(CBCS BASED)
ORDINANCE, REGULATION & SYLLABUS
For
B. Sc. [PHYSICS]

Offered by

NEHRU GRAM BHARATI
(DEEMED TO BE UNIVERSITY),
KOTWA- JAMUNIPUR- DUBAWAL
PRAYAGRAJ- 221505
UTTAR PRADESH

Commencing Session
2019– 22 & Onwards

ABOUT THE UNIVERSITY

Nehru Gram Bharati (Deemed to be University) occupies an esteemed place among the rural universities of India for over decades now. Established on 27th June 2008, it is one of the promising institutes in the State of Uttar Pradesh situated at the bank of river Ganges. It was basically conceived by our Ist Prime Minister of India, Late Pt. Jawahar Lal Nehru, who laid the foundation stone of Nehru Gram Bharati on 26th July 1962 in the village of Rishi Durvasha Ashram, Kotwa- Jamunipur, Dubawal Complex of his phulpur constituency in Allahabad District. His dream was translated into reality by Sri J.N. Mishra, who had a clear vision and dedication to the cause of upliftment of rural masses through education.

As on date, the campus has emerged as a prominent establishment of professional, technical education and traditional education for meeting the aspirations of youth from rural as well as urban areas. To begin with Rajiv Gandhi Degree College was established in the year 1996 and upgraded to Rajiv Gandhi Post Graduate College from the academic session 2000-01 which subsequently merged into the Nehru Gram Bharati (Deemed to be University) in 2008-09 after University Grants Commission recommended to the Ministry of Human Resource & Development for granting it Deemed to be University Status. The MHRD notified vide its gazette Notification no. F.9-42/2005-43(A) dated as 27th June 2008 bestowing the Deemed to be University status to Nehru Gram Bharati.

The Nehru Gram Bharati (Deemed to be University) is composed of six campuses encircling approximately 76 acres of land spread over within a radius of about 5 Kilometers. The campuses are as under:

1. **Nehru Gram Bharati (Deemed to be University), Jamunipur Main Campus:** The lush green campus has buildings for Administrative Office, Central Library, Faculty of Teacher Education, Arts, Science & Commerce. The Undergraduate Courses viz., Bachelor of Arts (in the subjects Ancient History, Pol. Science, Hindi, Geography, Education, Sanskrit, English, Sociology, Home Science, Economics, Music & Philosophy), Bachelor of Commerce, Bachelor of Science (In Physics, Chemistry, Zoology, Mathematics & Physics), Bachelor of Education(B.Ed.), Bachelor of Special Education (Hearing Impairment), Diploma in Special Education(D. Ed. Spl. Ed.[HI]), Bachelor of Elementary Education (B. El. Ed.), Diploma in Elementary Education (D. El. Ed.) are being offered in this campus. The Post Graduate Courses viz., Master of Arts (In Ancient History, Pol. Science, Hindi, Education, Sanskrit, English, Economics, Sociology, Home Science, Philosophy & Geography), Master of Commerce, Master of Science (In Physics, Chemistry, Zoology, Mathematics and Botany), Master in Education (M.Ed.), Master of Special Education in Hearing Impairment (M. Ed. Spl. Ed. [HI] are being offered in the campus.Nehru Gram Bharati (Deemed to conduct research programmes in various available disciplines for Ph.D. Degree. The departments of Journalism & Mass Communication and Social Work also share a part of the building offering Post Graduate Diploma in Journalism & Mass Communication (PGDJMC), Bachelor of Arts (Journalism & Mass Communication), Master of Arts (Journalism & Mass Communication), & Master of Social Work.
2. **Nehru Gram Bharati (Deemed to be University), Kamal Goindi Campus :** The campus is situated at a distance of 500 meters. from the Jamunipur main Campus. It houses the Department of Music and Performing Arts and Library & Information Science offering the degrees of Bachelor in Performing Arts (Vocal & Tabla), Masters in Performing Arts (Vocal & Instruments), Bachelor & Masters degree in Library and Information Science

3. **Nehru Gram Bharati (Deemed to be University) Hanumanganj Campus:** The Faculty of Law is located at a distance of around 06 Kms from Jamunipur Main Campus on Prayagraj-Varanasi route offering LL.B. (3 years), B.A.LL.B. (Integrated 5 years) and LL.M. Courses. Department of Computer Application is also a part of Hanumanganj Campus and offers B. C. A., M. C. A. and PGDCA Courses. Nehru Gram Bharati (Deemed to be University), Civil Lines Campus: The Department of Management is placed at Civil Lines Campus of the Deemed to be University offering B.B.A. and M.B.A. Courses.
4. **Nehru Gram Bharati (Deemed to be University), Sarpatipur Campus:** The Nehru Gram Bharati proposes to start medical education wing in near future.

