ಡಾ. ಮನಮೋಹನ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

Dr. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

Office of the Registrar, Central College Campus, Dr. B.R. Ambedkar Veedhi, Bengaluru – 560 001.
PhNo.080-22131385, E-mail: registrar@bcu.ac.in/registrarbcu@gmail.com

No.MSBCU/BoS/Syllabus/Science/ 109 /2026-27 Date: 29.06.2026

NOTIFICATION

Sub: Syllabus for the V & VI Semester Under Graduate Courses in the Faculty of Science -reg

Ref: 1. Government Order No. ED 166 UNE 2023 Bengaluru dated. 08.05.2024
2. Recommendations of the Boards of Studies in the Faculty of Science
3. Approval of the Academic Council in its meeting held on 08.06.2026
4. Orders of Vice-Chancellor dated.29.06.2026

****

The Syllabus prepared by the Boards of Studies for the different Subjects of V & VI semester Under Graduate Courses, in the faculty of Science based on the Guidelines and Curriculum Structure issued by the Government under ref(1) have been approved by Academic Council meeting held on 08.06.2026.

Accordingly, the CBCS Syllabus for the V & VI Semester UG Courses of Science Faculty in respect of following subjects are hereby notified for implementation from the academic year 2026-27.

Sl. No.	Subjects
1.	Botany– V & VI Semester
2.	Chemistry– V & VI Semester
3.	Zoology and Genetics– V & VI Semester
4.	BoS in Fashion and Apparel Design i. FAD – V & VI Semester ii. IDD– V & VI Semester
5.	Geography– V & VI Semester
6.	Mathematics– V & VI Semester
7.	Physics – V & VI
8.	BoS in Home Science i) Home Science – V & VI ii)Nutrition & Dietetics – V & VI iii)Clinical Nutrition & Dietetics – V & VI iv)Food Technology – I & II Sem

p.t.o

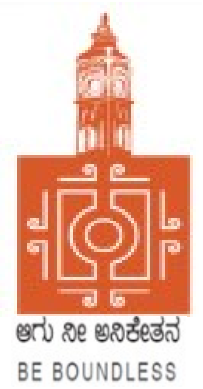
9.	Criminology and Forensic Science– V & VI
10.	Psychology– V & VI Semester
11.	Electronics – V & VI
12.	Statistics – V & VI
13.	Microbiology– V & VI
14.	Biotechnology– V & VI
15.	Environmental Science– V & VI

The detailed Syllabi for above subjects are notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR

Copy to;

1. The Registrar(Evaluation), Dr. Manmohan Singh Bengaluru City University
2. The Dean, Faculty of Science, MSBCU.
3. The Principals of the concerned affiliated Colleges of MSBCU- through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), MSBCU.
5. Office copy / Guard file / University Website: www.bcu.ac.in



Dr. MANMOHAN SINGH BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
[As per SEP]

Syllabus for B.Sc.
Physics

2026-27 onwards

ಡಾ. ಮನಮೋಹನ್ ಸಿಂಗ್
ಬೆಂಗಳೂರು ನಗರ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ

ಆಗು ನೀ ಅನಿಕೇತನ
BE BOUNDLESS

DR. MANMOHAN SINGH
BENGALURU CITY UNIVERSITY

Board of Studies in Physics (UG)

1	Dr. B. Eraiah, Chairman, PG Dept. of Physics, Bangalore University, Bengaluru-56	Chairperson
2	Dr.D. Usharani, MES College of Arts, Commerce and Science, Malleswaram, Bengaluru-03	Member
3	Mr. Chandrashekar Gandigudi, HKES College, Sadashivanagar, Bengaluru-80	Member
4	Dr. Mohan Kumar B. V, GFGC, Yelahanka, Bengaluru-64	Member
5	Dr. Manjula S N, SJR College for Women, Rajajinagar, Bengaluru-10	Member
6	Dr. Ramakrishna Gowda, GFGC, Yelahanka, Bengaluru-64	Member
7	Dr. Srilatha M C, GFGC, Malleswaram, Bengaluru-12	Member
8	Smt. Anupama, MLAC, Malleswaram, Bengaluru-12	Member

Date: 08-04-2026
Bengaluru

Proceedings of the BOS Physics (UG) meeting of Bangalore City University, Bangalore, held on 8th April 2026

2026

The Chairman welcomed all the BOS members and presented the following agenda for discussion.

Agenda:

(i) To finalize the Panel of Examiners (UG) for the 2026-27

(ii) To approve the BSc Physics Syllabus V & VI Semester (prepared in accordance with the State Education Policy (SEP))

After elaborate discussions the members approved

1. Syllabus for V & VI Semester B.Sc Physics Course (UG) to be implemented from the academic year 2026-27 following SEP guidelines.
2. The UG Panel of examiners has been updated by including teachers from all the affiliated colleges. The BOS unanimously approves the panel of examiners for UG for the academic year 2026-27.

8/4/2026

Dr. B. Eraiah
Professor & Chairman
Department of Physics
Bangalore University
Bangalore-560056

Proceedings of the meeting of Board of Studies in Physics (UG), Dr. Manmohan Singh Bengaluru City University held on 8th April 2026 at 11am in the Department of Fashion Technology, Dr. Manmohan Singh Bengaluru City University.

