SYLLABUS FOR FOUR YEAR INTEGRATED B.Sc. B.Ed. COURSE

FIRST YEAR

JAI NARAIN VYAS UNIVERSITY
JODHPUR

Rules for Admission in INTEGRATED B.Sc. B.Ed. COURSE
(Four Years Course)

Admission rules for the INTEGRATED B.Sc. B.Ed. course shall be the same as decided by the NCTE/Government of Rajasthan from time to time. Reservation of seats for SC/ST/OBC/SBC/Specially-abled and others shall be as per existing Rajasthan Govt. /Central Govt. /University rules

A. Eligibility

(a) Candidate with at least 50% marks in the senior secondary /+2 or its equivalent are eligible for admission.

(b) The reservation and relaxation in marks for SC/ST/OBCPWD and other category shall be as per the rules of the Central Government/State Government whichever is applicable.

B. Admission Procedure for B.Ed.

Admission shall be made on the basis of marks obtained in the qualifying Examination or through the entrance examination or any other selection process or as per policy decided by the State Government and the University time to time.

C. Duration and Working Days

Duration

The Integrated B.Sc. B.Ed.Programme shall be of duration of Four Academic Years, which must be completed in a Maximum of Six Years from the date of the admission to the programme.

Working Days

- There shall be at least Two Hundred Fifty Working Days each year exclusive of the period of examination and admission.
- Institution shall work for a minimum of thirty six hours a week, during which physical presence in the institution of all the teachers and student teachers is necessary to ensure their availability for advice, guidance, dialogue and consultation as and when needed.
- The minimum attendance of student-teachers shall be 80% for all course work and practicum, and 90% for school internship.
- Candidates falling short in above stated attendance criteria will not be allowed to appear in the final examinations conducted by the university.
- There will be six days week system.
- Candidates remaining absent from college for 15 or more days without any justifiable reason or without any valid information, their names will be struck off from the college roll list. Such candidates will have to seek readmission from a fresh end.

Criteria for Awarding Division

Successful candidates will be placed in three divisions both in theory and practice of teaching examination separately.

- **I Division:** Candidates obtaining 60% or more of aggregate marks
- **II Division:** Candidates obtaining 48% or more but less than 60% of the aggregate marks.
- **III Division:** Candidate obtaining 40% or more but less than 48% of the aggregate marks.

Rules: Examinations & Results

1. This integrated degree will include papers of B.Sc. as well as B.Ed. in all four years. The university will conduct the examinations every year for all papers (Except EPC) of three hours duration while the pedagogy paper will be of 2 hours duration in Fourth year.
2. In Fourth year there will be two pedagogy papers with an internal weightage of 15 marks. The External Assessment of both the papers will be done externally at the university level for 35 marks. For a pass in pedagogy papers candidate will have to obtain 6 marks in internal & 14 marks in external.
3. Internship activities will be compulsory for students. Failing to attend /perform anyone of the mentioned activities shall result into a failure in that year.
4. It is mandatory for any student to attain 90% attendance in internship programme, failing which; they will be declared fail in that year.
5. Candidate will have to obtain 40% marks in Theory Total, Internal Total, Practical Total and Foundation Total separately (Not in individual paper). In the papers carrying 70 marks, candidate will have to obtain minimum 28 marks for a pass.
6. If a candidate fails to score 40% in any of the Theory subject total/ Internal Subject Total/ Practical Subject Total, than he/ she shall be eligible for due paper in Theory or Internal or Practical subject (maximum two subjects) (except foundation subject). The marks of other subjects except due paper shall be carried forward.
7. Candidates failing in more than two External Subjects will be declared fail & they will have to reappear in next year in all the Theory Papers and in Foundation Paper, if applicable. However, their internal marks can be carry-forwarded.
8. Examination Scheme of B.Sc. B.Ed. Course (Mathematics) Paper shall be 70 (Theory) + 30 (Internal) marks which is at par with the weightage other papers of the B.Sc. B.Ed. all years.
9. Candidates failing in two or less than two papers in internal will be allowed a promotion in next year, provided that they reappear in them at later stages. However, any candidate can get this benefit of promotion in a maximum of two papers internals & externals combined together. However, their internal marks can be carry-forwarded.
10. B.Sc. Practicals of all the papers of particular subject (Botany/ Zoology/ Chemistry/ Physics) will be conducted on the same day but marks will be allotted as prescribed in the respective syllabi.
11. B.Sc. Practical Examination of all the papers of particular subject (Botany/ Zoology/chemistry/ Physics) will be conducted by the board of examiners consisting of two external examiners and one internal examiner (Faculty member of that subject)
12. A candidate will have to obtain 40% marks separately in the final lesson of B.Ed. Candidates failing in the final lesson will be declared fail. To pass the final lesson he/she has to appear in final lesson Examination next year and has to pass. Maximum of two chances will be given to pass final lesson exam. However, as an Ex-student, they can carry-forward their all other internal and external marks including Internship Marks.
13. Internship activities in third year will be of 06 weeks and will include teaching of both the pedagogy subjects, one week observation, criticism lessons & Action Research/Survey/Case Study (Any one). All the above said activities will be compulsory for students. Failing to attend /perform anyone of the above-said activities shall result into a failure in that year. These activities are-
    (i) Candidates have to practice five skills (assigned by college) in microteaching as a part of pre – internship activity. Each Skill will be performed twice as teach and reteach . They have to maintain the record of the micro lessons delivered.