Nehru Gram Bharati (Deemed to be University), Kotwa, Jamunipur, Dubawal, Prayagraj believes in the words of Nehru ji that,

"University stands for humanism, tolerance, reason, the adventure of ideas & the search for truth".

Vision:

We aim to nurture and promote youth, especially from the rural areas by providing high-quality education and training in keeping with the promise of Late Pt. Jawahar Lal Nehru. Our dream is to build a role model Institution with state-of-the-art infrastructure providing the right ambiance for creativity and stimulation in thinking to generate new ideas for research and application of skills for developing technology for the welfare of humanity.

Mission:

Our mission is to empower the nation through preparation of competent and trained human resource. University has plans to enhance capability of young talents for fulfillment of their aspirations through innovation, skill development and proper training. We endeavor to enhance employability through training and spirit of competitiveness. We emphasize inculcating initiative for entrepreneurship generating self employment and national wealth.

About The Department

The department of physics was established in year 2003. The physics department is among the first few departments since the inception of the Deemed University (former Rajiv Gandhi Post Graduate College). It offers B. Sc., M. Sc. and Ph. D. courses. The Department offers six semesters undergraduate B. Sc. and four semesters' postgraduate M. Sc. courses. The choice based credit system (CBCS) has been implemented. There are three specializations in M.Sc.; these are Laser and Spectroscopy, Electronics and Nanotechnology. The Department has an excellent library. The library has seating capacity of thirty persons. Besides these, the Department also offers Ph.D. program in various research areas of experimental and theoretical physics. Currently research works are going in the field of Condensed Matter, Biophysics, Optical Networks, Optical Fiber, Nonlinear Optics, Quantum Communication, and Spectroscopy. Ph. D. program started in the department of physics since 2009. The first Ph. D. in Physics was awarded in 2013.

Vision:

To establish a platform for the dissemination and creation of knowledge through teaching and research in Physics at various levels. To help create a scientific society that encourages logical thinking

Mission:

- To offer state-of-the-art Academic Programmes in Physics and in interdisciplinary areas.
- To create an intellectual property through innovations, quality research publications, and patents.
- To create state-of-the-art research laboratories which will facilitate the research of NGB(DU) as well as other academic institutions.

ORDINANCE AND REGULATIONS FOR B. Sc. DEGREE PROGRAMME

A. ORDINANCE

1. The Degree of Bachelor of Science (B. Sc.)

The Nehru Gram Bharati (Deemed to University) may confer the Degree of Bachelor's Programme in Science on Such candidates who, being eligible for admission to the Bachelor's Degree Programme, have received regular instruction in the prescribed course of study, passed successfully relevant examinations and being otherwise suitable by virtue of their character, have fulfilled such other condition as may be laid down from time to time by the appropriate authorities.

2. Requirement for Admission

A. Registration:

(i) Candidates of Bachelor Degree shall first be admitted to the first semester upon the reopening of the University after summer vacation every year.

(ii) Subsequent Registration

A candidate, who fails to clear a regular course of study during any of the second, third, fourth, fifth and sixth semesters may be registered in the appropriate term of any subsequent year to the semester concerned but within such time as enables him, to compete the study of all semester comprising Bachelor Degree Programme within a maximum period of five years from the date of his/herregistration for the first semester.

B. Minimum Qualification for Admission

(i) Admission to the Bachelor's Degree Programme of study shall be open to those candidates who have passed the 10+2/intermediate exam from any Board (U.P Board/CBCS board/ICSC/or any other Govt. recognized board). Admission shall be made according to merit subject to the fulfillment of eligibility requirement as determined by the University and availability of seats in the Bachelor courses.

C. Conditions of Admission:

(i) No application for registration to the First Semester shall be entertained unless it is accompanied by:

(a) Original Transfer certificate of a candidate who has been a regular student in any Institution at any time prior to making application for registration in the Faculty.

(ii) Candidate shall give also a written undertaking to the effect that:

(a) He/She shall exclusively devote his/her time to the study of courses prescribed for Bachelor's Degree and in particular he/she shall not offer any other course leading to a degree of any description whatsoever, not shall he/she undertake any remunerative work, though with the prior permission of the Faculty, he/she may join certificate of or diploma courses in any foreign language.

(b) He/She shall abide by the provision of NGB (DU) Act, Statutes, Ordinances, Regulations and Rules that are framed or may be framed there under and the orders of Officers and authorities

of the University and the concerned Faculty from time to time.

3. **Fees**

The students pursuing Bachelor's Degree Program of study shall have to pay fee as may be prescribed by the University from time to time.

