programming using Scilab.
- It is a high level programming language allowing access to advanced data structures, 2-D and 3-D graphical functions.

Sr. No.	COURSE CONTENT	Lectures
Unit 1-	1.1 Introduction to Scilab – what is Scilab, downloading & installing scilab, a quick taste of scilab. 1.2 The Scilab Environment – manipulating the command line, working directory, comments, variables in memory, the scilab menu bar. 1.3 Scalars & Vectors – introduction, initializing vectors in scilab, mathematical operations on vectors, relational operations on vectors, logical operations on vectors, built-in logical functions. 1.4 Practical demonstration / Hands on experiments	**6**
Unit 2-	2.1 Scalars & Vectors – elementary mathematical functions, mathematical functions on scalars, trigonometric functions, inverse trigonometric functions, Matrices – introduction, arithmetic operators for matrices, basic matrix processing. 2.2 Polynomials – introduction, creating polynomials, basic polynomial commands, finding roots of polynomial, polynomial arithmetic, miscellaneous polynomial handling. 2.3 Practical demonstration / Hands on experiments	**6**
Unit 3-	3.1 Basic plotting, Built in functions, Generating waveforms, load and save, Standard input and output statements and plot functions, simple graphs, multiple plots, other features, styles.	**7**

	3.2 Practical demonstration / Hands on experiments.	
References	1. Introduction to Scilab, Consortium Scilab 2. Scilab (a Free Software to Matlab),Er. HemaRamachandran and Dr. Achutsankar Nair, S. Chand Publishers, ISBN-10: 8121939704, 2011. 3. Scilab - A Beginner's Approach by Anil Kumar Verma 4. Scilab: A Practical Introduction to Programming and Problem Solving Book by Tejas Sheth,2016 5. http://in.mathworks.com/ 6. http://spoken-tutorial.org/ 7. https://www.scilab.org/resources/documentation/tutorials	
Learning outcomes	After completion of this course students will get to know- ➢ Understand the main features of the Scilab program development environment to enable their usage in the higher learning. ➢ Implement simple mathematical functions/equations in Scilab. ➢ Interpret and visualize simple mathematical functions and operations there on using plots/display.	

Suggested Activities [15 Hrs.]

Sr. No.	Practical demonstrations to communicate concepts and applications in Physics.
1	Use built commands to simplify given algebraic expression.
2.	Addition, subtraction and of two matrices.
3.	Multiplication of two matrices.
4.	Verify whether the given matrix is singular or non-singular and compute its inverse if applicable.
5.	Sorting of 1-D array and searching of an element in an array.
6.	Plot the governing equation of given physical phenomenon e.g. voltage across capacitor during charging $\mathbf{V_c = V_0[1-e^{-(t/RC)}]}$.
7.	Plot a straight line for the given slope and intercept using different plot attributes.
8.	Plot standard curves e.g. equation of circle, parabola.
9.	Integrate sin(x) or cos(x) and display the results on the same plot in different colours.
10.	Programming in SciLab using if else statement
11.	Programming in SciLab using for loop.
12.	Programming in SciLab using while loop.

Note:-

1. Out of the total time allotted to each unit, half the time should be utilized for classroom teaching and remaining half for the activity/demonstration.
2. Student should be encouraged to study this course using 'hands-on' experience.

14. EVALUATION PATTERN :

(i) Each course shall be evaluated with Continuous Evaluation (CE) and Semester-end Examination (SEE) mechanism.

(ii) Distribution of marks CE and SEE for theory and practical courses:

Theory Courses			
Credits	**CE (marks)**	**SEE (marks)**	**Total (Marks)**
04	30	70	100
02	15	35	50
Practical Courses			
02	15	35	50

15. PASSING MARKS:

(i) Passing marks will be 40 % in each paper of continuous evaluation and semester end exam separately.

Course Credits	**Passing marks CE (a)**	**Total marks CE (b)**	**Passing marks SEE (c)**	**Total Marks SEE (d)**	**Total Passing marks (a+c)**	**Total marks (b+d)**
02	06	15	14	35	20	50
04	12	30	28	70	40	100

(i) To pass a course of 2 credits, a student has to earn minimum 20 marks out of 50, provided that he/she should earn minimum 6 marks in Continuous Evaluation (out of 15) and minimum 14 marks (out of 35) in End-Semester Examination. That is passing criterion is minimum 40% marks in the examination.

(ii) For 4 credit course, a student has to earn minimum 40 marks out of 100, provided that he/she should earn minimum 12 marks in Continuous Evaluation (out of 30) and minimum 28 marks (out of 70) in End-Semester Examination. That is passing criterion is minimum 40% marks in the examination.

16. PROCEDURE FOR CONTINUOUS EVALUATION

CE type	02 Credits course	04 Credits course
Written test	10 marks	20 marks
Assignment	3 marks	5 Marks
Seminar/ attendance	2 marks	5 Marks
Total marks (CE)	**15 marks**	**30 marks**

(i) For Continuous Evaluation 2 credit course, (out of 15 marks), there has to be one written test of 10 marks (Mid-Semester Examination). The remaining 5 marks shall be based on the continuous evaluation consisting of tutorial, viva, seminars, home-assignments, mini project, survey, group discussion etc. (on approval of Head of the Department) and performance and attendance in the lectures and labs.