(ii) Co-curricular & Extra-curricular activities must be spread all through the year which should also include special days' celebration.

(iii) To understand the local resources, people & community, an open air session of two days' will be conducted. It includes survey of that area as well as community work. Record of the work down is to be maintained.

(iv) Individual appraisal of the student-teachers will be done by the supervisor through a portfolio on some set criteria about their year-long activities, individual attributes & personal qualities like discipline, honesty, dedication, commitment etc.

(v) Internship of 6 weeks includes initial six days for general observation of the ongoing school activities & classroom teaching of the host teachers.

(vi) The students will deliver at least 15 lessons of each pedagogy paper. It is expected that the students play the participative role in all school activities and take necessary responsibilities as and when required. If required they can take all vacant and required classes.

(vii) There will be two criticism lessons (one in each pedagogy subject) for the progressive assessment of the student-teacher.

(viii) The student-teacher will have to do an Action Research or Survey or a Case Study (Any one) as assigned by the concerned supervisor and will submit the report.

14. In fourth year, the total internship program will be spread in duration of 14 weeks. This rigorous internship in surrounding schools will enable the student-teacher to perform better as a teacher. Only 10 students will be allowed to deliver lessons in a school. During internship program the student-teacher will ensure that they get a teaching exposure of secondary and senior secondary level preferably. Activities to be performed are as under-

(i) Co-curricular & Extra-curricular activities (in college) must be spread all through the year which should also include special days' celebration.

(ii) Individual appraisal of the student-teachers will be done on some set criteria about their year-long activities, individual attributes & personal qualities like discipline, honesty, dedication, commitment etc.

(iii) School internship will include the participation of the Student- teacher in all the activities of the school including teaching.

(iv) The student teacher will prepare a project report on the various aspects of the school on some set criteria where internship will be performed.

(v) The student teacher will deliver at least 5 ICT based lessons while doing the internship.

(vi) Co-curricular & Extra-curricular activities (in School) must be spread all through the internship program which should also include special days' celebration

15. Each candidate should be prepared to teach two lessons (One in each Pedagogy subject) at the final Practical Examination. However, the candidates will deliver one lesson (in the subject of their choice) for final practical out of prepared two lessons. The external examiner may pick up at least 10% of the candidate to deliver two lessons (if required), Lessons to be assessed by the Board of Examination consisting of:

(a) one external examiner of Science Pedagogy.

(b) Two internal examiners of whom one would be the Principal of the College and other would be a member of the faculty of the College of Science Pedagogy and marks will be awarded out of 100.

16. Candidate will be awarded degree of this course only when he/she has passed all the papers, as well as EPC Papers of all four years. This includes Theory, Internals, Internship and Practical's

Scheme of Examination

The examination for the degree of B.Sc. - B.Ed. shall be held in Theory, Practical and Practice of teaching.

Paper-wise scheme of examination: Theory

B.Sc.-

As mentioned with each paper for all the years in the syllabus.

B. Ed.-

Papers with External weight-age of 70 Marks (3 hours duration)

1. One essay type question will be set from each unit carrying 14 marks. There will be an internal choice of attempting two questions of short answer type (with a word limit of 200 words) from the same unit. Each short answer type question will carry 7 marks.
2. **Internal weight-age of 30 will be divided as under:**

   Assessment in the papers with internal weight-age of 30 marks will be divided in following parts.

   (i) Summative test I (10 Marks) On completion of 50 percent course

   (ii) Summative test II (10 Marks) On completion of 90 percent course

   (iii) There will be a provision of Sessional work in each paper with 10 marks weightage. Out of the suggested Practicum/field work, it will be compulsory to attempt at least two activities ensuring that a minimum of two units have been covered in the same. Students have to maintain a record/portfolio etc. as per the nature of related activity. 10 Marks will be bifurcated - 50 percent for conducted activities and 50 percent for documentation of conducted activities.
3. **Pedagogy Papers (in fourth year) with External weight-age of 35 Marks will be divided in two parts A & B (2 hours duration)**

Part-A

In part -A Three short answer type questions (Answer limit 150 words) will be set; one question from each unit. Candidate will attempt 2 questions out of three. Each question will carry 4 marks.

Part-B

There will be three essay type questions, one from each unit with an alternative choice. Each question will carry 9 marks.

- Assessment in the papers with internal weight-age of 15 marks (Pedagogy Courses in fourth year) will be divided in 2 parts. Only one summative test will be conducted for 10 marks & the rest 5 marks will be awarded for participating & documentation of the practicum activities suggested with syllabus.

General Rules

1. Candidates can apply for re-evaluation in any of the theory papers as per rules stipulated by the University for B.Sc.-B.Ed. degree. Changes in statutes/ ordinances/ rules/ regulations/ syllabi and books may from time to time be made by amendment or remaking and a candidate shall, except in so far as the university determines otherwise, comply with any change that applies to years he/she has not completed at the time of change.
2. Teaching Subjects means a subject offered by a candidate at Bachelor's Degree examination either as a compulsory subject or as an optional subject or a subsidiary subject provided that the candidate studied it for at least two years and took university examination each year.
3. General Science may be allowed to be offered by a candidate possessing B.Sc. with Chemistry and any one subject of Life Sciences i.e. Biology or Botany or Zoology.

