



Karmaveer Bhaurao Patil University, Satara

Syllabus for

B. Sc. III Physics

Under

Faculty of Science and Technology

(As per NEP 2020)

With effect from Academic Year 2026-2027

Syllabus for Bachelor of Science (B. Sc.) Part – III Physics

PREAMBLE:

The B.Sc. Physics course under the autonomy framework will be introduced in the academic year 2026-2027. It has been designed to meet the specific needs of B.Sc. Physics students in accordance with the NEP 2020 guidelines. The curriculum has been developed to reflect the expanding scope of physical sciences. The focus is on equipping students with up-to-date knowledge while maintaining a strong foundation in classical physics. The course also includes new practical exercises, providing students with hands-on experience with the latest techniques currently in use. Additionally, the course is intended to inspire students to pursue higher studies in physics, become entrepreneurs, and seek employment in physic-based industries.

GENERAL OBJECTIVES OF THE COURSE:

1. To develop a strong conceptual understanding of advanced topics.
2. To enhance problem solving and analytical skills through the application of mathematical and physical principles.
3. To gain familiarity with experimental techniques, instrumentation and data analysis through advanced laboratory work.
4. To help students understand scientific terms, concepts, facts, phenomena, and their interrelationships.

1. TITLE: **Physics**

2. YEAR OF IMPLEMENTATION: **2026-2027**

3. DURATION: **01 year**

4. PATTERN: **Semester examination**

5. MEDIUM OF INSTRUCTION: **English**

6. STRUCTURE OF COURSE:

As per NEP-2020 (2.0)

Level	Sem.	Subject				VSC/SEC	FP	CEP	OJT	AEC	C.C	Total
		DSC		DSE*								
		T	P	T	P							
5.5	V	DSC IX (2)	DSC P (2)	DSE XII (2)	DSE P (2)	VSC III (2)	--	CEP (2)	OJT (4)	AEC III (2)	----	22
		DSC X (2)										
		DSC XI (2)										
5.5	VI	DSC XIII (2)	DSC P (2)	DSE XIV (2)	DSE P (2)	VSC IV (2) SEC III (2)	FP (2)	--		AEC IV (2)	C.C (2)	22
		DSC XIV (2)										
		DSC XV (2)										

* DSE - One Papers out of two for each semester.

7. COURSE TITLE

1) Fifth Semester

Sr. No.	Subject	Theory				Practical		
		Cour se No. & Cour se Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC IX	BPT 351	Mathematical Physics	2	2	BPP356	1	2
2.	DSC X	BPT 352	Quantum Mechanics	2	2			
3.	DSC XI	BPT 353	Classical Mechanics and Electrodynamics	2	2	BPP357	1	2
4.	DSE XII (E1)	BPT 354	Electrical Winding & Analog Circuits		2			
5.	DSE XII (E2)	BPT 355	Introduction to Nanotechnology					
6.	VSC	--	--	--	--	BPPVSC III	1	2
7.	AEC	AEC III	English	2	2	--	--	--
8.	CEP	--	--	2	2	BPP CEP	1	2
9.	OJT					BPPOJT	2	4

2) Sixth Semester

Sr. No.	Subject	Theory				Practical		
		Course No. & Course Code	Title of Paper	No. of lectures per week	Credits	Course No. & Course Code	No. of Practical Per week	Credits
1.	DSC XIII	BPT 361	Nuclear and Particle Physics	2	2	BPP 366	1	2
2.	DSC XIV	BPT 362	Solid State Physics	2	2			
3.	DSC XV	BPT 363	Atomic, Molecular and Astrophysics	2	2	BPP 367	1	2
4.								
5.	DSE XVI (E1)	BPT 364	Solar Energy, Wind & Energy Studies					

6.	DSE XVI (E2)	BPT 365	Material Characterization	2	2			
7.	VSC	--	--	--	--	BPPVSC IV	1	2
8.	AEC	AEC IV	English	2	2			
9.	FP		--	--	--	BPTFP	1	2
10.	SEC		--	--	--	BPTSEC	1	2
11.	C.C					C.C	1	2

1. EVALUATION STRUCTURE:

➤ B.Sc. III NEP 2.0

- Semester V (5.5)

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BPT 351	10	10	10	30	50	02
	T	BPT 352	10	10	10	30	50	02
	T	BPP 353	10	10	10	30	50	02
	P	BPP 356	20			30	50	02
DSE (1 Theory Papers out of two)	T	BPT 354	10	10	10	30	50	02
	T	BPT 355	10	10	10	30	50	02
	P	BPP 357	20			30	50	02
AEC	T	AEC III	10	10	10	30	50	02
VSC	P	BPPVSC III	20			30	50	02
OJT	P	BPPOJT I	40			60	100	04
CEP	P	BPPCEP I	20			30	50	02
Total							550	22

-Semester VI (5.5)

Course	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
DSC	T	BPT 361	10	10	10	30	50	02
	T	BPT 362	10	10	10	30	50	02
	T	BPP 363	10	10	10	30	50	02
	P	BPP 366	20			30	50	02
DSE (1 Theory Papers out of two)	T	BPT 364	10	10	10	30	50	02

	T	BPT 365	10	10	10	30	50	02
	P	BPP 367	20			30	50	02
AEC	T	AEC IV	10	10	10	30	50	02
VSC	P	BPPVSC IV	20			30	50	02
FP	P	BPPFP II	20			30	50	02
SEC	P	BPPSEC I	20			30	50	02
C.C	P	BPP C.C	20			30	50	02
Total							550	22

DSC: Discipline Specific Course; DSE: Discipline Specific Elective VSC: Vocational Skill Course; OJT: On Job Training; FP: Field Project; CEP : Community Engagement Program, T: Theory; P: Practical

9. OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

- | | |
|-----------------------------|------------------|
| 1. Microwave oven | 2. Hot Air Oven |
| 3. Digital weighing balance | 4. Incubator |
| 5. pH meter | 6. Refrigerator |
| 7. Ultrasonicator | 8. Furnace |
| 9. Optical bench | 10. Spectrometer |



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSC IX

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 351-Mathematical Physics

Course Objectives: By the end of the course, Students should be able to...

1. know wave method of solving partial differential equations.
2. study applications of partial differential equations.
3. partial differential equation learning Cartesian, spherical polar and cylindrical co-ordinate systems.
4. introduce students to special functions such as Gamma, Beta, and Error functions and their mathematical significance.

Course Outcomes: After completion of course, students will be able to....

1. solve partial differential equations.
2. apply the methods of solving partial differential equations.
3. differentiate among cartesian, spherical polar and cylindrical co-ordinate systems.
4. derive and apply properties of Gamma and Beta functions in solving mathematical problems.