4. The course of study, scheme of examination, result and promotion are covered in theregulation, and are given below.

REGULATIONS

1. The syllabus for B. Sc. based on semester with credit based pattern comprises of six semesters. The examination shall be of Minimum 18 (eighteen) and Maximum 20 (twenty) theory papers and 6 practical. From semester I to IV, each theory and practical will be of 50 marks.

2. During semester V & VI, the marks for theory will be 75 or 50 and the marks of practical will be 75 or 100. The theory papers and practical in semesters I to IV will be of 2 credits, while in V and VI semester, theory will be of 3 or 2 credits and practical will be of 3 or 4 credits respectively. Thus total number of credits from I to IV will be 32 credits while in V and VI semester the number of total credits will be 24 credits. Thus the grand total of credits in B.Sc. will be 56 for each subject.

3. The semester I to IV has 8 credits (2X3=6 theory and 2×1=2 practical, Total=08 credit) and V to VI has 12 credits (2X4=8 theory and 4×1=4 practical, Total 12 credits or 2×4=8 theory and 4×1=4 practical, Total=12 credits). There shall be six practical and one seminar/project in complete course. The Examination in each theory paper shall be of three hours duration. The structure of syllabus for B.Sc. (Semester with credit based pattern) is given in the following table.

4. Each semester shall have minimum 90 teaching days, exclusion of holidays, admission and examinations.

SCHEME OF EXAMINATION

1. The evaluation scheme of examination consists of two parts: Internal Assessment (IA) and End Semester Examination (ESE). Internal assessment includes Assignments/Seminars/ Unit test/Group activities/Discussion, etc. The internal assessment will contribute 20% and the end semester examination will contribute 80% to the total marks.

2. There shall be continuous assessment of the student in each course. The course instructor shall hold a maximum of three and minimum of one internal test/assignment /presentation, etc.

3. In case of semester examination, there shall be no binding on the number of external paper setters/examiners; generally the course instructor shall be the paper setter and examiner. The duration of the End Semester Examination (ESE) of each course will be 3 Hours.

Note: The ratio of internal assessment and end semester examination will be the same as determined by the University.

B.Sc. – Physics (Six-Semester Credit System)

The syllabus for B. Sc.Physics based on semester with credit based pattern comprises of six semesters. The examination shall be of 20 (twenty) theory papers and 4 practical each of 50 marks from Semester I to IV. During Sem. V & VI, practical will be 100 marks. The theory papersin semesters I to IV have 2 credits and practical in semesters V to VI have 4 credits. Thus total number of credits from I to VI will be 32 credits while in V and VI Sem, the

number of total credits will be 24 credits. Thus, the grand total of credits in B.Sc. Physics will be 56. The semester I to IV has 8 credits (2X3=6 theory and 2 practical=08 credit) and V to VI has 12 credits (2X4=8 theory, 4 practical=12). The student has freedom to choose paper of his/her choice in semester V and VI. There shall be six practical in complete course and only one project work in VI Semester. The Examination in each theory paper shall be of three hours duration. The structure of syllabus for B.Sc. Physics (Semester with credit elective based pattern) is given in the following table.

Syllabus of
B. Sc. Semester I, II, III, IV, V, VI
(A Six Semester Degree Course)
DEPARTMENT OF PHYSICS
(w. e. f. Session- 2019- 20)

No.	Code	Paper	Title	IA	ESE	Total Marks	Credits
Semester I							
1.	BOP 101	Paper I	Mechanics	10	40	50	2
2.	BOP 102	Paper II	Thermal Physics	10	40	50	2
3.	BOP 103	Paper III	Electrical Circuits	10	40	50	2
4.	BOP 104	Practical		10	40	50	2
			Total Credits			200	8
Semester II							
5.	BOP 201	Paper I	Elasticity and Fluid Mechanics	10	40	50	2
6.	BOP 202	Paper II	Conduction and Radiation of Heat	10	40	50	2
7.	BOP203	Paper III	Basic Semiconductor Electronics	10	40	50	2
8.	BOP 204	Practical		10	40	50	2
						200	8
Semester III							
9.	BOP 301	Paper I	Optics-1	10	40	50	2
10.	BOP 302	Paper II	Waves and Oscillation	10	40	50	2
11.	BOP 303	Paper III	Atomic Physics	10	40	50	2
12.	BOP 304	Practical		10	40	50	2
						200	8
Semester IV							
13.	BOP 401	Paper I	Optics-2	10	40	50	2
14.	BOP 402	Paper II	Electromagnetism	10	40	50	2
15.	BOP 403	Paper III	Nuclear Physics	10	40	50	2
16.	BOP 404	Practical		10	40	50	2
						200	8
Semester V							
17.	BOP 501	Paper I	Quantum Mechanics- 1	10	40	50	2
18.	BOP 502	Paper II	Statistical Mechanics	10	40	50	2
19.	BOP 503	Paper III	Basic Digital Electronics	10	40	50	2
20.	BOP 504- (A) & (B)	Paper IV Elective (A) & (B)	(A) ElectromagneticTheory (B) Mathematical methods	10	40	50	2
21.	BOP 505	Practical		20	80	100	4
						300	12
Semester VI							
22.	BOP 601	Paper I	QuantumMechanics-2	10	40	50	2
23.	BOP 602	Paper II	Solid State Physics	10	40	50	2
24.	BOP 603	Paper III	Photonic Devices	10	40	50	2
25.	BOP 604-(A) & (B)	Paper IV Elective	(A)Laser, Holography and Optical Instruments	10	40	50	2