B. Sc. – B. Ed. I Year

PHYSICS 2025-26

Course	Nomenclature of Theory Papers	Number of Periods per week	Exam. Hours	Univ. Exam.	*Internal	Total
Paper I	MECHANICS	2	3	40	10	50
Paper II	OPTICS	2	3	40	10	50
PRACTICAL COURSE		3 X 2	5	40	10	50

PAPER -I
MECHANICS

Unit I: Frames of Reference: Inertial frames, Galilean transformations, Non-inertial frames, fictitious forces, Displacement, Velocity and acceleration in rotating coordinate systems and their transformations, Coriolis force, Focault's pendulum, Motion relative to earth. Centre of Mass, collision of particles in laboratory and C.M. frame.

Unit II: Special Theory of Relativity: Invariance of c, Michelson-Morley Experiment, Lorentz transformations, addition of velocities, time dilation and length contraction, conservation of momentum in collision at relativistic speeds and variation of mass with velocity, relativistic energy, mass-energy equivalence, work and energy, transformation equations for momentum, energy and rate of change of momentum.

Unit III: Oscillations: Qualitative idea of oscillations in an arbitrary potential well, General differential equation for the harmonic motion, mass on a spring, oscillation of two masses connected by a spring, reduced mass, coupled oscillations, normal modes, normal coordinates of two linear coupled oscillators, damped harmonic motion, Forced oscillations and resonances, Resonance width and quality factor.

Unit IV: Waves: General differential equation of one dimensional wave motion and its solution, plane progressive harmonic wave, differential calculus methods for speed of transverse waves on a uniform string and for that of longitudinal waves in a fluid, energy density and energy transmission in waves, superposition of waves, group and phase velocity.
Fourier series, Fourier analysis of square and saw-tooth waves.

Unit V: Rigid Body Dynamics: Equation of motion of a rotating body, angular momentum of a rigid
body, inertial coefficient and idea of principal axes, case of j not parallel toω, kinetic energy of

rotation.
Elasticity : Young modulus, Bulk modulus and modulus of rigidity, Poisson ratio, relation between elastic constants, Theory of bending of a beam and torsion of a cylinder, experimental determination of Y by loading a beam in the middle and of η by static and dynamic methods, Searle's two bar experiment.

Books suggested

Berkeley: Physics Course, Vol. I, Mechanics, Tata McGraw Hill, New Delhi.
Berkeley: Physics Course, Vol. III, Waves and Oscillations, McGraw Hill, New Delhi.
A. P. French: Physics of Vibration and Waves.
Alonso and Finn: Fundamental University Physics, Vol. I, Mechanics.
R. S. Gambhir: Mechanics, CBS Publishers.
J.C. Upadhyaya: Mechanics, Ram Prasad & Sons, Agra.

PHYSICS
PAPER -II
OPTICS

Unit I: Geometrical Optics: Axial, Lateral and angular magnifications and their inter-relationship, Abbe's Sine condition for spherical surfaces, Aplanatic points for a spherical refracting surface.
Focal length of two thin lenses separated by a distance, Cardinal points of a co-axial lens system, properties of cardinal points, construction of image using cardinal points, Newton's formula and other relations for a lens system using cardinal points, Ramsden's and Huygen's eye pieces, their cardinal points, and relative merits.

Unit II: Interference: Division of Amplitude-Interference exhibited by thin film, Production of colours in thin films, Wedge-shaped film, Newton's rings and determination of wavelength and refractive index of a liquid by Newton's rings.
Michelson Interferometer: Measurement of wavelength and difference between two close wavelengths.
Fabry-Perot interferometer: Intensity Distribution, Co-efficient of sharpness and half width, measurement of wavelength.

Unit III: Lasers: Population inversion, laser as source of coherent radiation, Basic principles of He-
Ne Laser and Ruby Laser.
Diffraction: Fresnel's class of diffractions, Zone Plate, Phase reversal Plate, Cylindrical wave front and its effect at an external point and geometrical construction, diffraction at a straight edge; thin wire, rectangular slit and circular aperture.

Unit IV: Fraunhofer class of diffraction: Amplitude and phase due to a number of SH Motions acting on a particle simultaneously, Diffraction at two slits and intensity distribution, Diffraction at N slits.

Plane Transmission Grating: Theory and formation of spectra, width of principal maxima, absent spectra, overlapping of spectral lines, number of spectra, measurement of wave-length of light, Rayleigh's criterion, Resolving Power of a Prism, Telescope, Microscope and plane transmission grating.

Unit V: Polarization: Double refraction, production of plane polarized light by double refraction, Nicol Prism, Double refraction in uniaxial crystals, Huygen's explanation of Double Refraction, Plane, circular and elliptically polarized light, Half-wave and quarter-wave plates, production and detection of plane, circularly and elliptically polarized light by Nicol Prism and Quarter-wave plate. Rotatory Polarization, Fresnel's explanation, specific rotation, half shade and BiquartzPolarimeter, determination of specific rotation and strength of sugar solution.

Books suggested:

Jenkins and White: Optics, McGraw Hill.
Ghatak A.K.: Optics, Tata McGraw Hill.
Khandelwal D.P.: Optics and Atomic Physics, ShivlalAgarwal& Co.
Subramanayam and Brijlal: A text book of Optics, S.Chand New Delhi.