Module	Title and Contents	Hrs
Module -1:	Partial Differential Equation 1.1 Introduction to differential equations. 1.2 Method of separation of variables for solving second order partial differential equations. 1.3 Form of two-dimensional Laplace equation in Cartesian coordinates and its solution. 1.4 Three-dimensional partial differential equation in Cartesian coordinates and its solution.	8
Module -2:	Application of Partial Differential Equation 2.1 The differential equation of progressive wave and its solution, 2.2 Equation of Vibrating String, One Dimensional Heat Flow, 2.3 Two-Dimensional Heat Flow.	7
Module -3:	Orthogonal Curvilinear Coordinates 3.1 Introduction to cartesian, plane polar, spherical polar, and cylindrical co-ordinate systems. 3.2 Concept of orthogonal curvilinear co-ordinates, unit tangent vectors, arc length, area and volume elements in orthogonal curvilinear co-ordinate system, gradient, divergence, curl, del and Laplacian in orthogonal curvilinear co-ordinate system, extension of gradient, divergence, curl. 3.3 del and Laplacian in Cartesia. 3.4 spherical polar and cylindrical coordinate systems.	8
Module -4:	Some Special Integrals 4.1 Gamma function, 4.2 Properties of Gamma function, 4.3 Beta function, Properties of Beta function, 4.4 Relation between Beta and Gamma functions, 4.5 Error function (Probability Integral)	7

Reference Books:-

1. R.C. Wrede and M. R. Spiegel, *Schaum's Outline of Advanced Calculus*. 3rd ed. New York: McGraw-Hill Education, 2010.
2. D.G. Zill, *A First Course in Differential Equations with Modeling Applications*. 10th ed. Boston: Cengage Learning, 2012.
3. N.P. Bali, *Partial Differential Equations*. New Delhi: Laxmi Publications, 2011.
4. B.S. Rajput, *Mathematical Physics*. Meerut: Pragati Prakashan, 2016.
5. G.B. Arfken, H. J. Weber and F. E. Harris, *Mathematical Methods for Physicists*. 7th ed. Amsterdam: Elsevier, 2012.

Evaluation Pattern: 40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**
(Best of two CCE)

- CCE-I: 10 M
- CCE II: 10 M
- CCE-III: 10 M

End Semester Examination: (50 M)**(50 Marks are converted to 30 marks)**

- Question -1 :10 M (2x5=10 M)
- Question -2 :20 M (2x10=20 M)
- Question -3 :20 M (4x5 =20 M)



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester – V

Type: DSC X

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 352-Quantum Mechanics

Course Objectives: By the end of the course, Students should be able to....

1. know the particle aspect of radiation.
2. learning Schrödinger wave equations, Eigen values and Eigen functions.
3. study the applications of Schrödinger wave equation.
4. understand operators, Eigen values and Eigen functions of L^2 and L_z , Commutation relation between x and p , the Hilbert space and wave functions.

Course Outcomes: After completion of course, students will be able to....

1. classify the photoelectric and Compton effect.
2. solve Schrödinger time dependent and time independent wave equations.
3. apply Schrodinger equation for the study of microscopic phenomena.
4. use operators and commutation relations.

Module	Title and Contents	Hrs
Module -1:	Review of Quantum Mechanics 1.1 Inadequacy of classical mechanics. 1.2 Origin of quantum theory. 1.3 Photoelectric effect. 1.4 Law of photoelectric emission. 1.5 Compton effect. 1.6 Ritz combination. 1.7 Hydrogen spectrum 1.8 Limitations of Bohr's theory	7
Module -2:	Schrodinger's Wave Equation 2.1 Wave function and its physical interpretation. 2.2 Condition of physically acceptable wave function. 2.3 Normalized and orthogonal wave functions. 2.4 Schrödinger time dependent and time independent (steady state) 2.5 Wave equations in 1D and 3D. 2.6 Probability current density (continuity equation). 2.7 Eigen values and Eigen functions. 2.8 Expectation values of dynamic variables.	8
Module -3:	Application of Schrodinger's Equation 3.1 Particle in a rigid box (infinite potential well) in one dimension and three-dimension. 3.2 Step potential- reflection and transmission coefficients. 3.3 Potential barrier-tunneling effect (qualitative treatment) 3.4 Schrodinger equation for Hydrogen atom in spherical polar 3.5 Coordinates Separation of radial and angular parts. 3.6 Solution of radial part of Schrodinger's equation - Energy Eigen value.	8

Module -4:	Operators and Mathematical Tools in Quantum Mechanics 4.1 Definition of an operator. 4.2 Position operator (x). 4.3 Linear momentum operator (p). 4.4 Hamiltonian operator (H). 4.5 Angular momentum operator (L)—components of angular momentum operator in Cartesian coordinate system. 4.6 Ladder operators. 4.7 Eigen values of L_z and L^2 (use equations for L^2 and L_z in spherical polar coordinates). 4.8 Commutation relation between x and p. 4.9 The Hilbert space and wave functions: The linear vector space. 4.10 The Hilbert space. 4.11 Dimension and basis of a vector space. 4.12 Square integrable functions (Wave functions).	7
Reference Books:- 1.V. Murugan, <i>Quantum Mechanics</i> . 1st ed. New Delhi: Pearson India, 2014. 2.S. Prakash and C. K. Singh, <i>Quantum Mechanics</i> . Allahabad: Kedar Nath and Ram Nath, 2012. 3.P.M. Mathews and K. Venkatesan. <i>A Textbook of Quantum Mechanics</i> . 2nd ed. New Delhi: Tata McGraw-Hill Education, 2010. 4.N. Zettili, <i>Quantum Mechanics: Concepts and Applications</i> . 2nd ed. Hoboken, NJ: John Wiley & Sons, 2009. 5.G. Aruldas, <i>Quantum Mechanics</i> . 2nd ed. New Delhi: Prentice Hall India Learning Private Limited, 2008.		
Evaluation Pattern: 40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5 =10 M) • Question -2 :20 M (2x10 =20 M) • Question -3 :20 M (4x5 =20 M)	



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Faculty of Science and Technology

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Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSC XI

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 353-Classical Mechanics and Electrodynamics

Course Objectives: By the end of the course, Students should be able to....

1. understand moving co-ordinate system and pseudo forces.
2. learn Lagrangian formulation, D'Alembert's principle and application
3. study equation of motion with the help of Hamiltonian
4. know concept of motion of charge particles in uniform electric and magnetic fields.

Course Outcomes: After completion of course, students will be able to....

1. recognize the moving coordinate system
2. understand the coupled oscillations
3. define constraints, Degree of freedom and generalized coordinates etc., and understand principle of virtual work and D'Alembert's principle.
4. define Poissons and Laplace equation and their physical significance and describe motion of charged particles in electric and magnetic fields.

Module	Title and Contents	Hrs
Module -1:	Moving coordinate System and Coupled Oscillation 1.1 Moving origin of coordinates. 1.2 Pseudo force, Rotating coordinate system. 1.3 Coriolis force, effect of Coriolis force in nature (Flight of missiles, formation of cyclones and freely falling body) 1.4 Frequencies of coupled oscillatory systems. 1.5 Normal modes and normal coordinates. 1.6 Energy of coupled oscillations. 1.7 Energy transfer in a coupled oscillatory system	8
Module -2:	Langrangian Formulation 2.1 Constraints, degrees of freedom. 2.2 Generalized co-ordinates. 2.3 Principle of virtual work. 2.4 D'Alembert's principle. 2.5 Lagrange's equation from D'Alembert's principle. 2.6 Applications of Langrange's equation: Motion of particle in free space. 2.7 Atwood's machine and Bead sliding on rotating wire.	7
Module -3:	Hamiltonian Formulation 3.1 Hamilton's principle. 3.2 Deduction of Hamilton's principle from D'Alembert's principle. 3.3 Deduction of Lagrange's equation from Hamilton's principle. 3.4 Application- Shortest distance between two points in a plane, Brachistochrone problem.	8

Module -4:	Charge Particle Dynamics 4.1 Poisson's and Laplace's equation and their physical significance. 4.2 Laplace equation in one dimension and it's solutions. 4.3 Non-relativistic motion of charged particles- in uniform electric field E 4.4 Magnetic field B, crossed uniform electric field E and magnetic field B 4.5 Relativistic motion of charged particles- in constant electric field E and magnetic field B	7

Reference Books:-

- 1.H. Goldstein, C. P. Poole, and J. L. Safko, *Classical Mechanics*. New Delhi: Narosa Publishing House/Pearson Education, 2018.
2. P.V. Panat, *Classical Mechanics*. Oxford: Alpha Science International Ltd., 2004.
3. N.C. Rana and P. S. Joag, *Classical Mechanics*. New Delhi: Tata McGraw-Hill Publishing Co. Ltd., 2001.
4. S.L. Gupta, V. Kumar and H. V. Sharma, *Classical Mechanics*. Meerut: Pragati Prakashan, 2001.
5. R.G. Takawale and P. S. Puranik. *Introduction to Classical Mechanics*. New Delhi: Tata McGraw-Hill, 1980.