MEMBERS PRESENT:

Sl. No.	Name	Address	Designation	Signature
1	Prof. B. Eraiah	Professor & Chairman PG Department of Physics Bangalore University, Bengaluru-56	Chairperson	8/4/2026
2	Dr. Usharani D	Professor MES College 15th Cross Road, Malleswaram, Bengaluru-560032	Member	
3	Sri. Chandrashekar B Gandigudi	Associate Professor HKES Sree Veerendra Patil Degree College, 15th Main Road, 9th Cross Rd. Bengaluru-560080	Member	
4	Dr. Mohan Kumar B V	Professor Govt. First Grade College, NES Office Rd, Yelahanka, Bengaluru-560064	Member	
5	Dr. Manjula S N	Associate Professor SJR College for Women, IV 'M' Block, Rajajinagar, Bengaluru-560009	Member	8/04/2026
6	Dr. Ramakrishna Gowda	Professor Govt. First Grade College, NES Office Rd, Yelahanka, Bengaluru-560064	Member	
7	Dr. Srilatha M C	Associate Professor Govt. First Grade College, 18th Cross Road, Malleshwaram, Bengaluru-560032	Member	
8	Smt. Anupama	Assistant Professor MLA College for Women 18th Cross Road, Malleshwaram, Bengaluru-560012	Member	

8/4/26

Dr. B Eraiah
Professor & Chairman
Department of Physics
Bangalore University
Bangalore-560056

PROGRAMME OUTCOMES (POs)

After successful completion of the programme, students will be able to

PO1: Disciplinary Knowledge
Understand and apply fundamental concepts of physics across core areas.

PO2: Problem Solving
Analyse and solve theoretical and numerical problems using appropriate methods.

PO3: Experimental Skills
Design, perform, and analyse experiments using standard laboratory techniques.

PO4: Scientific Reasoning
Apply logical thinking and scientific methodology to interpret physical phenomena.

PO5: Modern Tool Usage
Use modern tools, software, and instruments for data analysis and simulations.

PO6: Communication Skills
Communicate scientific ideas effectively in written and oral forms.

PO7: Ethics and Teamwork
Demonstrate ethical practices and work effectively individually and in teams.

PO8: Lifelong Learning
Engage in continuous learning and adapt to advancements in science and technology.

PROGRAMME SPECIFIC OUTCOMES (PSOs) – B.Sc

PSO1: Apply core physics principles to understand natural phenomena.

PSO2: Solve physics problems using mathematical and analytical techniques.

PSO3: Perform experiments and interpret results using scientific instruments.

PSO4: Apply physics in real-world domains (electronics, nanotechnology, energy).

PSO5: Use computational tools and simulations in physics.

PSO6: Develop basic research and investigative skills.

PSO7: Integrate physics with interdisciplinary fields.

V Semester

B. Sc Physics Syllabus

(Paper V and VI) SEP Scheme

V Semester Paper-V: PHY 501

Program Name	B.Sc	Semester	V
Quantum mechanics, Nanomaterials, Atomic and Molecular Physics			
Course Code	PHY 501	No. of credits	03
Contact Hours	4 Hours	Duration of Examination	03 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE OUTCOMES (COs)

After successful completion of the course, the student will be able to

CO1: Explain the limitations of classical physics and the need for quantum mechanics.

CO2: Describe the de Broglie hypothesis, matter waves, and the relation between group and phase velocities.

CO3: State and explain the uncertainty principles (position–momentum and energy–time) and its applications.

CO4: Understand the wave function, Schrödinger equation, and basic postulates of quantum mechanics. Set up SWE for 1-D particle in an infinite potential well, LHO and energy eigenvalues.

CO5: Explain quantum operators, expectation values, and basic concepts of quantum computing (qubits).

CO6: Classify molecules and explain molecular motions, spectra, and the Born–Oppenheimer approximation.

CO7: Understand the vector atomic model, quantum numbers, and coupling schemes (L–S and j–j coupling), Pauli's exclusion principle, Zeeman effect

CO8: Solve numerical problems with conceptual understanding.

UNIT-1

QUANTUM MECHANICS-I

Introduction to Quantum Mechanics, failure of classical physics to explain black body radiation, Photoelectric effect, Compton effect, stability of atoms and spectra of atoms and explanation based on quantum theory. **(3 Hours)**

Compton scattering: Expression for Compton shift (With derivation). Matter waves: de Broglie hypothesis of matter waves, Wave description of particles by wave packets, Group and Phase velocities and relations between them, concept of dispersive and non-dispersive medium. Experimental evidence for matter waves: Davisson- Germer experiment, G.P Thomson's experiment and its significance. **(6 Hours)**

Heisenberg's uncertainty principle-relation between momentum and position, energy and time, angular momentum and angular position. Why cannot electrons exist in nucleus? Illustration of uncertainty principle by Gamma ray microscope thought experiment, Consequences of the uncertainty relation: Diffraction of electrons at a single slit-theory. Problems. **(4 Hours)**

UNIT-2

QUANTUM MECHANICS-II

Probabilistic interpretation of wave function (Max Born's) - normalization and orthogonality of wave functions, Admissibility conditions on a wave function. Schrodinger wave equation for a free particle - time-

dependent and time-independent wave equations. Postulates of Quantum mechanics, Quantum mechanical operators, expectation value. Particle in a one-dimensional infinite potential well (derivation of energy eigen values and wavefunctions), degeneracy in three-dimensional case. Quantum tunnelling (qualitative with examples).

One-dimensional simple harmonic oscillator (SWE, Mention of the energy eigenvalues and eigen functions), concept of zero - point energy. Qubit and quantum computing. Problems**.** **(7 Hours)**

MOLECULAR PHYSICS

Types of molecules based on their moment of inertia. Types of molecular motions and energies; Born-Oppenheimer approximation; Nature of molecular spectra. Theory of rigid rotator – energy levels and spectrum. Theory of vibrating molecule as a simple harmonic oscillator – energy levels.