		(A) & (B)	(B)Renewable Energy Source, Energy Harvesting and its Application				
26.	BOP 605	Practical		20	80	100	4
						300	12

Semester- I

Semester- I, Paper- I: Mechanics

Unit- 1. Mathematical Background :

Background of Vector Calculus, Concept of line, surface and volume integral, Physical significance of Gradient, Divergence and Curl.

Unit- 2: Special Theory of Relativity:

Frame of Reference, Inertial and Non- inertial frames, Galilean transformation, Galilean invariance, Pseudo forces, Rotating reference frame, Centrifugal force, Coriolis Force. Inertial and Gravitational mass, Principle of Equivalence. Inference of Michelson- Morley Experiments. Postulates of special relativity, Lorentz transformations, Length contraction, Time dilation, Simultaneity in relativity theory.

Unit- 3: Relativisticdynamics:

Addition of velocities, Relativistic dynamics, Variation of mass with velocity, mass- energy relation. Relativistic Doppler shift.

Unit- 4. Mechanics of Rigid Bodies:

System of particles, Centre of Mass, Linear momentum, Centre of mass frame, Rotational motion in two and three dimensions, Angular momentum, Moment of inertia tensor, Central forces, Conservative forces, Potential energy, Gravitational potential and field due to a uniform spherical shell and solid sphere, Conservation Laws.

Unit- 5. Motion Under a Central Force:

Two- particle central force problem reduced mass,lab and Center of mass co-ordinate systems, Motion in an inverse square field, Kepler's laws.

Reference Books:

1. Berkeley Physics Course 2/e ,Vol1: Mechanics by C. Kittel ,W. D. Knight, M. A. Ruderman, C. A. Helmholz, B. J. Moyer (McGraw- Hill).
2. The Feynman Lectureson Physics, Volume 1by R. P. Feynman, R. B. Leightonand M. Sands (Narosa Publishing House)
3. Introduction to Special Relativity 1/e by R. Resnick (Wiley India Pvt Ltd)
4. Mechanics by J. C.Uppadhyaya (Ram Prasad& Sons)
5. Mechanics by D. S. Mathur (S. Chand& Company Ltd)

Semester I, Paper- II: Thermal Physics

Unit- 1. Basic Concept:

Thermodynamic systems, Macroscopic and Microscopic variables, Thermodynamical State, Thermal Equilibrium, Zeroth Law of Thermodynamics and Concept of Temperature**.** Heat and Work and their path-dependence, Thermal processes,

Unit-2. First Law of Thermodynamics:

First law of thermodynamics and internal energy, Joule's law, Applications of first law.

Unit-3. Second Law of Thermodynamics & Entropy:

Carnot cycle, Carnot Engine and Refrigerator, Reversible and irreversible processes, Carnot's Theorem. Thermodynamical scale of temperature, Clausius- Clapeyron's equation, Specific heat of saturated vapour, Clausius theorem, Clausius inequality,

Unit-4. Entropy:

Entropy, Calculation of entropy invarious processes, Entropy and unavailable energy, Physical significance of entropy, Second Law of thermodynamics**.**

Unit-5. Thermodynamic Relations:

Conditions for natural changes, Thermodynamic potentials and Maxwell's equation, Applications of Maxwell's equations, Joule- Thomson effect, Inversion Temperature. Third Law of Thermodynamics. Change of Phase, First and second order phase transitions,Ehrenfest's equations.

Reference Books:

1. Thermal Physics 2/e by C. Kittel, H. Kroemer (W.h. Freeman & Company).
2. Fundamentals of Statistical and ThermalPhysics by F. Reif (waveland Press, 2009).
3. Heat and Thermodynamics (SIE) by M. W. Zemansky, Phillips, Dittman R. H. (Tata Mcgraw Hill Education Private Limited).
4. Thermal Physics by B. K. Agarwal (Lokbharati Prakashan).
5. Thermal Physics by Garg, Ghose & Bansal (Tata Mcgraw Hill Education Private Limited).
6. Treatise on Heat by M. N. Saha, B. N. Srivastava (Unknown Publisher)
7. Heat,Thermodynamics and Statistical Physics 12/e by BrijLal, N. Subrahmanyam, P. S. Hemne (S.Chand Publisher).