Evaluation Pattern: 40:60

Total Marks: 50 Marks

Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5 =10 M) • Question -2 :20 M (2x10 =20 M) • Question -3 :20 M (4x5 =20 M)
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Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSE XII

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 354-Electric Winding and Analog Circuits

Course Objectives: By the end of the course, Students should be able to....

1. study construction and working of UJT.
2. learn working of Operational Amplifier and its applications.
3. understand number system.
4. know derived gates and Timer IC.

Course Outcomes: After completion of course, students will be able to....

1. explain characteristics of UJT and its applications.
2. describe characteristics of an ideal and practical Op-Amp.
3. distinguish number systems.
4. construct derived gates using basic gates.

Module	Title and Contents	Hrs
Module -1:	Electrical Supply System and Introduction to Re-winding 1.1 AC single phase and 3-phase supply. 1.2 Difference between single and three phase supply in respect of voltage, current and power. 1.3 Safe handling of stripping/winding tools. 1.4 BIS rules for winding/re-winding. 1.5 Types of winding wires, type of insulating materials. 1.6 Insulating materials as per class of insulation (A/E/B/C/F/H), Reasons for insulation failure in electrical machines. 1.7 Method of stripping the old winding. 1.8 Methods of preparing the winding former and the coils, Preparation of winding data as per old winding and rating plate of machine.	8
Module -2:	Rewinding Procedure of Motors 2.1 Procedure followed for re-winding of all kind of electric motors like single phase AC motors. 2.2 pump motors, ceiling fan motors, table fan motors, submersible pump motor, etc. 2.3 various methods of inserting coil into the slots. 2.4 Preparation of winding table, connection diagram. 2.5 winding diagram for given Motor. 2.6 Testing for continuity and insulation.	7
Module -3:	Transistor Amplifier and Oscillator 3.1 Single stage transistor CE amplifier. 3.2 load line analysis- D.C. load line, A.C. load line and Q point. 3.3 Basic Concept of feedback in amplifier, 3.4 Types of feedback, Barkhausen's criterion for sustained oscillations,	8

	3.5 Oscillatory circuit (tank circuit), essentials of transistor oscillator, 3.6 Sinusoidal oscillators, Phase shift oscillator, Colpitts oscillator, Crystal oscillator using transistors.	
Module -4:	Charge Particle Dynamic Basic Theory and Application of Cathod Ray Oscilloscope s 4.1 Introduction to CRO. 4.2 Block diagram of CRO. Principle, Construction and working of CRT, 4.3 Applications of CRO: measurement of A.C. and D. C. voltages, periodic time, frequency and phase difference, Lissajous figures.	7

Reference Books:-

- 1.A.D. Sedra, K. C. Smith and A. N. Chandorkar, *Microelectronic Circuits*. 6th ed. Oxford: Oxford University Press, 2014.
- 2.A.P. Malvino, D. P. Leach and G. Saha, *Digital Principles and Applications*. 7th ed. New Delhi: Tata McGraw-Hill Education, 2011.
- 3.A.A. Kumar, *Fundamentals of Digital Circuits*. 2nd ed. New Delhi: PHI Learning Private Limited, 2009.
- 4.A.P. Malvino, *Electronic Principles*. 7th ed. New Delhi: Tata McGraw-Hill Education, 2008.
- 5.R.A. Gayakwad, *Op-Amp and Linear Integrated Circuits*. New Delhi: PHI Learning Private Limited, 2000.

Evaluation Pattern: 40:60

Total Marks: 50 Marks

Internal Continuous Evaluation: (20 M)
(Best of two CCE)

- CCE-I: 10 M
- CCE II: 10 M
- CCE-III: 10 M

End Semester Examination: (50 M)
(50 Marks are converted to 30 marks)

- Question -1 :10 M (2x5 =10 M)
- Question -2 :20 M (2x10 =20 M)
- Question -3 :20 M (4x5 =20 M)



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Faculty of Science and Technology

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Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSE XII

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 355- Introduction to Nanotechnology

Course Objectives: By the end of the course, Students should be able to....

1. foundational understanding of the principles governing nanoscale phenomena.
2. familiarization with various techniques for synthesizing.
3. explore the diverse application of nanotechnology.
4. analyze the ethical and environmental implications of nanotechnology.

Course Outcomes: After completion of course, students will be able to....

1. compare and contrast top-down and bottom-up approaches to nanomaterial synthesis.
2. synthesizing and characterizing nanomaterials.
3. discuss the importance of responsible nanotechnology development.
4. evaluate the potential risks and benefits of nanomaterial use.

Module	Title and Contents	Hrs
Module -1:	Introduction to Nanoscience 1.1 Defining the nanoscale (1-100 nanometers). 1.2 Historical overview of nanotechnology. 1.3 Types of nanomaterial (0D,1D,2D,3D). 1.4 Nanoparticles, nanotubes, nanowires, thin film. 1.5 Nanotechnology applications in various fields (medicine, electronics, materials science, energy).	8
Module -2:	Nanomaterial Synthesis Methods 2.1 Spray pyrolysis technique. 2.2 Sol-gel synthesis method. 2.3 Hydrothermal method. 2.4 Chemical Bath Deposition (CBD). 2.5 Chemical Vapor Deposition (CVD). 2.6 Synthesis using plant extract.	7
Module -3:	Some Special Nanomaterials 3.1 Carbon Base nano materials: Graphene, Carbon nanotubes, Carbon 60, CNT. 3.2 Perovskite materials. 3.3 Metal organic Framework (MOF). 3.4 Quantum Dots.	7
Module -4:	Application of Nanomaterials 4.1 Solar cell. 4.2 Batteries, Fuel cells. 4.3 Drug delivery, Tissue Engineering. 4.4 Nanotransistors, Quantum Computing. 4.5 Water purification, Pollution control.	8

Reference Books:-

- 1.H.M. Mansour, and A. J. Hickey, eds. *Nanotechnology in Pharmaceutical Aerosol Science and Pulmonary Delivery*. London: Royal Society of Chemistry, 2026.
- 2.S.K. Kulkarni, *Nanotechnology: Principles and Practices*. 4th ed. Singapore: Springer, 2025.
3. J. Huang, *Nanotechnology and Nanomaterials*. London: IntechOpen, 2024.
- 4.C.N.R Rao, A. Müller and A. K. Cheetham, eds. *The Chemistry of Nanomaterials: Synthesis, Properties and Applications*. 2 vols. Weinheim: Wiley-VCH, 2004.
- 5.C.P. Poole and F.J. Owens, *Introduction to Nanotechnology*. Hoboken, NJ: Wiley-Interscience, 2003.

Evaluation Pattern: 40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**
(Best of two CCE)

- CCE-I: 10 M
- CCE II: 10 M
- CCE-II: 10 M

End Semester Examination: (50 M)
(50 Marks are converted to 30 marks)

- Question -1 :10 M (2x5 =10 M)
- Question -2 :20 M (2x10 =20 M)
- Question -3 :20 M (4x5 =20 M)



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSC Practical

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPP 356: Major Practical's V

Course Objectives: By the end of the course, Students should be able to....