EXPERIMENTS FOR PRACTICAL WORK

Note: Any 15 experiments to be performed by all the students out of following list.

1. Determination of Young's modulus by bending of a beam.
2. Modulus of rigidity by statical method using horizontal apparatus.
3. Modulus of rigidity by statical method using vertical apparatus.
4. Elastic constants by Searle's method.
5. Nodal slide, determination of cardinal points of a combination of two lenses.
6. Formation of spectrum, prism spectrometer and determination of dispersive power of the material of a prism.
7. Wavelength of light by Newton's rings.
8. Wavelength of light by plane transmission grating.
9. Wavelength of light by biprism.
10. Specific rotation of the sugar solution by polarimeter.
11. Resolving power of telescope.
12. To determine the Poisson's ratio of a rubber tube.
13. Determination of surface tension of water by Jagger's method.
14. Resolving power of a plane transmission grating.
15. To determine the polarizing angle for the glass prism surface and to determine the refractive index of material of prism using Brewster's law.
16. Modulus of rigidity by dynamical method using Hollow Maxwell needle.
17. Modulus of rigidity by dynamical method using Solid Maxwell needle.
18. Verification of Malus law.
19. Determine the thermodynamic constant $\gamma = C_p / C_v$ using Clement and Desormes method.
20. Verification of Rutherford and Soddy's law of radioactive disintegration using dices and statistical Board.

Note: - New experiments may be added on availability of equipments.

SYLLABUS FOR FOUR YEAR INTEGRATED B.Sc. B.Ed. COURSE

SECOND YEAR

JAI NARAIN VYAS UNIVERSITY
JODHPUR

B. Sc., B. Ed. – II Year
PHYSICS 2026-27

Course	Nomenclature of Theory Papers	Number of Periods per week	Exam. Hours	Univ. Exam.	*Internal	Total
Paper I	Electromagnetics	2	3	40	10	50
Paper II	Statistical and Thermal Physics	2	3	40	10	50
Paper III	Quantum Mechanics and Spectroscopy	2	3	40	10	50
PRACTICAL COURSE		3 X 2	5	60	15	75

PAPER -I
ELECTROMAGNETICS

Unit I: Vector Fields: Scalar and Vector fields, gradient of a scalar field, divergence of vector field and their physical significance, curl of vector field, line integral of vector field, surface integral and flux of a vector field. Gauss law, its integral and differential form, statement and explanation of Gauss theorem and Stokes theorem.

Unit II: Electrostatics: Potential and field of an arbitrary charge distribution, concept of multipoles, Potential & field due to a dipole and quadrupole, torque on a dipole in an electric field. Electrostatic energy of a uniformly charged sphere. Classical radius of an electron.
Electric field in matter: Atomic and molecular dipoles, polarizability, permanent dipole moment, Dielectrics, polarization Vector, capacity of parallel plate condenser with partially or completely filled dielectrics, electric displacement and Gauss Law in general form, electrostatic energy of a charge distribution in dielectrics. Lorentz local field and Clausius-Mossotti equation.

Unit III: Electrostatic fields: Conductors in an electric field, boundary condition for potential, boundary conditions for electrostatic field at electric surface, uniqueness theorem, method of images and its application for system of point charge near a grounded conducting plane. Poisson's and Laplace equation in Cartesian, cylindrical and spherical polar coordinates (without derivation). Solution of Laplace equation in Cartesian coordinates, potential at a point inside a rectangular box.

Unit IV: Magnetics: Biot-Savart law, Ampere circuital law in integral and differential forms, divergence of B field, Force on a current carrying wire and torque on a current carrying loop in magnetic field.
Magnetic field in matter: Magnetization Vector, uniform magnetization and surface current, non-uniform magnetization, B,M,H Vectors and their inter-relations, Bohr magneton, orbital magnetic moment and angular momentum, Electron Spin and Magnetic moment, Magnetic Susceptibility.

Unit V: Electromagnetic Induction, Faraday's laws of Electromagnetic induction, its integral and differential form; Lenz's law; Self and mutual inductance, measurement of self inductance by Rayleigh method; Energy stored in magnetic field.
Transient response: Charge and discharge of condenser through resistance, determination of high resistance by leakage, growth and decay of current in LR circuit; A. C. Circuits, use of *j* operator in alternating current circuits. LCR circuit in series and in parallel (A.C.), phase diagram, Resonance and Q factor, Sharpness of resonance.

Books suggested:

Berkeley: Physics Course, Vol. II: Electricity and Magnetism, Tata McGraw Hill.
Spiegel, M.R.: Vector Analysis, Schaum's Outline Series, McGraw Hill.
Laud, B.B.: Electro-magnetics, Wiley Eastern.
Matveev, A.N.: Electricity and Magnetism, Mir Publishers, Moscow.
Griffiths: Introduction to Electrodynamics, PHI.

PAPER -II
STATISTICAL AND THERMAL PHYSICS

Unit I: Statistical Method: Particle States, distribution of particles in two particle states, Probability of a given distribution, distribution corresponding to maximum probability, relative probability curve with increasing number of particles, binomial distribution, Standard deviation, micro-states and macro-states of a system, principle of equal 'a priori' probabilities, equilibrium state, fluctuations, reversibility and irreversibility, States of a particle inside a box, number of accessible states between an infinitesimally small energy interval, momentum interval, phase space, statistical weight of a configuration of a macro state, indistinguishable and distinguishable particles, entropy and principle of increase of entropy, statistical ensemble, time and ensemble averages; Thermal interaction between
two systems, zeroth law of thermodynamics, concept of temperature.