Semester 1, Paper- III: Electrical Circuits

Unit- I: Electrical Circuits

Circuit parameters, R, L & C. Kirchoffs Law for a loop and junction, Solutions by determinant and matrix methods. Applications to T, and bridge circuits, Norton and Thevenin's theorems, Maximum power transfer theorem.

Unit- II: Growth & decay of current

Difference between steady state & transients; Growth & decay of current in an inductive circuit, Charging and discharging of a capacitor through a resistor, CS and through an inductor and resistor in series.

Unit- III: Galvanometer

Ballistic Galvanometer, and QS, Measurement of a capacity and of a high resistance by leakage method.

Unit- IV: A. C. Analysis

A.C. Analysis (Vector treatment only): Complex impedance and phasor notations. Impedance & Admittance & Admittance operators, vector diagrams for Voltage and Current in RL, CR and LCR in series & parallel, Power consumed in the circuit, Series and parallel resonance, Q of acoil, Transformer- its equivalent circuit and turn ratio.

Unit- V: A. C. Bridges

A.C. Bridges: Balance and sensitivity conditions for A. C. bridge, Measurement of L by

Maxwell's Bridge, Measurement of C by Schering's bridge.

Reference Books:

1. Electronic Devices And Circuits (SIE) (Schaum's Outline Series) by J. J. Cathey (Tata Mcgraw Hill Education Private Limited).
2. Millman's Electronic Devices and Circuits by J. Millman (Tata Mgraw Hill)
3. Electronic Devices and Circuits Theory 10/e by R. L. Boylestad,L. Nashelsky (Pearson).
4. Eletrical Circuits and Introductory Electronics by Vinod Prakash (Lokbharati Prakashan).
5. Basic Electronics and Linear Circuits by N. Bhargava, D. Kulshreshtha, S. Gupta (Tata Mcgraw Hill Education Private Limited).
6. Introductory Circuit Analysis 12/e by R. L. Boylestad (Pearson)
7. Electronic Devices and Circuits 5/e by D. A. Bell (Oxford University Press).
8. Electricity & Magnetism 3/e by K. K. Tiwari (S. Chand Publisher).

B. Sc. Semester– 1: Practical Physics

List of Experiments

(Mechanics, General Properties of Matter)

1. **Flywheel**:To determine the moment of Inertia (I) of a fly- wheel about the axis of rotation.
2. **Compound Pendulum**: To determine the value of 'g' with the compound pendulum and the radius of gyration (k) of the pendulum about an axis passing through the centre of gravity and perpendicular to its length.
   Rectangular Lamina: To determine:

(i) The value of 'g' with a rectangular lamina.

(ii) The Moment of Inertia (I) and Radius of Gyration (k) of a rectangular lamina about an axis passing through the centre of gravity and perpendicular to the plane of the lamina.

3. **Spiral Spring**: To determine the force per unit extension (K) and effective mass (m_e) of a spiral- spring (static and dynamic method).
4. **Maxwell's Needle**: To determine the rigidity modulus of the material in the form of a wire by Maxwell's needle. / **Searle's Apparatus**: To determine Y, η and $\sigma$of the material of a given wire by Searle's apparatus.
5. **Surface Tension**:To determine the surface tension (T) of water by Jaeger's method.
6. **Y by bending**:To determine the Young's modulus (Y) of the material of the beam.
7. **Viscosity**: To determine the viscosity of a liquid by Poiseuille's method.
8. **Torsion Table**: To determine the modulus of rigidity of the material of the given wire and moment of inertia of an irregular body with the help of a torsion table./ **Statistical Method**: To determine the modulus of rigidity of the given material in the form of a wire by statistical method.

Reference Books:

1. Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot, Allahabad)
2. Practical Physics by Arora (S. Chand Publisher)

Semester- II

Semester II, Paper- I: Elasticity and Fluid Mechanics

Unit- 1. Mechanics of Non- Rigid Bodies

Strain and stress in an isotropic homogeneous medium,Elastic moduli and relations between them, Torsion of cylinders,

Unit- 2. Bending of beams

Bending of beams, Internal energy of a strained body.

Unit- 3.Streamline flow:

Ideal fluids, Equation of continuity, Streamline flow, Rotational and irrotational flows,

Unit- 4. Equations of motion:

Euler's equations of motion, Bernoulli's theorem, Viscous fluids

Unit- 5. Poiseuillie's equation:

Poiseuillie's equation, Viscosity by rotating cylinder method.