1. develop numerical solutions and visualize physical phenomena.
2. gain skill in numerical methods.
3. visualize quantum phenomena like functions, probability densities, and energy levels.
4. design and implement electronic circuits.

Course Outcomes: After completion of course, students will be able to....

1. discretize common PDEs (e.g., Laplace, heat, wave equations) using appropriate numerical methods.
2. generate informative visualizations of scientific data using appropriate plotting tools.
3. implement fundamental numerical algorithms.
4. analyze the performance of electronic circuits, including gain, frequency response, and stability.

Sr. No	List of Experiments	Hrs
1	Solve a 2D Laplace Equation solve and visualize the Laplace equation in Cartesian coordinates using the method of separation of variable.	60
2	3D Partial Differential equation solves given 3D PDE in Cartesian coordinates and plot the results.	
3	Wave Equation Simulation simulate the progressive wave equation and visualize its propagation over time.	
4	Vibrating String Simulation solve the wave equation for a vibrating string with fixed ends and visualize the standing wave patterns.	
5	One-Dimensional Heat Equation solve the 1D heat equation using an explicit finite difference method and plot temperature distribution over time.	
6	Program to convert a complex number from rectangular to exponential form	
7	Program to convert a complex number from exponential to rectangular form	
8	Program to represent a phasor using VPython	
9	Program to represent a wavefunction of a particle at rest at time $t = 0$ using phasors and vpython	
10	Program to represent a wavefunction of a moving particle using phasors and VPython	
11	Op-Amp as inverting amplifier.	
12	To build and test Hartley oscillator using BJT.	
13	To determine A.C. and D.C. sensitivity of the C.R.O. and to measure unknown frequency.	
14	Measurement of phase shift oscillator using CRO.	
15	Band gap energy of semiconductor using p-n junction diode.	

Reference Books:-

- 1.A. Gilat, *MATLAB: An Introduction with Applications*. 6th ed. Hoboken, NJ: John Wiley & Sons, 2016.
- 2.R. Pratap, *Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers*. Oxford: Oxford University Press, 2016.
- 3.J.M. Hughes, *Practical Electronics: Components and Techniques*. 1st ed. Sebastopol: O'Reilly Media, 2015.
- 4.A.S. Nair, *SCILAB (A Free Software To MATLAB)*. S. Chand Publishing New Delhi, 2012.
- 5.P. Mathieu and P Roux, *SCILAB, From Theory to Practice*. Scilab: I. Fundamentals.D-Booker, 2016.

Evaluation Pattern:40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: DSE Practical

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPP-357: Major Practical's VI (Elective)

Course Objectives: By the end of the course, Students should be able to....

1. design, conduct, and analyze experiments using various instruments and techniques.
2. Addition a deeper kind of concepts like resonance, surface tension, viscosity, elasticity properties.
3. gain experience in thin films deposition.
4. introduce students to XRD.

Course Outcomes: After completion of course, students will be able to....

1. accurately measure physical properties by using appropriate experimental techniques.
2. analyze experimental data to know meaningful conclusions about the physical phenomena under investigation.
3. measure thickness of thin films.
4. identify different XRD patterns.

Sr. No	List of Experiments	Hrs
1	Resonance pendulum.	60
2	S.T. of soap solution.	
3	Surface tension of mercury by Fergusson modified method.	
4	Surface tension of mercury by ripple method.	
5	Y and n using Flat Spiral Spring.	
6	Y by Koenig's method.	
7	Y by Cornu's spiral.	
8	Searle's Viscometer.	
9	Preparation of thin film by Drop casting method.	
10	Analysis and Plot XRD graph using origin software.	
11	Structural Analysis Using XRD	
12	Determination of Crystallite Size using Scherrer's formula	
13	Calculating deposition rate by using python.	
14	Stress calculation in thin films (Stoney Equation) by using python.	
15	Study of optical properties of thin film.	

Reference Books:-

1. M.N. Avadhanulu and P. G. Kshirsagar. *A Textbook of Engineering Physics*. New Delhi: S. Chand Publishing, 2015.
2. S.O. Pillai, *Solid State Physics*. 7th ed. New Delhi: New Age International, 2013.
3. V. Raghavan, *Materials Science and Engineering*. 6th ed. New Delhi: PHI Learning Pvt. Ltd., 2015.
4. G. Cao and Y. Wang. *Nanostructures and Nanomaterials: Synthesis, Properties and Applications*. World Scientific Publishing, 2011.
5. C.P. Poole and F. J. Owens. *Introduction to Nanotechnology*. Wiley-Interscience, 2003

Evaluation Pattern: 40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B.Sc.	Semester - V
	Type: VSC	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BPPVSC-III: Advanced Python Programming		

Course Objectives: By the end of the course, Students should be able to....

1. develop a strong foundation in Python programming with an emphasis on mathematical problem-solving and scientific simulations.
2. enable students to apply programming concepts for solving algebraic, numerical, and physics-related problems.
3. introduce students to data visualization techniques using Python for analyzing mathematical functions and physical phenomena.
4. foster computational thinking through simulations of real-world scientific experiments like projectile motion, wave functions, and quantum mechanics.

Course Outcomes: After completion of course, students will be able to....

1. write Python programs to solve mathematical problems involving arithmetic operations, number theory, and algebraic equations.
2. apply control structures, functions, and iterative techniques to generate mathematical series, Fibonacci sequences, and prime number evaluations.
3. implement Python-based simulations for visualizing physical phenomena such as projectile motion, wave functions, and quantum energy levels.
4. utilize Python libraries for plotting graphs and simulating scientific experiments like the double-slit interference pattern and harmonic oscillators.

Sr. No	List of Experiments	Hrs
1	Program to swap two numbers using temporary Variable.	60
2	Program to find the largest of two numbers.	
3	Program to find the largest of three numbers.	
4	Program to find even number between 1 to 50.	
5	Program to find odd numbers between 1 to n where n is a positive Integer.	
6	Program to find sum of series $1+2+3+\dots+N$.	
7	Program to find sum of series $1 - X + X^2 - X^3 \dots X^N$.	
8	Program to print multiplication Table of a number.	
9	Program to generate first n Fibonacci terms 0,1,1,2,3,5...n ($n>2$).	
10	Program to find sum and average of given series of numbers.	
11	Program to find roots of quadratic equations $AX^2+BX+C=0$.	
12	Program to find if a number is prime or not.	
13	Program to find GCD and LCM of two numbers	
14	Program to find Factorial of number n ($n! = 1 \times 2 \times 3 \times \dots n$).	
15	Program to find all the divisor of a number.	

Reference Books:-

- 1.M. Lutz, *Learning Python*. 5th ed. Sebastopol, CA: O'Reilly Media, 2013.
- 2.J.M. Zelle, *Python Programming: An Introduction to Computer Science*. 2nd ed. Franklin, Beedle & Associates, 2010.
- 3.A.B. Downey, *Think Python: How to Think Like a Computer Scientist*. 2nd ed. Needham, MA: Green Tea Press, 2015.
- 4.H.P. Langtangen, *A Primer on Scientific Programming with Python*. 5th ed. Cham: Springer, 2016.
- 5.W. McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*. 2nd ed. Sebastopol, CA: O'Reilly Media, 2017.

Evaluation Pattern:40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: OJT

Marks: 50

Credits: 4

From: A. Y. 2026-27

Name of the Course: BPPOJT: On-Job Training Programme in Physics

Course Objectives: By the end of the course, Students should be able to....