Fluorescence and phosphorescence, energy level diagrams. Raman effect – Experimental study of Raman effect, Stokes and anti-Stokes lines. Quantum theory of Raman effect, Applications. Problems. **(6 Hours)**

UNIT-3

ATOMIC PHYSICS

Vector atomic model – spatial quantisation, electron spin, Quantum numbers associated with vector atomic model, Coupling schemes – L-S and j-j coupling, Pauli's exclusion principle. Maximum number of electrons in a shell (derivation). Magnetic dipole moment due to orbital motion of electron – (derivation). Larmor precession and frequency. Stern-Gerlach experiment – Experimental arrangement and theory. Problems **(6 Hours)**

Optical Spectra – spectral terms and notations, selection rules, Lande g- factor and its calculation for different states. Fine structure of sodium D-lines. Zeeman effect, Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation). Stark effect: Experimental study and types. Problems **(7 Hours)**

UNIT-4

NANOMATERIALS

Introduction to Nanomaterials: Definition of Nanomaterials, Nanoscale, Comparison with bulk materials, surface-to-volume ratio, Quantum confinement effect, Unique Properties at Nanoscale-Optical, Electrical, Mechanical and Magnetic. Problems. **(3 Hours)**

Classification of Nanomaterials: Based on Dimensionality- Zero-Dimensional (quantum dots), One-Dimensional (nanowires and nanotubes), Two-Dimensional (nanofilms/nanosheets) and Three-Dimensional (Solid) nano structures. Carbon-based Nanomaterials: structure, properties and applications of Graphene and Fullerene, Carbon Nanotubes (CNT): Types, Single-Walled CNT (SWCNT) and Multi-Walled CNT (MWCNT). **(3 Hours)**

Synthesis Methods: Top-down and Bottom-up approaches, Top-down approach-Ball milling and Lithography. Bottom-up approaches: Sol-gel technique, Chemical Vapour Deposition (CVD), advantages and limitations of each technique. **(3 Hours)**

Characterization Techniques: Structural characterisation using X-ray diffraction - Bragg's Law (statement only) peaks & intensity in diffraction pattern. Electron microscopy techniques: Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscopy (AFM) (basic working principle with diagram and applications in each case) Applications: Nanoelectronics, energy storage devices (batteries and fuel cells), chemical and biosensors, biomedical uses. **(4 Hours)**

Reference Books

1. A Textbook of Quantum Mechanics by P.M. Mathews and K. Venkatesan
2. Quantum Mechanics by K.K. Chatwal and Anand Satya Prakashan
3. Quantum Mechanics by G.P. Singh and S.N. Singh Pragati Prakashan
4. Quantum Mechanics by H.C. Verma Bharati Bhawan
5. Quantum Mechanics: Theory and Applications by Ajoy Ghatak and S Lokanathan Springer/Macmillan
6. Principles of Quantum Mechanics by R. Shankar Plenum/Springer (Note: R. Shankar is an Indian American author)
7. Quantum Mechanics I: The Fundamentals by S. Rajasekar and R. Velusamy, CRC Press
8. Quantum Mechanics by V.K. Thankappan New Age International
9. Introduction to Quantum Mechanics by S.N. Biswas Oxford University Press
10. Quantum Mechanics by Two Brothers Publications
11. Atomic and Nuclear Physics by S. N. Ghoshal
12. Atomic Physics by J. B. Rajam
13. Modern Physics by R. Murugeshan
14. Atomic and Molecular Physics by Satya Prakash
15. Atomic and Molecular Physics by K. K. Sharma
16. Nanoscience and Nanotechnology – M. S. Ramachandra Rao & Shubra Singh
17. Introduction to Nanoscience and Nanotechnology – K. K. Chattopadhyay & A. N. Banerjee
18. Introduction to Nanotechnology – Charles P. Poole Jr. & Frank J. Owens
19. Nano: The Essentials – T. Pradeep

****

V Semester Paper-VI: PHY 503

Program Name	B.Sc	Semester	V
Relativity, Astrophysics and Electronics-I			
Course Code	PHY 503	No. of credits	03
Contact Hours	4 Hours	Duration of Examination	03 Hours
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE OUTCOMES (COs)

After successful completion of the course, the student will be able to

CO1: Explain the Newtonian principle of relativity.

CO2: Describe the Michelson–Morley experiment and interpret its null result.

CO3: Compare Galilean and Lorentz transformations.

CO4: Derive and apply Lorentz transformations, length contraction, and time dilation.

CO5: Explain variation of mass with velocity and mass–energy equivalence.

CO6: Classify stars based on spectral and luminosity characteristics

CO7: Analyse the structure, properties, and evolution of stars

CO8: Apply Boolean algebra and logic gates to design digital circuits.

CO9: Understand semiconductor devices such as p–n junctions, Zener diodes, tunnel diode, and transistors, CE amplifier.

CO10: Study op-amps in integrators, differentiators, summing amplifiers and DACs.

CO11: Solve numerical problems with conceptual understanding.

UNIT-1

RELATIVITY

Inertial and non- inertial frames, Special Theory of Relativity: Michelson-Morley Experiment and its result, Postulates of Special Theory of Relativity. Galilean transformation equations, Lorentz Transformation equations. Lorentz length contraction. Time dilation (Illustrations: muon decay quantitative and twin paradox), Simultaneity of events. Problems. **(7 Hours)**

Relativistic transformation of velocity, Relativistic addition of velocities. Variation of mass with velocity, Mass energy Equivalence. Relativistic Doppler effect, mention of expressions for frequency and wavelength, applications. Energy- momentum relation, General theory of relativity: principle, gravitational waves, GPS - (qualitative). Problems. **(6 Hours)**

UNIT-2

ASTROPHYSICS

Measurement of Distance and brightness of a star, Heliocentric parallax; Definition of parsec (pc), Astronomical unit (AU), light year (l y) and their relations, Apparent brightness and absolute brightness

(definitions). Apparent magnitude - scale of Hipparchus; Absolute magnitude; Relation between apparent magnitude, absolute magnitude and distance of a star; visual magnitude, bolometric magnitude and distinction between them. problems. **(3 Hours)**

Stellar classifications:

Pickering classification (OBAFGKMCS) and Yerke's luminosity classification. H-R diagram, Main sequence stars and their general characteristics. **(1 Hour)**