Unit II: Canonical ensemble, Boltzmann canonical distribution, partition function, a two state system, paramagnetic susceptibility, heat capacity, Boltzmann formula for entropy, average energy and fluctuations, free energy, adiabatic interaction, enthalpy, general interaction, Gibbs free energy, first law of thermodynamics, phase transitions, Clausius-Clapeyron equation.
Ideal Classical Gas, Maxwell velocity and speed distributions, partition function, entropy (Sackur-Tetrode relation), Gibbs paradox; equation of state, ideal gas temperature scale, Vander-Waal's equation of state; heat capacities of monatomic and diatomic gases, ortho and para hydrogen.

Unit III: Systems with variable Energy and Particle Number: Chemical potentials, grand canonical distribution, Partition function, number fluctuations, grand potential, equation of state of an ideal classical gas, Saha's ionization formula, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, Fermi gas at 0K temperature; thermionic emission, strongly degenerate boson gas; Bose-Einstein Condensation, liquid helium.

Unit IV: Macroscopic Thermodynamics: Second law of thermodynamics; Carnot cycle, Carnot theorem, thermodynamic temperature scale and its identity with perfect gas temperature scale, entropy change in isothermal, and adiabatic expansions of an ideal gas; Thermodynamic potentials,

Maxwell's equations C_p-C_v, C_p/C_v, Black body radiation, energy density and pressure, Stefan-Boltzmann law, Wien's displacement law, Planck's law.

Unit V: Temperature changes in Joule and Joule-Thomson expansions, Regenerative cooling, adiabatic demagnetization and production of low temperatures, third law of thermodynamics, negative temperatures. Transport Phenomena: Mean free path, collision cross-sections, mean free time, viscosity, thermal conductivity and self-diffusion.

Books suggested:

1. Reif : Statistical Physics, Berkeley, Vol. 5, McGraw Hill.
2. Mandl : Statistical Physics, ELBS and Wiley.
3. Reif : Fundamentals of Statistical and Thermal Physics, McGraw Hill.
4. C. Kittel and H. Kroemer : Thermal Physics, CSS.
5. W.G.V. Rosser: An Introduction to Statistical Physics, Elis Horwood.
6. Lokanathan and Gambhir: Statistical and Thermal Physics, Prentice Hall.

PAPER -III
QUANTUM MECHANICS AND SPECTROSCOPY

Unit I: Development of quantum theory: Blackbody radiation and their characteristics, failure of classical physics to explain spectral distribution of blackbody radiation, Planck's quantum Hypothesis, Average energy of Planck oscillator, Planck's radiation formula, Wien's law, Rayleigh-Jean's Law, Stefan-Boltzmann's Law; Failure of classical physics to explain photo-electric effect and Compton effect, photons as carrier of energy and momentum of electro-magnetic waves.

Unit II: Wave Mechanics and Schrödinger equation: Phase velocity and group velocity of waves, wave particle duality; De Broglie Hypothesis; De Broglie group and phase velocity, wave packet, Heisenberg uncertainty principle, Statement and its equation from wavepacket in space and time; Application of uncertainty principle such as (i) Non-existence of electron in nucleus, (ii) Ground state of H-atom, (iii) Natural line width of spectral lines, X-ray microscope, Particles passing through (a) single slit and (b) double slit and observed on screen behind, explanation of distribution in terms of probability amplitude and interference of probability amplitude.
Postulates of Quantum Mechanics: Wave functions, Schrödinger superposition principle, operators in Quantum mechanics, Hermitian operators, expectation values, Interpretation of wave-function, symmetric and anti-symmetric wave functions, concept of parity; Probability density, Schrödinger equation, Schrödinger equation for free particle; Arguments in favour of this equation.

Unit III: Application of Schrödinger equation: Schrödinger equation for particle moving in potential field, Time dependent and time independent Schrödinger equation, Stationary states, Orthogonality of wave functions, Probability current density, Ehrenfest Theorem, Simple solution of Schrodinger equation (Restricted to one dimensional case), Particle in one dimensional infinite well, Particle in one dimensional finite well (one or both sides of well may be non-rigid), Calculation of reflection and transmission coefficient for potential step and potential barrier.

Unit IV: Atomic Spectroscopy: Orbital angular momentum, electron spin and Stern Gerlac experiment, Total angular momentum, Spin-orbit interaction, Vector model of atom and quantum

numbers associated with atom, L-S coupling and j-j coupling, Statement of Hund's Rule and Lande Interval Rule (without derivation), Fine structure of spectral lines, spectral terms up to two valence electron system, Pauli's exclusion principle.

Unit V: Atom in magnetic field: Magnetic moment of atom, contribution from orbital and spin angular momentum, gyro-magnetic ratio; Interaction energy of atom in magnetic field, splitting of energy levels, using good quantum numbers in Normal Zeeman effect, Anomalous Zeeman effect and Paschen-Back effect, Selection rules for dipole transitions.
Molecular spectroscopy: qualitative features of molecular spectra, rigid rotator, rotational and vibrational energy levels of diatomic molecules, rotational-vibrational spectra.