1. provide practical exposure to industrial, research, or laboratory environments related to physics.
2. develop technical skills in handling instruments, experimental techniques, and data analysis methods.
3. enhance problem-solving ability and application of theoretical physics concepts in real-world situations.
4. build professional skills such as communication, teamwork, work ethics, and report writing.

Course Outcomes: After completion of course, students will be able to....

1. apply fundamental physics concepts in practical industrial or research-based environments.
2. operate scientific instruments and perform experiments with accuracy and safety.
3. analyse and interpret experimental/field data using appropriate tools and techniques.
4. demonstrate professional behaviour, teamwork, and effective communication in workplace.

On-Job Training provides practical exposure to real-world application of physics in industries, laboratories and research organizations. Students gain hand-on experience with instruments, experimental techniques, data analysis and workplace practicals. It helps students connect theoretical concepts learning in the classroom with practical application. OJT develops technical skills, problem-solving abilities, professional ethics and confidence for higher education and employment.

Evaluation Pattern: 40:60

Total Marks: 100 Marks

Internal Continuous Evaluation:

- Q.1 Internal Work = 40 M

End Semester Examination:

- Q. 1 = 60 M

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B.Sc.	Semester - V
	Type: CEP	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BPPCEP: Community Engagement Programme in Physics		
Course Objectives: By the end of the course, Students should be able to.... 1. create awareness among students about societal issues and the role of science in community development. 2. encourage application of physics concepts in solving real-life problems at the community level. 3. develop social responsibility, leadership, and ethical values among students. 4. promote active participation in outreach activities such as science awareness programs, environmental campaigns, and energy conservation initiatives.		
Course Outcomes: After completion of course, students will be able to.... 1. apply basic physics principles to address community-related problems such as energy conservation and environmental protection. 2. communicate scientific knowledge effectively to the public through demonstrations and awareness activities. 3. demonstrate leadership, teamwork, and social responsibility while working in community-based projects. 4. analyse and evaluate the impact of scientific interventions on society and environment.		
A community engagement program for students is an outreach activity where students apply physics knowledge to serve society and solve local needs. It may include science awareness talks, school demonstration, surveys, cleanliness drives and energy saving or environmental campaigns. The program helps students develop communication skills, teamwork, leadership and social responsibility while making physics more useful and relatable.		

Evaluation Pattern: 40:60	
Total Marks: 50 Marks	
Internal Continuous Evaluation: • Q.1 Internal Work = 20 M	End Semester Examination: • Q. 1 = 30 M



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester – VI

Type: DSC XIII

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 361- Nuclear and Particle Physics

Course Objectives: By the end of the course, Students should be able to....

1. interpret properties of nucleus and nuclear reactions.
2. classify nuclear models.
3. discuss different detectors and accelerators.
4. differentiate elementary particles.

Course Outcomes: After completion of course, students will be able to....

1. compare different nuclear models (liquid drop model, shell model, collective model) and evaluate their significance in explaining nuclear structure.
2. working principles, construction, and applications of various radiation detectors.
3. Differentiate between various elementary particles based on their properties.
4. understand their classification (leptons, hadrons, bosons).

Module	Title and Contents	Hrs.
Module -1:	General Properties of Nuclei and Nuclear Reaction 1.1 Composition of nucleus, nuclear size, nuclear radius, nuclear spin, Nuclear magnetic moment. 1.2 Electric quadrupole moment, Mass defect, Packing fraction. 1.3 Magic numbers, Binding energy, Binding energy per nucleon and its variation with mass number. 1.4 Nucleus as a liquid drop, Liquid drop model of nucleus to obtain semi-empirical mass formula.	8
Module -2:	Nuclear Reaction 2.1 General scheme of nuclear reactions. 2.2 Q value of reaction and its calculation. 2.3 Exothermic and endothermic nuclear reactions. 2.4 threshold energy, deuteron induced reactions, stripping reaction.	7
Module -3:	Particle Accelerators 3.1 Need of accelerators, Cyclotron- construction, working, theory- expression for energy of cyclotron and its limitations. 3.2 Principle of phase stable orbits, 3.3 Synchrocyclotron- construction, working, advantages and disadvantages. 3.4 Betatron- Principle, construction, working condition, expression of energy gain.	8

Module -4:	Particle Physics 4.1 Elementary particles and their classification into leptons, mesons and baryons. 4.2 Symmetries and conservation laws: energy and momentum. 4.3 angular momentum, parity, Baryon number, Lepton number. 4.4 isospin, strangeness and charm, quark model.	7
Reference Books:- 1.D.C. Tayal, <i>Nuclear Physics</i> . 5th ed. Mumbai: Himalaya Publishing House,2011. 2.J. Yarwood, <i>Atomic Physics, Volume II: Electricity, Magnetism, and Atomic Physics</i> . 1st ed. London: University Tutorial Press,1958. 3.H.A. Enge, <i>Introduction to Nuclear Physics</i> . 1st ed. Boston:Addison Wesley Publishing Co.,1996. 4.J.B. Rajam, <i>Nuclear Physics</i> . 7th ed. New Delhi: S. Chand Publishing Co.,1966. 5.W.E.B. Burcham, <i>Nuclear Physics</i> . 2nd ed. London: Longman Group Limited,1973.		
Evaluation Pattern:40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5=10 M) • Question -2 :20 M (2x10=20 M) • Question -3 :20 M (4x5 =20 M)	



Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - VI

Type: DSC XIV

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 362- Solid State Physics

Course Objectives: By the end of the course, Students should be able to....

1. classify types of crystal structures.
2. analyze the X-ray diffraction methods for structural analysis of crystals.
3. understand the band formation concept.
4. study the superconductivity and types of superconductors.

Course Outcomes: After completion of course, students will be able to....

1. classify types of solids.
2. discuss different methods for structural analysis of crystal.
3. differentiate energy bands in solid.
4. explain superconductivity phenomenon and its types.

Module	Title and Contents	Hrs
Module -1:	Crystal Structure 1.1 Solids: amorphous. 1.2 Polycrystalline and crystalline materials; lattice, basis, unit cell-primitive, non-primitive unit cell. 1.3 Symmetry elements of a cube. 1.4 Bravais lattices in three two dimensions. 1.5 Miller indices and interplanar spacing. 1.6 simple crystal structures – SC, BCC, FCC and HCP (coordination number, atoms per unit cell and packing fraction).	8
Module -2:	X-Ray Diffraction by Crystals 2.1 Reciprocal lattice and its properties. 2.2 Brillouin zone, Diffraction of X-rays by crystals. 2.3 Ewald construction, Bragg's law in reciprocal lattice. 2.4 Experimental Methods X-ray diffraction (Laue method, rotating crystal method, powder photograph method). 2.5 Analysis of crystal by powder crystal method.	7
Module -3:	Elementary Band Theory of Solids 3.1 Origin of energy bands, one electron approximation. 3.2 Bloch theorem (statement only). 3.3 Kronig-Penny model, Velocity of electrons according to band theory. 3.4 Effective mass of an electron. 3.5 Distinction between metals, semiconductors and insulators. 3.6 Hall Effect- Hall voltage and Hall Coefficient.	8