Properties of main sequence stars

Gravitational potential energy of a star based on the linear density model (derivation), Statement and explanation of Virial theorem, Expressions for - average temperature, core temperature of a star, hydrostatic equilibrium (derivation), core pressure of a star based on the linear density model (derivation). Photon diffusion time (qualitative), Mass – Luminosity relationship and expression for lifetime of a star (derivation). Expression for radius of a star using luminosity and surface temperature. Problems. **(7 Hours)**

Evolution of Stars

Stages of star formation (Giant Molecular Cloud – Protostar- T-Tauri) and main sequence evolution, Red giant, White dwarfs, Pulsars, Neutron stars and Black holes - (brief explanation). Supernova explosion- its types, Chandrasekhar limit (mention of expression). Event Horizon, Singularity, Schwarzschild radius. **(2 Hours)**

UNIT-3

ELECTRONIC DEVICES

Basic p-n junction, Zener diode I-V characteristics, breakdown voltage. Tunnel diode – Principle, I-V Characteristics. Transistor - CE characteristics. CE amplifier (Voltage-divider biasing with emitter bypassed, no load) - working, expression for current gain and voltage gain. Problems. **(3 Hours)**

Op amp-characteristics (ideal and practical), pin configuration, concept of virtual ground. Op Amp Inverting and Non-inverting amplifier -expressions for voltage gain (derivation), Op amp Integrator and Differentiator, Summing amplifier. Digital-to-Analog converter (DAC) using op amp – binary weighted resistors, mention of expression for output voltage. Low pass, High pass and Band pass filters using Op amp-theory and frequency response. Problems. **(10 Hours)**

UNIT-4

POWER SUPPLY AND DIGITAL ELECTRONICS

Power Supply Circuits: Basics of DC power supplies - block diagram of a regulated power supply. Half-wave and bridge type full-wave rectifiers, (Efficiency, Ripple Factor, Peak Inverse Voltage (PIV). Filtering method using shunt capacitor. Voltage regulation using Zener diode and IC voltage regulators - line and load regulation**.** Problems. **(7 Hours)**

Digital electronics : Decimal, binary, octal and hexadecimal number systems and their conversions. Logic gates (AND, OR, NOT, XOR, NAND, NOR). NAND and NOR gate as universal gates. De Morgan's theorems. Half adder and Full adder. Problems. **(6 Hours)**

Reference Books

1. Physics for Degree students (Third Year) – C.L. Arora and P.S. Hemne, S, Chand and Co. Pvt. Ltd.2014.
2. Modern Physics by R. Murugeshan
3. Mechanics and Relativity by V. S. Soni
4. Classical Mechanics by J. C. Upadhyaya
5. Introduction to Astrophysics by Baidyanath Basu & Sudhindra Nath Biswas
6. Astrophysics: Stars and Galaxies by K. D. Abhyankar
7. General Astronomy & Astrophysics by R. Murugeshan
8. An Introduction to Stellar Astrophysics by Francis LeBlanc
9. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd
10. Integrated Electronics J. Millman, C. Halkias& C. Parikh McGraw Hill Education 2017
11. Digital Fundamentals T. L. Floyd Pearson Education 2005
12. Principles of Electronics V.K Mehta and Rohit Mehta S. Chand Publishing 2020
13. Electronic Principles A Malvino and D J Bates McGraw Hill Education 2017
14. Electronic Devices and Circuits David A. Bell PHI, New Delhi
15. Basic Electronics B L Theraja 2004 S Chand and Co.
16. Fundamentals of Special and General Relativity by K.D. Krori
17. The Special Theory of Relativity: A Mathematical Approach by Farook Rahaman,
18. General Relativity and Gravitational Waves by Sanjeev Dharanidhar and Sanjit Mitra
19. The Special Theory of Relativity by S. Banerji
20. Concepts of Physics (Vol II) by H.C. Verma
21. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad
22. Operational Amplifiers and Linear ICs by David A. Bell
23. Linear Integrated Circuits by B. Visveswara Rao
24. A Textbook of Applied Electronics by R. S. Sedha

****

V Semester–Practical Paper: PHY 502

Titles of the experiments

1. Study of rotational vibrational spectrum HBr molecule.
2. To determine the force constant and vibrational constant for iodine molecule from its absorption spectrum.
3. Study of Raman spectrum of Nitrogen.
4. To study the tunnelling in Tunnel Diode using I-V characteristics.
5. To determine the value of Rydberg's constant using diffraction grating and hydrogen discharge tube.
6. To determine fine structure constant using fine structure separation of sodium D-lines using a plane diffraction grating.
7. Transistor as a switch and active device.
8. Frequency response of CE amplifier and determination of bandwidth.
9. Determination of solar rotation period from sunspot observation.
10. Determination of temperature of a star by analysing the spectrum.
11. Plotting of H R Diagram and identification of star-type from the data given.
12. Zener diode as voltage regulator- Line/Load regulation.
13. Voltage regulator using LM 317 IC.
14. Op amp Inverting and Non-inverting amplifier.
15. Op amp summing amplifier.
16. NAND and NOR as Universal gates.
17. Half adder and Full adder.

NOTE: A minimum of 8 (EIGHT) experiments must be performed.

Reference books for V semester Physics Practical

1. Practical Physics, D.C. Tayal, First Millennium Edition- 2000, Himalaya Publishing House.
2. B.Sc. Practical Physics, C.L. Arora, Revised Edition- 2007, S. Chand & Comp. Ltd.
3. An Advanced Course in Practical Physics, D. Chattopadhyay, P.C. Rakshith, B. Saha, Revised Edition-2002, New Central Book Agency Pvt. Ltd.
4. Physics through experiments, B. Saraf, Edition -2013, Vikas Publications.
5. Experiments in General Physics, Dr. Rohini V S, Edition- 2019, Taranga publications.
6. IGNOU: Practical Physics Manual.
7. Saraf: Experiment in Physics, Vikas Publications.
8. S.P. Singh: Advanced Practical Physics.
9. Melissons: Experiments in Modern Physics.
10. Misra and Misra, Physics Lab.manual, South Asian publishers, (2000).