Books suggested:

1. Semat: Atomic Physics
2.Alonso and Finn: Fundamental University Physics, Vol. – III.
3. Beiser: Concepts in Modern Physcis
4. Waghmare: Quantum Mechanics
5. Wehr, Richards, Adair: Physics of the Atom, Narosa.

EXPERIMENTS FOR PRACTICAL WORK

Note: Any 15 experiments to be performed by all the students out of following list.

1. Low resistance by Carey Foster Bridge.
2. Variation of magnetic field along the axis of circular Coil.
3. Study of an RL Circuit for Phase relations.
4. Study of rise and decay in CR Circuit.
5. Study of electro-magnetic function and verification of Faraday's Laws.
6. Determination of temperature coefficient of platinum resistance thermometer using Carey Foster Bridge.
7. Determine thermal conductivity of a bad conductor by Lee's method.
8. Determination of Ballistic Constant of a Ballistic galvanometer using condenser.
9. Determination of Ballistic Constant of a Ballistic galvanometer by steady deflection method.
10. Determination of high resistance by method of leakage.
11. Study of Gaussian distribution using statistical board.
12. Determination of mutual inductance of a coil.
13. Experimental verification of the first law of thermodynamics by discharging the condenser.
14. Study of variation of total thermal radiation with temperature.
15. Plot thermo emf versus temperature and find the neutral temperature and temperature of inversion.
16. Determination of Self Inductance of a Coil using Ballistic galvanometer.
17. To study the electromagnetic damping of a compound pendulum.
18. To study the excitation of normal modes and measure frequency splitting using two coupled oscillator.
19. Study of dependence of velocity of wave propagation on line parameters using torsional wave apparatus.
20. Study of variation of reflection coefficient on nature of termination using torsional wave apparatus.

SYLLABUS FOR FOUR YEAR INTEGRATED B.Sc. B.Ed. COURSE

THIRD YEAR

JAI NARAIN VYAS UNIVERSITY
JODHPUR

B. Sc, B. Ed. – III Year

PHYSICS 2027-28

Course	Nomenclature of Theory Papers	Number of Periods per week	Exam. Hours	Univ. Exam.	*Internal	Total
Paper I	Electronics	2	3	40	10	50
Paper II	Solid State Physics	2	3	40	10	50
PRACTICAL COURSE		3 X 2	5	40	10	50

PAPER I: ELECTRONICS

Unit I: Intrinsic and extrinsic semi-conductors, Fermi levels, mass-action law; carrier injection, recombination, diffusion and diffusion length, drift and diffusion currents, continuity equation; p-n junction, potential barrier, biasing, current-voltage relation, space charge and diffusion capacitances; varactor diode; Zener diode; tunnel diode; photovoltaic effect, solar cell.
Power supplies: Full wave and half wave rectifiers; ripple factor, voltage regulation; filters; Zener regulation.

Unit II: Network theorems – Thevenin, Norton, Maximum power transfer and Miller theorems. Dipolar junction transistors, Ebers-Moll equations; CB, CE and CC configurations, BJT characteristics; biasing and thermal stabilization, self bias; hybrid parameters of a two port network; small signal hybrid equivalent model of a BJT at low frequencies, current, voltage and power gains; input and output impedances; high frequency hybrid pi model, short circuit current gain, fβ and fα; current gain with resistive load.

Unit III: Field effect transistors, JFET, MOSEET, construction and characteristics; FETs as voltage Controlled Devices, small signal model.
Large signal amplifiers, class A, B and C operations and efficiencies; distortions; determination of second harmonic distortion; push-pull amplifiers; impedance matching.

Unit IV: Negative Feedback: Current and voltage negative feedbacks; effect on stability, input and output impedances, distortion, frequency response; emitter follower.
Oscillators: Positive feedback, Barkhausen criterion; RC phase-shift oscillator; Hartley and Colpitts oscillators, UJT and sweep generators using UJT; Transistor as a switch and Astable multi-vibrator.

Unit V: Operational amplifiers, inverting and non-inverting; differential amplifiers, CMRR; measurement of OP AMP parameters; use of OP AMPs as adder, in analog integration and differentiation.
Digital circuits, Boolean algebra; AND, OR, NOT, NOR, NAND, XOR gates; logic gate

circuits; realization of logic functions.

Books suggested:

1. J. Millman and CC Halkias: Integrated Electronics : Analog and Digital Circuits and Systems, Tata McGraw Hill.
2. A. Mottertshead: Electronic Devices and Circuits – An Introduction, Prentice Hall India.

. PAPER II: SOLID STATE PHYSICS

Unit I: Crystal structure : Different terms of crystal structure, Fundamental types of lattices, Two and three dimensional lattice types; Seven system of crystals, Characteristics of sc,bcc, fcc, hcp; Miller indices, orientation of planes in cubic lattices; Distribution of Atoms in atomic planes of cubic lattices. Distance between successive planes; Von-Laue's equations of diffraction of X-rays, Bragg's Law, scattering from lattice of point-atoms. Scattering factor. Geometrical Scattering factor for sc, bcc, fcc. Reciprocal lattice and its properties.

Unit II: Crystal binding and lattice vibrations : Inter-atomic forces of solids. Crystal of inert gases, cohesive energy and bulk modulus. Ionic crystals, Madelung energy and bulkmodulus.Covalent crystals. Hydrogen bonded crystals, Atomic radii. Concept ofphonons Vibration of monatomic lattices, lattice with two atoms per primitive cell. Localphonon modes.Density of states in one dimension, three dimensions, lattice heat capacityfor Einstein model, Debye model.