Reference Books:

1. BerkeleyPhysicsCourse2/e,Vol1:Mechanicsby C. Kittel,W. D. Knight, M. A. Ruderman, C. A. Helmholz, B. J. Moyer (McGraw- Hill).
2. The Feynman Lectures on Physics, Volume 1 by R. P. Feynman, R. B. Leightonand M. Sands (Narosa Publishing House)
3. Introduction to Special Relativity 1/e by R. Resnick (Wiley India Pvt Ltd)
4. Mechanics by J. C. Uppadhyaya (Ram Prasad & Sons)
5. Mechanics by D. S. Mathur (S. Chand & Company Ltd)

Semester II, Paper- II: Conduction and Radiation of Heat

Unit- 1. Kinetic Theory of Gases

Maxwell Boltzman law of distribution of molecular velocities, Equation of r. m. s. velocity and average and most probable speeds, Mean free path, Transport phenomena.

Unit- 2. Conduction of Heat

Fourier equation for one- dimensional flow of heat and its steady- state solution, Periodic flow of heat (only sinusoidal heat current).

Unit- 3. Emission and Absorption of Radiation

Radiation as electromagnetic waves, Emissive and Absorptive powers, Radiation in a hollow enclosure, Black-body radiation, Kirchoff's Law, Intensity and energy density, Pressure and energy density, Stefan Boltzmann law,

Unit- 4. Solar Radiation

Solar constant and temperature of sun, Temperature of Non- black bodies.

Unit- 5. Radiation's Spectrum

Distribution of energy in the spectrum of black body radiation, Adiabatic expansion of black-body radiation, Wein's distribution law, Wein's displacement law, Wein's formula, Rayleigh-Jean's law, Planck's law.

Reference Books:

1. Thermal Physics 2/e by C. Kittel, H. Kroemer (W.h. Freeman & Company).
2. Fundamentals of Statistical and Thermal Physics by F. Reif (Waveland Pr Inc)
3. Heat and Thermodynamics (SIE) by M. W. Zemansky, Phillips, Dittman R. H. (Tata

Mc graw Hill Education Private Limited).

4. Thermal Physics by B. K. Agarwal (Lokbharati Prakashan).
5. Thermal Physics by Garg, Ghose & Bansal (Tata Mcgraw Hill Education Private Limited).
6. Treatise on Heat by M. N. Saha, B. N. Srivastava (Unknown Publisher)
7. Heat, Thermodynamics and Statistical Physics 12/e by Brij Lal, N. Subrahmanyam, P. S. Hemne (S. Chand Publisher).

Semester II, Paper- III: Basic Semiconductor Electronics

Unit- 1. Conduction in Solid

Conductor, Insulator and Semiconductor, electrons and holes as charge carriers, Intrinsic and extrinsic semiconductors Conductivity and mobility, Conduction by diffusion and drift.

Unit- 2. P. N. Junctions

Built- in- voltage and charge depletion region, Statement of diode equation and diode characteristics, Forward and reverse resistances, Zener diode: its characteristics, Half wave, Full wave and Bridge rectifiers, Ripple factor, filtering by RC and LC circuit. Regulation: voltage regulation using Zener diode, Photo- diode, Solar cell.

Unit- 3. BJT:

NPN and PNP transistor action, Characteristics in CB, CE and CC configurations. Hybrid, alpha and beta parameters, the irinter- relationship, Load line, small signal hybrid equivalent circuit, CE amplifier, Mid frequency response, Practical amplifier circuit

Unit- 4. Oscillators

Barkhausen criteria for sustained oscillations, Qualitative discussion of collector tuned oscillator, Circuits of Hartley and Colpitts oscillator, sweep oscillator.

Unit- 5. Modulation and CRO

Modulation: Need for modulation, three types of modulation, Amplitude modulation, Frequency spectrum and power in A. M. wave typical A. M. circuit, Linear diode detector.

CRO: Working of cathode ray tube, block diagram of CRO, typical applications of CRO.

ReferenceBooks:

1. Electronic Devices and Circuits (SIE) (Schaum's Outline Series) by J. J. Cathey (TataMcgraw Hill Education Private Limited).
2. Millman's Electronic Devices and Circuits by J. Millman (Tata Mgraw Hill)
3. Electronic Devices and Circuits Theory 10/e by R. L. Boylestad, L. Nashelsky (Pearson).
4. Eletrical Circuits and Introductory Electronics by Vinod Prakash (Lokbharati Prakashan).
5. Basic Electronics and Linear Circuits by N. Bhargava, D. Kulshreshtha, S. Gupta (Tata Mcgraw Hill Education Private Limited).
6. Introductory Circuit Analysis 12/e by R. L. Boylestad (Pearson)
7. Electronic Devices and Circuits 5/e by D. A. Bell (Oxford University Press).
8. Electricity & Magnetism 3/e by K. K. Tiwari (S. Chand Publisher).