Course title	**B.Sc Physics – V semester Practical**	**Practical credits**	**02**
Course Code	**PHY 502**	**Contact Hours**	**03 hours**
Internal Assessment			**10 marks**
Examination			**40 marks**
Total			**50 marks**

Internal Assessment for Practical Physics	
	Marks
Internal test	**05 marks**
Assignment/Activity	**05 marks**
Total	**10 marks**

PATTERN OF QUESTION PAPER

PART A		**Total marks**
1 Mark answers		
1x10=10 marks (10 out of 12)	**a) True or false** **b) Fill in the blanks** **c) One word / one phrase** **d) MCQs**	**10**
PART B		
2 Mark answers (10 out of 12 questions)		
2x10=20 marks	**Short answers (direct and conceptual)**	**20**
PART C		
6 Mark answers (answer any 5 out of 8)	**Long answers (Single or Split questions in one main question)**	
6x5=30 marks		**30**
PART D		
4 Mark answers (answer any 5 out of 8)		
4x5=20 marks	**Problems**	**20**
	Total	**80 marks**

Distribution of Marks for the Practical Examination		
Sl. no.	Particulars	Marks
1.	Writing Formulae / Statement with symbols, units and explanation of terms	**05**
2.	Drawing illustrative diagrams and expected graphs	**05**
3.	Setting up of the experiment& taking readings	**10**
4.	Calculations and graphs drawn based on experimental data.	**10**
5.	Accuracy of results with units	**05**
6.	Valuation of Practical Record	**05**
	Total	**40**

Dr. B.ERAIAH
M.Sc.M.Phil.Ph.D.,
Professor, Department of Physics
Bangalore University, Bangalore - 560056

V Semester B. Sc Physics SEP Scheme

Compulsory Practical Skill paper: PHY SK2

Sl. No.	Title of the experiment	Remarks
1	Studying the effect of mass of the bob on the time period of the simple pendulum.	
2	Studying the effect of amplitude of oscillation on the period of the simple pendulum.	
3	A code in C/C++/ Scilab/ Python, to find the first five eigen states and eigen functions of particle in a one-dimensional infinite potential well	Plotting of the wave functions and probability density
4	Plotting graphs using Desmos- $i)\ \boldsymbol{f(t) = a\left[sin\omega t + \frac{\sin 3\omega t}{3} + \frac{\sin 5\omega t}{5} + \frac{\sin 7\omega t}{7}\right]}$ $ii)\ \boldsymbol{f(x) = A \sin(bx - vt)}$ $iii)\ \boldsymbol{f(x) = x^2}$	Tracing of waveforms
5	Absorption spectrum of $KMnO_4$ – Calculation of wavelengths	
6	D/A conversion using Op-amp (4 bit)	
7	Determination of Numerical aperture and acceptance angle of optical fibre	
8	Determination of energy of rigid diatomic molecules: CO, HCl.	Plot the graph of rotational energy versus rotational quantum number 'J'.
9	Estimation of Q values of two inductors and draw inference.	Series R LC circuit

Note: A minimum of 6 (SIX) experiments must be performed.

Course title	**Physics practical skill VI semester**	**Practical credits**	**02**
Course Code	**PHY SK3**	**Contact Hours**	**03 Hours**
Internal Assessment			**10 marks**
Duration of Examination: 03 Hours		**Examination**	**40 marks**
Total			**50 marks**

Distribution of marks - PHY SK2

Internal Assessment for Practical Physics	
	Marks
Internal test	**05 marks**
Assignment/Activity	**05 marks**
Total	**10 marks**

****

VI Semester

B. Sc Physics Syllabus

(Paper VII and VIII) SEP Scheme

VI Semester Paper-VII: PHY 601

Program Name	B.Sc	Semester	VI
Condensed Matter Physics and Nuclear Physics			
Course Code	PHY 601	No. of credits	03
Contact Hours	4 hrs	Duration of Examination	03 hrs
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE OUTCOMES (COs)

After the successful completion of the course, the student will be able to

CO1: Understand crystal systems, Bravais lattices, and Miller indices

CO2: Calculate interplanar spacing and lattice constants

CO3: Understand X-ray production, Bragg's law, and Moseley's law, Compton effect

CO4: Understand Fermi-Dirac distribution and Fermi energy, Hall effect.

CO5: Understand properties of different magnetic materials

CO6: Interpret hysteresis curve, hysteresis loss, and applications of magnetic materials.

CO7: Understand polarization, dielectric constant, and relations between D, E, P

CO8: Explain types of polarization and electric breakdown.

CO9: Understand Nuclear properties, binding energy & stability, radioactivity laws, decay processes, nuclear reactions, and applications**.**

CO10: Understand Radiation interaction mechanisms, attenuation, detectors and particle accelerators.

CO11: Solve numerical problems with conceptual understanding

UNIT-1

CRYSTAL SYSTEM AND X-RAYS

Crystal systems - Bravais lattice, Miller indices, spacing between lattice planes of cubic crystals (derivation), Calculation of lattice constant. Production of X rays, Continuous and characteristic X-rays, Moseley's law, scattering of X-rays, Bragg's law. Problems. **(6 Hours)**

FREE ELECTRON THEORY OF METALS

Assumptions and Classical theory (Drude-Lorentz model). Electrical conductivity, Thermal conductivity, Weidemann-Franz's law. Density of states for free electrons (qualitative). Fermi-Dirac distribution function and Fermi energy, expression for Fermi energy and Kinetic energy at absolute zero (derivation). Hall effect in metals, expression for Hall coefficient (derivation). Problems. **(7 Hours)**

UNIT-2

BASIC CONCEPTS OF MAGNETISM

Magnetic field (B), magnetic field intensity (H), Magnetization (M), Magnetic susceptibility (χ), Magnetic permeability (μ), Relation between B, H and M, Magnetic dipole moment, Torque on a magnetic dipole in a uniform magnetic field. Problems.