Module -4:	Superconductivity 4.1 Idea of superconductivity 4.2 Critical temperature 4.3 Critical magnetic field. 4.4 Meissner effect, Type-I and Type-II superconductors, 4.5 Introduction of BCS theory, London equation and penetration depth. 4.6 Isotope effect, Application (magnetic levitation)	7
Reference Books: - 1.S.O. Pillai, <i>Solid State Physics</i> , New Age International, Publishers, (7th Ed.) 2009. 2.B.S. Saxena, R.C. Gupta, P.N. Saxena, J.N. Mandal, <i>Fundamentals of Solid-State Physics</i> , Pragati Pakashan, Meerut, (28th Ed.) 2016. 3.A.J. Dekker, <i>Solid State Physics</i> , Macmillan Publishers India Ltd., (1st Ed.) 2000. 4.C. Kittel, <i>Introduction to Solid state Physics</i> , Wiley India Pvt., (8th Ed.) 2004. 5.B.D. Cullity and S. Stock, <i>Elements of X-ray diffraction</i> , Addison-Wesley, Publishers, (2nd Ed.) 1978.		
Evaluation Pattern: 40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5=10 M) • Question -2 :20 M (2x10=20 M) • Question -3 :20 M (4x5 =20 M)	

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B.Sc.	Semester - VI
	Type: DSC XV	Marks: 50
	Credits: 2	From: A. Y. 2026-27
Name of the Course: BPT 363- Atomic, Molecular Physics and Astrophysics		
Course Objectives: By the end of the course, Students should be able to.... 1.learn atomic structure, atomic models and atomic spectra. 2.study fine structure and Zeeman effect. 3.understand Rotational spectra and Vibrational spectra. 4.study Raman Effect and Characteristic properties of Raman lines.		
Course Outcomes: After completion of course, students will be able to.... 1.discuss atomic structure, atomic models and atomic spectra. 2.understand fine structure and Zeeman effect. 3.analyze Rotational and Vibrational spectra, Raman Effect and identify Characteristic properties of Raman lines. 4.explain Milky Way galaxy, origin of solar system and universe.		
Module	Title and Contents	Hrs
Module -1:	Atomic Structure 1.1 Revision of atomic models- Rutherford and Bohr model. 1.2 Electron orbits, atomic spectra, Bohr atom, Energy level and spectra, Atomic excitation. 1.3 Vector atom model- quantum numbers, 1.4 Pauli's exclusion principle.	7
Module -2:	Atomic Spectra 2.1 Observed hydrogen fine structure, 2.2 Spectral notations and optical spectral series for doublet structure, 2.3 Spectrum of sodium and its doublet fine structure. 2.4 Selection and intensity rules for fine structure doublets. 2.5 Normal order offine structure doublets. 2.6 Electron spin-orbit interaction. 2.7 Normal and anomalous Zeeman effect and their explanation from vector atom model, Lande's g factor (qualitative).	8
Module -3:	Molecular Spectra 3.1Molecular Spectra Molecular bond, Electron sharing, H^+ molecular ion, The hydrogen molecule, Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational spectra, Vibration – rotation spectra, electronic spectra of diatomic molecules. 3.2Raman Spectra Raman Effect, Classical and quantum theory of Raman Effect, Characteristic properties of Raman lines, Difference between Raman spectra and infrared spectra and Application of Raman spectroscopy.	7

Module -4:	Structure of Universe 4.1 Formation and types of Galaxies 4.2 Milky Way galaxy. 4.3 Origin of solar system - Condensation theory; arguments for and against the theory. 4.5 Hubble law, Big-Bang theory, Steady state theory. 4.6 Oscillating theory, Cosmological tests.	8
Reference Books:- 1.J.B. Rajam, <i>Modern Physics</i> , S. Chand Publishers, (1 st Ed.) 1966. 2.H.E. White, <i>Introduction to Atomic Spectra</i> , McGraw Hill Publishers, 1934. 3. A. Beiser, <i>Concepts of Modern Physics</i> , McGraw-Hill Higher Education Publishers, (6 th Ed.) 1994. 4.S.L. Gupta, V. Kumar, and R.C. Sharma, <i>Elements of Atomic and Molecular and LASER Physics</i> , Pragati Prakashan, Meerut, (1 st Ed.) 2016. 5.R. Jastrow and M. H. Thompson, <i>Astronomy: Fundamentals and Frontiers</i> , John Wiley & Sons, (1 st Ed.) 1972		
Evaluation Pattern: 40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5=10 M) • Question -2 :20 M (2x10=20 M) • Question -3 :20 M (4x5 =20 M)	

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	Board of Studies in Physics	
	Programme: B.Sc.	Semester - VI
	Type: DSE XVI	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BPT 364- Energy Studies (Solar & Wind)	
Course Objectives: By the end of the course, Students should be able to.... 1.study solar dryer in which the grains are dried simultaneously by the heated air from the solar collector. 2.prepare foods for drying. 3.operate the Solar Food Dryer during the drying process. 4.learn the renewable energy systems, its components and interactions between the components.		
Course Outcomes: After completion of course, students will be able to.... 1.design the solar dryer. 2.testing foods, grains and vegetables after drying. 3.perform an initial design of a renewable energy system. 4.identify, discuss, present and communicate issues within the subject area.		
Module	Title and Contents	Hrs
Module -1:	Solar Drying 1.1 Introduction: Drying fundamentals, Sun Vs Solar Drying. 1.2 Types of Solar Dryers; Direct mode, indirect mode, mixed mode. 1.3 Solar Dryers in practice: Direct mode natural convection dryers. 1.4 Direct mode forced convection dryers. 1.5 Indirect mode forced convection dryers, In-house Dryer.	8
Module -2:	Evaluation of Solar Dryer 2.1 Drying behavior, Weather Conditions, Storage, Selection 2.2 Cleaning and Pre-treatment. 2.3 Overall System drying efficiency, Pick up efficiency, 2.4 Solar collection efficiency, Performance of solar dryer, comparative testing. 2.5 Technical development, costs and design.	7
Module -3:	Energy and Wind Energy 3.1 Energy, Forms of energy, Man and environment, Energy chains. 3.2 Classification of energy resources, Energy demands. 3.3 Age of renewable and alternatives. 3.4 Wind energy, Wind energy chains, Wind energy quantum, 3.5 Planning of wind farm, Wind power density. 3.6 Efficiency factor of wind turbine (P-H graph). 3.7 Power of wind turbine for a given incoming wind velocity. 3.8 Types of a wind turbine generator unit. 3.9 Horizontal axis propeller type wind turbine generator unit.	8

Module -4:	Solar Energy 4.1 Solar energy, Solar energy spectrum (UV, Visible and IR). 4.2 Utilization of solar energy- thermal route. 4.3 photovoltaic route, Essential subsystems in solar energy plant. 4.4 Solar constant, Clarity index, Solar insolation. 4.5 Solar energy from satellite station through microwave to earth station. 4.6 Solar photovoltaic systems, Merits and limitations of solar PV systems. 4.7 Prospects of solar PV systems, Power of a solar cell and solar PV panel.	7
Reference Books: - 1.J.Lüdemann, <i>Thin-Film Silicon Solar Cells</i> . Distributed by The University of Chicago Press. Published, 2021. 2.S.S. Rao and B.B. . Parulekar. <i>Energy Technology (Non-conventional, Renewable and Conventional)</i> . 3rd ed. Delhi: Khanna Publishers,1994. 3.G.D. Rai, <i>Non-conventional Energy Sources</i> . 6th ed. Delhi: Khanna Publishers,1988. 4.S.P. Sukhatme and J. K. Nayak. <i>Solar Energy</i> . 4th ed. New Delhi: Tata McGraw Hill Ltd.,2017. 5.G.D. Rai, <i>Solar Energy Utilization</i> . 5th ed. Delhi: Khanna Publishers,1995.		
Evaluation Pattern: 40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-III: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5=10 M) • Question -2 :20 M (2x10=20 M) • Question -3 :20 M (4x5 =20 M)	



Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - VI

Type: DSE XVI

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPT 365- Materials Characterization

Course Objectives: By the end of the course, Students should be able to....