(ii) For Continuous Evaluation 4 credit course, (out of 30 marks), there has to be one written test of 20 marks (Mid-Semester Examination). The remaining 10 marks shall be based on the continuous evaluation consisting of tutorial, viva, seminars, home-assignments, mini project, survey, group discussion etc. (on approval of Head of the Department) and performance and attendance in the lectures and labs.

17. PATTERN OF THE QUESTION PAPER (CE THEORY PAPERS)

(1) As a part of Internal Evaluation, there shall be written test (Mid-Semester Examination). Pattern of the question paper is as follows.

(2) Continuous Evaluation for 2 credits courses (Mid-Semester Examination of 10 marks, Duration: 45 min)

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	5	Solve any 5 out of 7 questions	Short answer / objective type of questions. Each question carries 1 mark
Q. 2.	5	Solve any 1 out of 2 questions	Each question carries 5 marks

(3) Continuous Evaluation for 4 credits courses (Mid-Semester Examination of 20 marks, Duration: 1 hour)

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	**10**	Solve any 5 out of 7 questions	Short answer / objective type of questions. Each question carries 2 marks
Q. 2.	**10**	Solve any 2 out of 4 questions	Each question carries 5 marks

18. PATTERN OF THE QUESTION PAPER (SEE THEORY PAPERS)

(4) Semester-End Examination for courses, out of 35 marks, shall be of 2 hours duration. The pattern of the question paper shall be as follows:

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	**5**	Solve any 5 out of 7	Short answer / objective type of questions. Each question carries 1 mark
Q. 2.	**10**	Solve any 5 out of 7	Each question carries 2 marks
Q. 3.	**10**	Solve any 2 out of 3	Each question carries 5 marks
Q. 4.	**10**	Solve any 4 out of 6	Each question carries 2.5 marks

(5) Semester-End Examination for courses, out of 70 marks, shall be of 2:30 hours duration. The pattern of the question paper shall be as follows:

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	**16**	Solve any 8 out of 10	Short answer / objective type of questions. Each question carries 2 marks
Q. 2.	**18**	Solve any 3 out of 4	Each question carries 6 marks
Q. 3.	**16**	Solve any 2 out of 3	Each question carries 8 marks
Q. 4.	**20**	Solve any 2 out of 2	Question carries 20 marks, long – answer questions

19. REVALUATION

There shall be revaluation of the answer scripts of End-Semester Examination (out of 70 marks and out of 35 marks) of theory papers only, but not of internal assessment papers and practical papers as per Ordinance No. 134 A and B.

20. AWARD OF GRADES AND GRADE POINTS

The mapping of percentage to l**e**tter grade and grade point (for each course) is given in the following Table.

Sr. No.	Grade Letter	Grade Point	Marks
1.	O (Outstanding)	10	$90 \leq$ Marks ≤ 100
2.	A+ (Excellent	9	$80 \leq$ Marks ≤ 89
3.	A (Very Good)	8	$70 \leq$ Marks ≤ 79
4.	B+ (Good)	7	$55 \leq$ Marks ≤ 69
5.	B (Above Average)	6	$50 \leq$ Marks ≤ 54
6.	C (Average)	5	$45 \leq$ Marks ≤ 49
7.	D (Pass)	4	$40 \leq$ Marks ≤ 44
8.	F (Fail)	0	Marks < 40
9.	Ab (Absent)	0	

CGPA: The CGPA is the weighted average of the grade points obtained in all courses (theory and Practicals) by a student in all the courses in 6 semesters.

Based on the performance of the student in the Semester Examinations, Nowrosjee Wadia College will declare the results and issue the Semester Grade sheets. Also, the College will declare the results and issue the Grade sheets at the end of the course. The class will be awarded to a student on the basis of CGPA. The award of the class shall be as per the following table:

Sr. No.	CGPA	Class of the degree awarded
1	9.50 or more than 9.50	OUTSTANDING (O)
2	8.50 or more but less than 9.50	EXCELLENT (A+)
3	7.50 or more but less than 8.50	VERY GOOD (A)
4	6.25 or more but less than 7.50	GOOD (B+)
5	5.25 or more but less than 6.25	ABOVE AVERAGE (B)
6	4.75 or more but less than 5.25	AVERAGE (C)
7	4.00 or more but less than 4.75	PASS (D)

Percentage of marks corresponding to CGPA is calculated by the formulae which are given in the following Table

GRADE	Formula for the percentage of marks
O	$20 \times CGPA - 100$
A+	$10 \times CGPA - 5$
A	$10 \times CGPA - 5$
B+	$12\times CGPA - 20$
B	$5\times CGPA + 23.75$
C	$10 \times CGPA - 2.50$
D	$6.6\times CGPA + 13.6$