Unit III: Free Electron theory of metals : Free electron model, Density of states of electron gas, Fermi-Dirac distribution function, effect of temperature on Fermi-Dirac distribution function, Fermi energy at absolute zero temperature and low temperature.Electron heat capacity.Thermionic emission. Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Thermal conductivity, Wiedmann-Franz Law. Hall effect.

Unit IV: Band theory: Formation of bands and origin of energy gap, Bloch theorem, Kronig Penney model, crystal momentum and velocity of an electron.Effective mass of electrons.Electrons and holes.Number of states in a band, insulator, semi-conductor and metal.Construction of Brillouin Zones and Fermi-surfaces. Fermi levels in intrinsic, n- type and p- type semi-conductors, Mass action Law. The static dielectric constants of solids.Local electric field at an atom.

Unit V: Magnetism : Diamagnetism and Larmor precession, classical theory of diamagnetism, Para-magnetism and its classical theory, free electron theory.Molecular theory of ferromagnetism. Experimental Survey of Superconductivity : Zero resistance, persistent currents, effect of magnetic fields, flux exclusion, Intermediate state, Entropy effect, frequency effects, Gyromagnetic ratio, Isotope effect. Occurrence of superconductivity. Thermoelectric effects, thermal conductivity. High temperature oxide, superconductors and their properties.BCS theory (elementary idea without mathematical derivation), Magnetic levitation.

Books Suggested:

1. Kittel: Introduction to Solid State Physics, Wiley Eastern.
2. A.J. Dekker: Solid State Physics, McMillian India.
3. L. Azaroff: Theory of Solids.

EXPERIMENTS FOR PRACTICAL WORK

Note: Any 15 experiments to be performed by all the students out of following list.

1. Study of dependence of velocity of wave propagation on line parameters using torsional wave apparatus.
2. e/m by Thomson's method.
3. Measurement of inductance of coil by Anderson's bridge.
4. Measurement of capacitance and dielectric constant of a liquid and gas by De-Sauty Bridge.
5. To determine the energy Band gap in a semiconductor using junction diode.
6. Study of the characteristics of a given transistor (PNP/NPN) in common emitter configuration and find the value of parameter of given transistor.
7. Study of the characteristics of a given transistor (PNP/NPN) in common base configuration and find the value of parameter of given transistor.
8. Study the characteristics of rectifier junction diode and Zener diode.
9. Study of ripple factor for shunt capacitor, series inductor, L-section and π section filters using full wave rectifier circuit.
10. Study of frequency response of single stage transistor amplifier (variation of gain with frequency).
11. Study the characteristics of field effect transistor (FET).
12. Study the negative feedback effect on voltage gain, and input and output impedances of the amplifier.
13. Study of operational amplifier (OP-AMP).
14. Design and study of RC phase shift oscillator.
15. Design and Voltage study of AND, OR, NOT, NAND and NOR gates circuits using diodes and transistors.
16. Study of RC circuits as integrating and differentiating systems with Square input.
17. Study of Hybrid Solar and wind energy.
18. Transient Analysis of C-R and L-R circuit.
19. Determination of parameter of transformer.
20. Study of Nano TiO_2 Solar Cell.

Note: - New experiments may be added on availability of equipments

SYLLABUS FOR FOUR YEAR INTEGRATED B.Sc. B.Ed. COURSE

FOURTH YEAR

JAI NARAIN VYAS UNIVERSITY
JODHPUR

PHYSICS

B. Sc. – B. Ed. IV Year

PHYSICS 2028-29

Course	Nomenclature of Theory Papers	Number of Periods per week	Exam. Hours	Univ. Exam.	*Internal	Total
Paper I	Nuclear Physics	2	3	40	10	50
Paper II	Relativity And Electrodynamics	2	3	40	10	50
PRACTICAL COURSE		3 X 2	5	40	10	50

PAPER I
NUCLEAR PHYSICS

Unit I: Rutherford scattering and Rutherford's nuclear model. Constituents of nucleus, discovery of neutron. Mass of proton and neutron. Measurement of charge radius (i) by Hofstadier experiment, (ii) by electron scattering method, (iii) by Mesonic X-ray Method.
Measurement of potential radius (i) from lifetime of □-emitters (ii) from neutron scattering experiment. Variation of nuclear radius with mass number A. Nuclear spin and parity, Magnetic dipole moment of nuclei, Rabi's method for determination of nuclear magnetic moment. Electric quadrupole moment of nucleus.

Unit II: Mass defect, Mass difference, packing fraction and binding energy of nucleus. Plot of binding energy per nucleon against mass number. Liquid drop model of Nucleus.
WEIZSACHER's Semi Empirical Mass formula (Volume, Surface, Coloumb – asymmetry and pairing energy terms).Predication of stability against beta-decay for members of an isobaric family. Stability limits against spontaneous fission. Energetic of Symmetric fission.

Unit III: The law of radioactive decay, statistical nature of radioactivity. Radio active growth and decay. Ideal equilibrium, transient equilibrium and secular equilibrium Radioactive series.
Types of nuclear reactions (only qualitative statement).The balance of Mass and energy in nuclear reactions. Q equation. Solution of the Q equations, concept of centre of mass in nuclear reaction, view of proton-proton collision and neutron-nucleus collision in CM frame.