Magnetic Materials: Diamagnetic, Paramagnetic and Ferromagnetic materials (basic characteristics and examples). Classical Langevin theory of paramagnetism, Curie's Law, Curie constant, Limitations of classical theory, Magnetic moment due to electron spin, Bohr magneton (concept only). Ferromagnetism- Domain concept, Weiss theory of ferromagnetism, Curie-Weiss law. Hysteresis curve, Hysteresis loss, Soft and hard magnetic materials, Applications (transformers, memory devices)**.** Problems. **(7 Hours)**

DIELECTRICS

Polar and non-polar molecules, Electric dipole moment, Polarization (P), Electric susceptibility, Dielectric constant, Relation between D, E and P. Electronic, Ionic, Orientation and Space charge polarization. Lorentz field, expression for local field (Derivation), Clausius–Mossotti Equation (Derivation). Dielectric strength, Dielectric Breakdown. Applications of dielectrics. Problems. **(6 Hours)**

UNIT-3

PROPERTIES OF NUCLEI

Constituents of nucleus, Mass number (A), Atomic number (Z), Isotopes, Isobars, Isotones. Intrinsic properties of nucleus-nuclear size, nuclear radius, Empirical relation: $R = R_O A^{1/3}$, nuclear density, nuclear spin, nuclear magnetic moment. Nuclear Mass and Binding Energy: Mass defect, Binding energy per nucleon, binding energy versus mass number curve, stability of nuclei. Problems. **(3 Hours)**

Radioactivity: Alpha, Beta and Gamma rays (basic properties), Decay law, Half-life and mean life, Radioactive equilibrium (secular equilibrium and transient equilibrium – qualitative), Alpha decay: Basics of α-decay processes, Range of alpha particles, Geiger-Nuttall law (statement and significance), disintegration energy of alpha decay, Gamow's theory of α emission- Quantum tunnelling concept. β-decay: energy kinematics for β decay, positron emission, electron capture, energy spectrum of β-particles, Conservation laws in β-decay, Pauli's neutrino hypothesis. Problems. **(7 Hours)**

Nuclear Reactions: Types of nuclear reactions- exoergic and endoergic reactions, Q-value of nuclear reaction (derivation), Conservation laws in nuclear reactions, nuclear fission and fusion, Applications of nuclear fission in nuclear reactors, defence, agriculture. Problems. **(3 Hours)**

UNIT-4

INTERACTION OF NUCLEAR RADIATION WITH MATTER

Gamma ray interaction with matter-photoelectric effect, Compton scattering, pair production, energy loss of heavy charged particles due to ionization, Bethe Bloch formula, energy loss of electrons-ionisation & excitation, attenuation of gamma rays- mention of exponential law $I = I_o\, e^{-\mu x}$, Linear attenuation coefficient (μ) and mass attenuation coefficient (μ/ρ). Cerenkov radiation. Problems. **(6 Hours)**

Nuclear Detectors and accelerators: Gas-Filled Detectors: Geiger–Müller counter: Principle, characteristic curve, dead time, applications. Scintillation Detectors: Principle of scintillation, Photomultiplier tube (PMT) – basic working. Semiconductor Detectors: Basic principle (Si/Ge detector). Particle Accelerators: Cyclotron- Principle, Construction, Working, cyclotron resonance condition and limitations, Synchrotron- Principle, Construction, working. Applications. Problems. **(7 Hours)**

Reference Books:

1. Introduction to Solid State Physics – Charles Kittel, 8th Edition (2004), Wiley Publication
2. Elementary Solid-State Physics – J P Srivastava, 4th Edition (2015) PHI, New Delhi.
3. Solid State Physics – S. O. Pillai, 5th Edition (2002), New Age International Publishers, New Delhi.
4. Solid State Physics: Theory, Applications and Problems – S L Kakani and C Hemarajani, 4th Revised Edition (2005) Sultan Chand & Sons, New Delhi.
5. Solid State Physics – Hem Chandra Gupta, 2nd Edition (2001) Vikas Publishing House Pvt. Ltd. New Delhi.
6. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
7. Nuclear Physics by D.C. Tayal, Paperback Edition , Himalaya Publishing House – 1 January 2020
8. Nuclear Physics, Irving Kaplan, Narosa Publishing House
9. Concepts of nuclear Physics by Bernard L. Cohen. (Tata McGraw Hill, 1998).
10. Introduction to the Physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
11. Concepts of Modern Physics by Arthur Beiser, Sixth Edition, McGraw Hill International Edition.
12. Concepts of Modern Physics by Arthur Beiser, Shobit Mahajan, S rai Choudhury, McGraw Hill International Education.

****

VI Semester Paper-VIII: PHY 603

Program Name	B.Sc	Semester	VI
Statistical & Atmospheric Physics, Transducers and Electronics -II			
Course Code	PHY603	No. of credits	03
Contact Hours	04 hrs	Duration of Examination	03 hrs
Formative Assessment Marks	20	Summative Assessment Marks	80

COURSE OUTCOMES (COs)

After the successful completion of the course, the student will be able to:

CO1: Explain atmospheric composition, structure, temperature variation, pressure, humidity, and instruments to measure humidity.

CO2: Apply concepts of hydrostatic equilibrium and lapse rates (dry adiabatic and environmental).

CO3: Understand rotating frame dynamics, including centripetal and Coriolis forces and their applications

CO4: Explain pressure gradient and gravitational forces; analyse gravity waves and Rossby waves. Describe greenhouse effect, global warming, and ENSO (El Niño & La Niña).

CO5: Identify and understand the different types of transducers and sensors used in robust and hand-held instruments.

CO6: Understand the working and different types of transducers and displays.

CO7: Connect the concepts learnt in the course to their practical use in daily life.

CO8: Solve numerical problems with conceptual understanding.