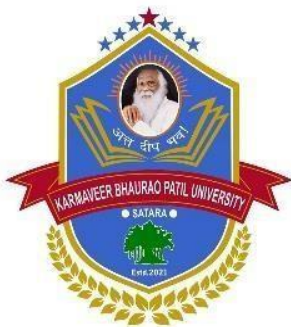
1. understand the fundamentals of spectroscopic methods.
2. know and describe the principles behind UV-visible, IR and Raman spectroscopy.
3. import knowledge on different electron microscopy techniques used for characterization.
4. characterize materials using thermal methods.

Course Outcomes: After completion of course, students will be able to....

1. their applications in analyzing the structure and properties of materials.
2. apply the principles of UV-visible, IR, and Raman techniques for material characterization.
3. understand the techniques of SEM, TEM, XRD and AFM.
4. evaluate the thermal of materials using analytical techniques.

Module	Title and Contents	Hrs
Module -1:	Introduction to Spectroscopy 1.1 Atomic and Molecular spectroscopy. 1.2 interaction of EMR with matter. 1.3 Energy levels in atoms and molecules. 1.4 Absorption and Emission techniques. 1.5 Fluorescence, Phosphorescence and Chemiluminescence, Beer Lambert's law, Qualitative and Quantitative analyses. 1.5 Visible absorption spectroscopy.	8
Module -2:	Optical Spectroscopy 2.1 Principle, Instrumentation (Block Diagram) and Working: UV-visible spectroscopy: IR spectroscopy, Raman Spectroscopy, 2.2 Differences between IR and Raman, 2.3 Mass Spectroscopy.	7
Module -3:	Characterization Techniques 3.1 Principle, Instrumentation (Block Diagram) and Working: Scanning electron microscopy (SEM), 3.2 Transmission electron microscopy (TEM), 3.3 X-Ray Diffraction (XRD), 3.4 Atomic Force Microscopy (AFM)	8
Module -4:	Thermal Analysis Methods 4.1 Discussion of thermogravimetry. 4.2 Instruments for thermogravimetry, applications of thermogravimetry.	7

	4.3 Experimental factors affecting TG analysis, Instruments for thermogravimetry. 4.4 Differential Techniques: Differential Thermal Analysis and Differential Scanning Calorimetry (DSC), 4.5 Instruments for DTA and DSC	
Reference Books:- 1.D.A. Skoog, F. J. Leary and T. A. Nieman. <i>Principles of Instrumental Analysis</i> . 5th ed. Saunders Publications,1998. 2.H.H. Willard, I. I. Merritt, J. A. Dean and F. A. Settle, <i>Instrumental Methods of Analysis</i> . 6th ed. CBS Publishers,1986. 3.B.K. Sharma, <i>Instrumental Methods of Analysis</i> . Goel Publishing House,1995. 4. Y. Leng, <i>Material Characterization: Introduction to Microscopic and Spectroscopic Methods</i> . 1st ed. Wiley and Sons,2008. 5.D.A. Skoog, F. J. Holler and S. R. Crouch, <i>Principles of Instrumental Analysis</i> . 6th ed. Thomas Brooks Cole, 2007.		
Evaluation Pattern: 40:60		
Total Marks: 50 Marks		
Internal Continuous Evaluation: (20 M) (Best of two CCE) • CCE-I: 10 M • CCE II: 10 M • CCE-II: 10 M	End Semester Examination: (50 M) (50 Marks are converted to 30 marks) • Question -1 :10 M (2x5=10 M) • Question -2 :20 M (2x10=20 M) • Question -3 :20 M (4x5 =20 M)	

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Physics	
	Programme: B.Sc.	Semester - VI
	Type: DSC Practical	Marks: 50
	Credits: 2	From: A. Y. 2026-27
	Name of the Course: BPP 366: Major Practical's VII	
Course Objectives: By the end of the course, Students should be able to.... 1.develop proficiency in using optical instruments and understanding fundamental principles of optics. 2.gain practical experience in electrical measurements and bridge circuits. 3.understand the principles of interference, diffraction, polarization and electrical measurements. 4.familiarize students with modern measurement techniques.		
Course Outcomes: After completion of course, students will be able to.... 1. perform optics experiments involving interference, diffraction, polarization, and spectroscopy. 2. measure physical quantities such as wavelength, refractive index, film thickness, particle size, resistance, inductance, and frequency. 3. operate optical and electrical instruments accurately and safely. 4. analyse experimental data and estimate uncertainties in measurements.		
Sr. No	List of Experiments	Hrs
1	Cardinal points by turn table method.	60
2	Measurement of temperature of Na flame.	
3	Diffraction at cylindrical obstacle.	
4	Lloyd's single mirror.	
5	Double refracting prism.	
6	To determine the diameter of Lycopodium powder	
7	Absorption spectrum of a liquid (KMnO4 solution).	
8	To determine the thickness of thin film by interference	
9	Newtons ring experiment.	
10	Diffraction due to single slit using Sodium/Lase source	
11	High resistance by leakage.	
12	P. O. Box- Measurement of resistance of galvanometer (Kelvin's method).	
13	Measurement of high resistance by method of nearly equal deflection method.	
14	Self-inductance by Maxwell's bridge.	
15	Frequency of an oscillator by Wien's bridge.	

Reference Books:-

1. D.R. Bhandari and S. Chand. *Advanced Practical Physics*. 22nd ed. New Delhi: S. Chand Publishing, 2021.
2. H. Singh and P. S. Hemne. *B.Sc. Practical Physics*. New Delhi: S. Chand & Company Ltd.2020.
3. S.L. Gupta, and V. Kumar. *Practical Physics*. 25th ed. New Delhi: Pragati Prakashan.2020.
4. C. L. Arora, *B.Sc. Practical Physics*. New Delhi: S. Chand Publishing,2018.
5. G. Sanon. *B.Sc. Practical Physics*. 10th ed. New Delhi: R. Chand & Company Pvt. Ltd.2017.

Evaluation Pattern: 40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - VI

Type: DSE Practical

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPP 367: Major Practical's VIII (Elective)

Course Objectives: By the end of the course, Students should be able to....

1. experimental determination of Self and Mutual Inductance by various methods.
2. calibration of wire by various electrical methods.
3. practical use of solar energy.
4. understand the relationship between the principal quantum number (n) and the energy levels.

Course Outcomes: After completion of course, students will be able to....

1. determine Self and Mutual Inductance by various methods.
2. calibrate wire by various electrical methods.
3. use solar energy in practical life.
4. calculate the energy levels of the hydrogen atom using appropriate formulas.

Sr. No	List of Experiments	Hrs
1	Self-Inductance by Owen's Bridge.	60
2	Self-Inductance by Rayleigh's Method.	
3	Measurement of B_H , B_V and theta using Earth Inductor.	
4	Mutual inductance using Ballistic galvanometer.	
5	Resistance of B.G. by half deflection method.	
6	Calibration of wire by Carey Foster bridge.	
7	Calibration of wire by Griffith's method.	
8	Absolute capacity of condenser.	
8	Determination of constants of BG.	
9	UJT as a voltage sweep generator	
10	FER as VVR	
11	Verify Inverse square law of intensity by using solar cell.	
12	I-V characteristics of Solar Cell.	
13	Polar graph using Photo Cell.	
14	Calculate particle size and plot distribution curve from SEM images.	
15	Photoelectric effect experiment (Threshold frequency, intensity of light, photocurrent).	