B. Sc. Semester– 2: Practical Physics
(Thermal, Electricity & Electronics)

1. **PN- Junction Diode**:To draw the characteristic curves of a PN junction diode.

2. **Zener Diode:** To study the breakdown characteristic of a Zener diode.
3. **P. O. Box:** (i) To measure resistances of by a Ammeter P. O. Box.
   (ii) To measure resistances of voltmeter by a P. O. Box.
   (iii) To determine internal resistance of a cell by Mance's constant deflection method.
   (iv) To measure the galvanometer resistance by Thomson's constant deflection method.
4. **Energy Meter:** To calibrate an electrical energy meter with the help of a Joule's calorimeter.
5. **Stefan- Boltzmann law:** To verify the Stefan- Boltzmann law for radiation.
6. **K of Rubber**: To determine the thermal conductivity (K) of a rubber given in the form of a tube.
7. **K of Copper**: To determine the thermal conductivity (K) of the given material in the form of a rod by Searle's apparatus.
8. **Transistor Characteristics**

Reference Books:

3. Practical Physics by S. K. Kor, R. P. Khare & S. K. Jain (United Book Depot, Allahabad)
4. Practical Physics by Arora (S. Chand Publisher)

Semester- III

Semester III, Paper- I: Optics- 1

Unit- 1. Geometrical Optics

Cardinal points of coaxial optical systems. Simple problem on combination of thin lenses, eyepieces, Aplantic points. Nature of light,

Unit- 2. Elementary Idea of EM Wave

Elementary ideas of electromagnetic wave and photon theories of light. Complex representation of waves and its application (to be used in the theory of various phenomenon).

Unit- 3. Interference

Conditions for observing interference, Degree of coherence and visibility off ringes. Production of interference fringes and determination of wavelength, Michelson interferometer and its uses, Color of thin films,

Unit- 4. Newton's Rings

Newton's Rings, Theory of multiple reflections, F. P. Etalon.

Unit- 5. Laser

Temporal and Spatial Coherence. Michelson Stellar interferometer. Stimulated emission, Basic ideas about laser emission, Ruby and He- Ne lasers as examples.

Reference Books:

1. Fundamentals of Optics 4/e by F. A. Jenkins and F. E. White (McGraw-Hill International Editions).
2. Geometrical & Physical Optics by R. S. Long hurst (Prentic Hall Press).
3. Optics 4/e by A. Ghatak (Tata Mgraw Hill).
4. Geometrical and Physical Optics by B. K. Mathur and T. P. Pandya (New Gopal Printing Press).
5. Optics (Schaum's Outline Series) by E. Hhecht (Tata McgrawHill Education Private Limited).
6. A Text book of Optics 4/e by M. N Avadhanulu, N Subrahmanyam, Brij Lal (S. Chand

& Company Ltd)

Semester III, Paper- II: Waves and Oscillation

Unit- 1. Oscillations

Simple Harmonic Motion, Damped Motion, Steady Forced Oscillations. Resonance.

Unit- 2. Fourier Series

Fourier Series Decomposition. Simple cases of square,Saw- tooth and Rectified Sinusoidal Waves.

Unit- 3. Ultrasonics

Generation and detection. Measurement of velocity in Liquids, Applications.

Unit- 4. One- dimensional Wave- motion in non- dispersive media

Wave Equation, Progressive Wave solution, Particle Velocity and Wave Velocity. Equations for Wave in fluids and on Strings. Specific Acoustic Impedance of fluids and Characteristic Impedance of strings. Energy density. Intensity of Energy Transfer.

Unit- 5. Propagation of Plane Waves

Reflection and transmission of plane wave satadiscontinuity, Standing Wave Solutions. Modes of Natural Oscillations. Energy Considerations.

Reference Books:

1. Physics of Vibration and Waves 6/e by H. J. Pain(Wiley India Pvt Ltd).
2. The Feynman Lectures on Physics, Volume 2 by R. P. Feynman, R. B. Leighton andM. Sands(Narosa Publishing House).
3. Physics of Oscillations and Waves by R. B. Singh(United Book Depot, Allahabad).
4. A Text Book Oscillations, Waves & Acoustics by M. M. Ghosh, D. Bhattacharya (S. Chand Publisher).