Unit IV: Alpha decay: Disintegration Energy, Range of α-particles, Geiger Nuttal's Law. α-spectrum and fine structure. Long range α- particles, α- particles paradox–Barrier penetration, Gamow Theory of α-emission.

Beta Decay: β-ray spectrometer (principle and working). β-ray spectrum; and its qualitative explanation.
Nuclear Energy: Nuclear induced fission, energy released in fission of U 235. Fission chain reaction, Neutron cycle in a thermal reactor. Four factor formula. Elementary idea of nuclear reactors. Nuclear fusion; fusion in stars, carbon and pp cycle problems of controlled fusion.

Unit V: Radiation Detectors: Introduction of various Methods used in detection of nuclear radiation. Detailed description of principle and working of following detectors based on detection of free-charge carriers – (i) Ionization Chamber, (ii) Proportional Counter, [iii) Geiger-Muller Counters, dead time, recovery time and paralysis time. Particle accelerators: Principle and working of Vande-Graff Generators Cyclotron and linear accelerators.
Elementary Particles: Properties of particles, Classification into leptons, mesons and baryons, conservation laws (only qualitative discussion) energy, momentum, angular momentum, charge, Lepton numbers, Iso-spin, Strangeness and Baryon number. Quark model (only qualitative idea).

Books suggested:

1. Alonso & Finn: Fundamental University Physics – Vol. III, Addision Wesley.
2. S.N. Ghoshal : Atomic & Nuclear Physics – Vol. II, S. Chand, New Delhi.

PAPER II
RELATIVITY AND ELECTRODYNAMICS

Unit I: Electromagnetic Waves: Displacement current, Maxwell's equations, Electromagnetic wave equation, Poynting theorem, Plane Electromagnetic waves in free space, wave impedance of free space, Propagation of plane Electromagnetic waves in non-conducting and conducting media, Skin depth, propagation of Electromagnetic waves in ionized gases, Polarization of Electromagnetic waves.

Unit II: Reflection and Refraction of Electromagnetic waves: Boundary conditions at the surface of discontinuity, reflection and refraction of Electromagnetic waves at the interface of non-conducting media, Fresnel's equations and their experimental verification, reflection and transmission coefficients, Brewster's Law and degree of polarization, total internal reflection, phase difference between parallel and perpendicular components and polarization of the reflected wave, reflection from a conducting plane.

Unit III: Interaction of Electromagnetic waves with matter: Normal and anomalous dispersion of light, empirical relations, Lorentz theory of dispersion of gases, experimental demonstration of anomalous dispersion in gases, scattering of electromagnetic waves and scattering parameters, Thomson, resonant and Rayleigh's scattering cross-section, polarization of scattered light, coherent and incoherent scattered light, dispersion in liquids and solids, Claussius Mossotti equation and Lorentz-Lorentz formula.

Unit IV: Relativistic Mechanics: Coordinate transformation, contravariant and covariant vectors, tensors of second and higher rank, addition, subtraction, contraction, outer and inner product of tensors, covariance of tensor equations, Minkowski space, geometrical interpretation of Lorentz

transformation, space like and time like intervals, four vectors, four dimensional gradient, divergence and curl operators, four-velocity, four-acceleration, four-momentum, four-force, relativistic classification of particles.

Unit V: Relativistic Electrodynamics: Invariance of charge, transformation of surface charge density, transformation of volume-charge density and current density, Equation of continuity in the covariant form, Scalar and vector potentials, Transformation of Electromagnetic potentials, Lorentz condition and its covariant form, Electromagnetic field tensor, Covariance of Maxwell's equations, Transformation of Electro-Magnetic fields, Lorentz-force in a covariant form, Electromagnetic field due to a moving charge.

Books suggested:

1. S.P. Puri: Electrodynamics, Tata McGraw Hill.
2. J.D. Jackson: Classical Electro-dynamics, John Wisely, New York
3. B.B. Laud: Electromagnetic, John Wisely, New York
4. E.C. Jordan: Electromagnetic waves, PHI, New Delhi
5. D. J. Griffiths: Introduction to Electrodynamics, PHI

EXPERIMENTS FOR PRACTICAL WORK

Note: Any 13 experiments to be performed by all the students out of following list.

1. Determination of Planck's constant using solar cell/ LED.
2. Determination of Stefan's constant (B-B method).
3. Study of characteristics of a GM counter and verification of inverse square law for the same strength of a radioactive source.
4. Determination of coefficient of rigidity as a function of temperature using torsional oscillator (resonance method).
5. e/m measurement by Helical Method.
6. Measurement of magnetic field using Ballistic galvanometer and search coil.
7. Measurement of electric charge by Millikan's oil drop method.
8. To study hysteresis loss of transformer by B-H curve using CRO.
9. Determination of dielectric constant of solids and liquids.
10. Determination of velocity of sound in air.
11. Verification of Cauchy's formula.
12. Study of Lissajous patterns.
13. Determination of separation of plates of Etalon using spectrometer.
14. To verify Fresnel's formula for the reflection of light.
15. Study of series and parallel LCR resonance circuit.
16. Study of characteristics of a GM counter and determination of dead time of GM tube.
17. To study the viscous fluid damping of a compound pendulum and to determine the damping coefficient and Q of the Oscillator.

Note: - New experiments may be added on availability of equipments.