Reference Books:-

- 1.D. Chattopadhyay and P. C. Rakshit, An Advanced course in Practical Physics, New Central Book Agency, (10th Ed.), 2011.
- 2.S. L. Gupta and V. Kumar, Practical Physics, Pragati Prakashan., (27th Ed.), 2010.
- 3.S.J. Fonash, *Solar Cell Device Physics*, Burlington, MA: Academic Press, 2010.
- 4.E. Robert and R. Resnick. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles. 2nd ed. Hoboken, NJ: Wiley, 1985.
- 5.B. L.Worsnop and H. T. Flint, Advanced Practical Physics for Students, Asia Publ. House., 1971.

Evaluation Pattern:40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



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Programme: B.Sc.

Semester - VI

Type: VSC

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPPVSC-IV: Basics of Mat Lab Practical's

Course Objectives: By the end of the course, Students should be able to....

- 1.introduce students to the MATLAB environment and its basic functionalities.
- 2.write efficient and well-structured MATLAB code.
- 3.learn to import, process, analyze, and visualize data using various MATLAB tools and functions.
- 4.familiarize students with MATLAB's data types, variables, and operators.

Course Outcomes: After completion of course, students will be able to....

- 1.navigate the interface, use the command window and editor, and access help resources.
- 2.use appropriate data types, operators, control flow statements, and functions to create efficient and readable code.
3. apply MATLAB to model, simulate, and analyze real-world systems and phenomena.
- 4.demonstrate proficiency in applying proper coding techniques.

Sr. No	List of Experiments	Hrs
1	Basic arithmetic using Mat Lab Commands.	60
2	Basic of Mat Lab Desktop & Editor.	
3	Run the Mat Lab scripts & debug Mat Lab codes.	
4	Learn the Manual entry of Array.	
5	Create Evenly spaced Vectors in Mat Lab.	
6	Create Array with function in Mat Lab.	
7	Using of indexing to extract rows, columns & elements in array.	
8	Using if indexing to modify rows, columns & elements in array.	
9	Perform array operation on vectors.	
10	Request multiples output in function calls by using Mat Lab.	
11	Use the Mat Lab documentation to learn Mat Lab features.	
12	Visualize variable using plotting function using Mat lab.	
13	Import data form external files in to Mat Lab.	
14	Use relation operators & logical indexing to extract elements from Mat lab Array.	
15	Decision Branching in Mat Lab Programming.	

Reference Books:-

1. T.A. Davis, *MATLAB Primer*. (8th ed.) Boca Raton, FL: CRC Press, 2010.
2. R. Pratap, *Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers*. Oxford: Oxford University Press, 2010.
3. S.J. Chapman, *MATLAB Programming for Engineers*. (6th ed.) Boston: Cengage Learning, 2019.
4. B.H. Hahn and D. T. Valentine, *Essential MATLAB for Engineers and Scientists*. (7th ed.) Amsterdam: Elsevier, 2019.
5. W.Y. Yang and W. Lee. *Applied Numerical Methods Using MATLAB*. Hoboken, NJ: Wiley, 2005.

Evaluation Pattern: 40:60**Total Marks: 50 Marks****Internal Continuous Evaluation: (20 M)**

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



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Programme: B.Sc.

Semester - VI

Type: SEC

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPP SEC III: DFT Analysis

Course Objectives: By the end of the course, Students should be able to....

1. understand crystal structure analysis of materials such as Si, Ge & diamond using DEF (Density of Energy Function / computational tools).
2. study the electronic properties of materials through Density of States (DOS) analysis.
3. evaluate the band gap energy of different materials.
4. develop practical skills in computational/material analysis tools for interpreting structural and electronic behavior of materials.

Course Outcomes: After completion of course, students will be able to....

1. analyze crystal structures and identify lattice parameters and symmetry of Si, Ge & diamond.
2. interpret Density of States (DOS) plots to understand electronic distribution and energy levels in materials.
3. determine and compare band gap values of different materials and classify them as conductors, semiconductors, or insulators.
4. apply DEF/computational techniques to study material properties and relate them to real-world applications like semiconductors, sensors, and energy devices.

Sr. No	List of Experiments	Hrs
1	Installation and demonstration of Burai Software	60
2	Visualization, Editing and exporting edited crystal structure of (Diamond, Si, Ge)	
3	Geometrical optimization of diamond and Si (Unit cell & Covalent Bonding)	
4	To determine the minimum energy of diamond	
5	To determine the minimum energy of silicon (Si)	
6	To determine the minimum energy of germanium (Ge)	
7	To determine the Fermi energy of diamond	
8	To determine the Fermi energy of silicon (Si)	
9	To determine the Fermi energy of germanium (Ge)	
10	To determine the band gap of silicon (Si)	

11	To determine the band gap of diamond	
12	To determine the band gap of germanium (Ge)	
13	To determine the band gap of TiO ₂ material	
14	To determine the band gap of ZnO material	
15	To determine the density of state of TiO ₂ material	

Reference Books:-

- 1.D.S. Sholl, and S.A. Janice, *Density Functional Theory: A Practical Introduction. (2nd ed)*. Hoboken, NJ: Wiley, 2023.
- 2.R. Hoffmann, *Solids and Surfaces: A Chemist's View of Bonding in Extended Structures*. Updated ed. Hoboken: Wiley, 2022.
- 3.C. Kittel, *Introduction to Solid State Physics*. 9th ed. Hoboken: Wiley, 2021.
- 4.A.P. Sutton, *Electronic Structure of Materials*. 2nd ed. Oxford: Oxford University Press, 2020.
5. R. M. Martin, *Electronic Structure: Basic Theory and Practical Methods*. Cambridge: Cambridge University Press, 2020.

Evaluation Pattern: 40:60

Total Marks: 50 Marks

Internal Continuous Evaluation: (20 M)

- Q.1 Student Performance= 5M
- Q.2 Oral = 5M
- Q.3 Journal = 10 M

End Semester Examination: (30 M)

- Q. 1 = 30 M



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Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Physics

Programme: B.Sc.

Semester - V

Type: FP

Marks: 50

Credits: 2

From: A. Y. 2026-27

Name of the Course: BPPFP: Field Project in Physics

Course Objectives: By the end of the course, Students should be able to....

1. develop the ability to apply theoretical physics concepts to real-world field situations.
2. enhance observational, analytical, and data collection skills through field-based investigations.
3. provide exposure to scientific instruments, measurement techniques, and environmental conditions.
4. promote teamwork, scientific communication, and report writing skills through project work.

Course Outcomes: After completion of course, students will be able to....

1. apply fundamental physics principles to analyze real-life problems encountered in the field.
2. collect, record, and interpret experimental/field data using appropriate scientific methods.
3. use basic instruments and techniques effectively for field measurements and observations.
4. present findings in a structured report and demonstrate improved communication and teamwork skills.

A field project for students is a practical learning activity where students study real-world physics application outside the classroom. The project can be done individually or in group under faculty guidances, with report writing and presentation included. Its helps students connect theory with observation, improve research skills and understanding the use of physics in daily life.

Evaluation Pattern: 40:60

Total Marks: 50 Marks

Internal Continuous Evaluation: (20 M)

- Q.1 Internal Work = 20M

End Semester Examination: (30 M)

- Q. 1 = 30 M

Bachelor of Science (B. Sc.) Part - III: Physics

Semester VI

C.C. (Co-Curricular) (Credit 2)

Evaluation Pattern: 40:60

Total Marks: 50 Marks

Internal Continuous Evaluation: (20 M)

- Q.1 Internal Work = 20M

End Semester Examination: (30 M)

- Q. 1 = 30 M