UNIT-1

STATISTICAL PHYSICS

Macrostate, Microstate, Phase Space, Stirling's Approximation, Thermodynamic Probability and its calculation (Description of each with an example); Entropy and Thermodynamic probability (derivation of $S = k\ ln\Omega$). Basic postulates of Statistical Physics; Ensembles (Micro – canonical, canonical and grand canonical). **(2 Hours)**

Maxwell – Boltzmann Statistics: M -B Distribution law (Derivation of $n_i = g_i\, e^{-(\alpha+\beta Ei)}$), derivation of the expression for average energy of an ideal gas molecule $\bar{E} = \frac{3kT}{2}$, velocity distribution law. Limitations of M-B statistics.

Bose – Einstein Statistics: B-E distribution law (Derivation of $n_i = g_i\ /\ (e^{\alpha+\beta Ei} - 1)$, Bose-Einstein condensation, properties of liquid He (qualitative). Mention of expression of Bose Temperature, variation of N_o (number of particles in Zero energy state) and N_e (number of particles in non-Zero energy state) with temperature, Radiation as photon gas. Derivation of Planck's law, Rayleigh-Jeans law, Wien's law. Specific Heat capacity of metals, Einstein's theory of specific heat capacity of solids – [Derivation of the equation

$\theta = h\nu/k$]. Problems. **(7 Hours)**

Fermi – Dirac Statistics: F-D distribution law (Derivation of $n_i = g_i / (e^{\alpha+\beta Ei} + 1)$, Fermi sphere, Derivation of expression for Fermi energy, Electronic Specific heat capacity in metals (Mention of the contribution to specific heat capacity from free electrons). Problems.

Comparison of Maxwell – Boltzmann, Bose – Einstein and Fermi – Dirac statistics. **(4 Hours)**

UNIT-2

ATMOSPHERIC PHYSICS

Fixed and variable gases, volume mixing ratio; atmospheric structure; temperature changes with altitude; pressure variation and scale height (derivation); relative and absolute humidity, Hygrometer and Psychrometer- Principle. Hydrostatic equilibrium, Lapse rate: Dry adiabatic lapse rate, lapse rates (mention of typical values). Problems. **(4 Hours)**

Black body radiation, Planck's law and Wiens's law (statements), Reflectivity, transmittivity and absorptivity of radiation, Beer's law (derivation); Accelerated rotational frames of reference – Centripetal and Coriolis force, Applications of Coriolis force – Formation of trade winds, cyclones, erosion of riverbanks. Gravity and pressure gradient forces (derivation). Gravity waves and Rossby waves: causes, characteristics and significance. Global energy balance for earth-atmosphere system. Problems. **(7 Hours)**

Greenhouse effect, Global warming: Causes and manifestations of global warming, El Nino and La Nina events - ENSO (definitions and characteristics). **(2 Hours)**

UNIT-3

TRANSDUCERS

Introduction, Classification, Characteristics of a transducer, factors governing the selection of a transducer, Resistive transducer-potentiometer, Strain gauge and types (Wire strain Gauge- unbonded and bonded, Foil Strain Gauge, Semiconductor Strain gauge - general description), Resistance thermometer principle- platinum resistance thermometer, Thermistor. Problems. **(7 Hours)**

Inductive Transducer-general principle, Linear Variable Differential Transducer (LVDT) - principle and working, Capacitive Transducer, Piezo-electric transducer, Photoelectric transducer, Photovoltaic cell, photo diode and phototransistor – principle and working. Problems **(6 Hours)**

UNIT-4

WAVEFORM GENERATORS AND DISPLAYS

Waveform Generators: Classification- 1. Types of waveforms-sine, square, triangular and saw tooth 2. fixed and variable frequency generators 3. AF and RF. Basic requirements of a waveform generator, principle of standard AF signal generator (Block diagram). Positive feedback-Barkhausen criteria, Sine wave generators: construction and working of Phase shift and Wien bridge oscillators using op amp - frequency of oscillation (mention of the expressions). Square wave and triangular wave generator using op amp – construction and working (mention of the expression of frequency). Problems. **(8 Hours)**

Displays: Cathode ray oscilloscope – block diagram, working, derivation for deflection of electron beam. Light emitting diode LED -principle and working - Forward bias I-V characteristics, 7-segment display. Liquid Crystal display LCD - description and working. Advantages of LED & LCD and their applications. OLED & QLED – Principle and working. Problems. **(5 Hours)**

Reference books

1. Fundamentals of Statistical Mechanics – B. B. Laud, New Age International (P) Ltd.
2. Statistical Mechanics – Satya Prakash, Kedarna Nath & Co.
3. Heat Thermodynamics and Statistical Physics – Brij Lal, N. Subrahmanyam & P. S. Hemne S. Chand Publishing
4. A Textbook of Statistical Mechanics – Suresh Chandra & Mohit Kumar Sharma,S. Chand Publishing
5. Statistical Physics and Thermodynamics – J. K. Sharma & K. K. Sarkar, Krishna Prakashan Media
6. Modern Physics, R. Murugeshan, Kiruthiga Sivaprakash, Revised Edition, 2009, S. Chand & Company Ltd
7. Basics of Atmospheric Science – A. Chandrasekar, PHI Learning Private Limited (New Delhi)
8. Electronic Instrumentation, 3rd Edition, H.S. Kalsi, McGraw Hill Education India Pvt. Ltd. 2011 (For Transducers and sensors)
9. Instrumentation – Devices and Systems (2nd Edition)– C.S. Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill Education Pvt. Ltd.

****

VI Semester–Practical Paper: PHY 602

Titles of the experiments

1. Analysis of X ray powder photograph and determination of lattice constant
2. Energy gap and temperature coefficient of resistance of a thermistor
3. Fermi energy of copper
4. Energy gap of a semiconductor (diode) by reverse saturation method
5. Specific heat of a solid by electrical method
6. B – H curve using CRO
7. Hall effect in semiconductor-determination of mobility and Hall coefficient
8. Simulation of radioactive decay using dice
9. Characteristics of GM counter
10. Verification of inverse square law in radioactivity
11. Determination of Mass Absorption coefficient of Aluminium
12. Op amp low pass filter
13. Op amp high pass filter
14. Phase shift oscillator using op amp
15. Wien Bridge Oscillator using op amp
16. Square wave generator using op amp
17. Measurement of susceptibility of paramagnetic substance (solid/liquid)
18. To study the I-V characteristics of solar cell
19. To study the I-V characteristics of photo diode
20. Quantum efficiency of photodiode

Note: A minimum of **8 (EIGHT)** experiments must be performed.

Reference books for VI semester Physics Practical syllabus

1. Practical Physics, D.C. Tayal, First Millennium Edition, 2000, Himalaya Publishing House.
2. B.Sc. Practical Physics, C.L. Arora, Revised Edition, 2007, S. Chand & Comp.Ltd.
3. An Advanced Course in Practical Physics, D. Chatopadhyaya, P.C. Rakshith, B. Saha, Revised Edition, 2002, New Central Book Agency Pvt. Ltd.
4. Physics through experiments, B. Saraf, 2013, Vikas Publications.
5. Experiments in General Physics, Dr. Rohini V S, 2019, Taranga publications
6. IGNOU: Practical Physics Manual
7. Saraf: Experiment in Physics, Vikas Publications
8. S.P. Singh: Advanced Practical Physics
9. Melissons: Experiments in Modern Physics
10. Misra and Misra, Physics Lab Manual, South Asian Publishers, (2000)

Course title	**B.Sc Physics VI Semester Practical**	**Practical credits**	**02**
Course Code	**PHY 602**	**Contact Hours**	**03 hours**
Internal Assessment			**10 marks**
Duration of Examination			**40 marks**
Total			**50 marks**

Internal Assessment for Practical Physics	
	Marks
Internal test	**05 marks**
Assignment/Activity	**05 marks**
Total	**10 marks**

Question paper pattern

B.Sc. Course Physics Question paper pattern

PART A		**Total marks**
1 Mark answers		
1x10=10 marks (10 out of 12)	**a) True or false** **b) Fill in the blanks** **c) One word / one phrase** **d) MCQs**	**10**
PART B		
2 Mark answers (10 out of 12 questions)		
2x10=20 marks	**Short answers (direct and conceptual)**	**20**
PART C		
6 Mark answers (answer any 5 out of 8)	**Long answers (Single or Split questions in one main question)**	
6x5=30 marks		**30**
PART D		
4 Mark answers (answer any 5 out of 8)		
4x5=20 marks	**Problems**	**20**
	Total	**80 marks**

Compulsory Practical Skill paper PHY SK3

Sl.no.	Title of the experiment
1	To determine angular spread of He-Ne laser using plane diffraction grating
2	To determine half-life of KCl (40 K) using a Geiger-Müller counter
3	Tracing of waveforms of op amp integrator and differentiator (pulse width greater than, equal to and less than time constant RC). (option: computer-interfaced kit may be used).
4	Determination of inductive and capacitive reactance for different frequencies
5	Verification of inverse square law of light using light sensor app in a mobile phone-measurement of light intensity
6	To find the value of e/m for an electron by Thomson's method using bar magnets
7	A code in C/C++/Scilab/ Python to find the first five eigen states and eigen functions of Linear Harmonic Oscillator - Plot of energy values versus 'n'
8	Measurement of distance of an object by measuring parallax angle (using spectrometer).
9	Measurement of ac voltage of sine wave and frequency of sine, triangular and square wave using CRO

Note: A minimum of 6 (SIX) experiments must be performed.

Course title	**Physics practical skill VI semester**	**Practical credits**	**02**
Course Code	**PHY SK3**	**Contact Hours**	**03 Hours**
Internal Assessment			**10 marks**
Duration of Examination: 03 Hours		**Examination**	**40 marks**
Total			**50 marks**

Internal Assessment for Practical Physics	
	Marks
Internal test	**05 marks**
Assignment/Activity	**05 marks**
Total	**10 marks**

Distribution of marks - PHY SK3

Distribution of Marks for the Practical Examination		
Sl. no.	Particulars	Marks
1.	Writing Formulae / Statement with symbols, units and explanation of terms	05
2.	Drawing illustrative diagrams and expected graphs	05
3.	Setting up of the experiment& taking readings	10
4.	Calculations and graphs drawn based on experimental data.	10
5.	Accuracy of results with units	05
6.	Valuation of Practical Record	05
	Total	40

Dr. B.ERAIAH
M.Sc.M.Phil.Ph.D.,
Professor, Department of Physics
Bangalore University, Bangalore - 560056

BSc Course for Bengaluru City university Framework for Physics as per Higher Education Council Guidelines (for three major)

Sem	Course category	Course code	Course title	Credits assigned	Instructional hours per week		Duration of exam (hrs)	Marks		
					Theory	Practical		IA	Exam	Total
V	Physics	**PHY 501**	(Theory)	03	04	-------	3 hrs	20	80	100
V	Physics	**PHY 503**	(Theory)	03	04	-------	3 hrs	20	80	100
V	Physics	**PHY 502**	(Practical)	02	-------	03	3 hrs	10	40	50
V	Physics	**PHYSK2**	Physics Practical Skill (Practical)	02	-------	03	3 hrs	10	40	50
VI	Physics	**PHY 601**	Solid-State Physics, Magnetic Properties of Matter and Dielectrics and Nuclear Physics (Theory)	03	04	-------	3 hrs	20	80	100
VI	Physics	**PHY 603**	Statistical and Atmospheric Physics, Transducers and sensors, Electronics -II (Theory)	03	04	-------	3 hrs	20	80	100
VI	Physics	**PHY 602**	(Practical)	02	-------	03	3 hrs	10	40	50
VI	Physics	**PHYSK3**	Physics Practical Skill (Practical)	02	-------	03	3 hrs	10	40	50

****