Semester III, Paper- III: Atomic Physics

Unit- 1: Spectra of hydrogen atom

Bohr- Summer field Model (Historical developments), Bohr model and the spectra of hydrogen atoms, critical resonance and the ionization potential. Frank- Hertz experiment.

Unit- 2: X- rays

Characteristic and continuous X- rays. Moseley's law, Bragg's Law.

Unit- 3: Basic Atomic Physics

Space Quantization, Magnetic moment of the electrons and magneton, Larmor Precession, Electron Spin, Stern- Gerlach experiment, Quantative concept of various quantum numbers of an electron, Pauli's exclusion principle and electronic configurations of atoms.

Unit- 4: Megnetic Properties of Materials

Diamagnetism, Larmor's theory and diamagnetic susceptibility. Paramagentism, Langvin's theory and Curie Weiss Law.Qualitative discussion of Ferromagnetism and anti-ferromagnetism.

Unit- 5: Quantum Concepts

Particle nature of radiation, Photo electric effect and Compton effect. Wave nature of particles. De- Broglie Waves, Davisson-Germer experiment, Wave Packets, Phase velocity and group velocity, Heisenberg's Uncertainty Principle and applications, One dimensional Schrodinger's Wave Equation and concept of probabilities, amplitude, application one-dimensional potential step and barrier, Quantum Mechanical Tunneling.

Reference Books:

1. Concept of Modern Physics 6/e (SIE) by A. Beiser, S. Mahajan, S. Rai Choudhury (TataMcgraw Hill Education Private Limited).
2. Atomic and Nuclear Physics- An Introduction by T. A. Little field (Little field Press).
3. Introduction to Elementary Particles 2/e by D. Griffiths (Wiley-vchVerlagGmbh).
4. Modern Physics by R. Murugeshan, Kiruthiga Sivaprasath (S. Chand Publisher).
5. Nuclear Physics by D. C. Tayal (Variety Book Depot).

B. Sc. Semester– III: Practical Physics

List of Experiments
(Electricity)

1. **Self Inductance (by BG):** To determine the self– inductance of a given coil by Rayleigh's method using post- office box.
2. **Mutual Inductance (by BG):** To determine the mutual inductance of a given pair of coils using a ballistic galvanometer.
3. **Capacity of condenser (by BG):** To determine the capacity of condenser using a ballistic galvanometer.
4. **High Resistance by leakage method (by BG):** To determine the high resistance by the method of leakage of condenser.
5. **Search Coil (by BG):** To determine field of an electromagnet with a search coil.
6. **Earth Inductor (by BG):** To determine the value of horizontal (H) and vertical (V) components of the earth's magnetic field and the angle of dip by an earth inductor.
7. **Maxwell's Bridge**: To measure mutual inductance of a pair of coils with a Maxwell's bridge.
8. **Schering Bridge**: With the help of Schering bridge:
    a) To measure the capacity and power factor of the given condenser.
    b) To verify the laws of series and parallel arrangement of capacities.
9. **A. C. Frequency:** To determine the frequency (f) of AC mains by sonometer.
10. **Ionization Potential**:
    (i) To draw the firing voltage Vs grid voltage curve for the thyratron.
    (ii) To observe the breakdown of Child- Langmuir's law, using thyratron as a diode.
    (iii) To observe the rise of plate current with positive grid bias greater than the ionization potential (applying negative plate voltage).

Semester IV

Semester IV, Paper- I: Optics- 2

Unit- 1. Fresnel's diffraction

Fresnel's theory of diffraction, Half- Period elements. Diffraction from circular obstacle and aperture (Elementary theory), Zone plate, Cornu's Spiral, Fresnel diffraction by straight edge and single slit.

Unit- 2. Fraunhofer's diffraction

Fraunhofer's diffraction by single slit and double slit,

Unit- 3. Grating

Theory of plane grating, Width of principal maxima, Rayleigh's criterion of resolution, Resolving power of prism, grating and FP etalon. Limit of resolution for telescope. Concave

grating (elementary theory) and its mountings.

Unit- 4. Polarization

Unpolarised, polarized and partially polarized lights. Polarisation by reflection, Double refraction by uni- axial crystals, Polaroids, Huygen's theory of double refraction. Half and quarter wave plates.

Unit- 5. Analysis of Polarized Light

Production of elliptically polarized light. Babinet compensator, Analysis of elliptically polarized light using a Nicol and a quarter wave plate, and by using Baninet compensator. Optical activity. Fresnel's theory of optical rotation, Specific rotation. Biquatz and Laurent's half shade polarimeters.

Reference Books:

1. Fundamentals of Optics 4/e by F. A. Jenkins and F. E. White (Mc Graw-Hill International Editions).
2. Geometrical & Physical Optics by R. S. Longhurst (Prentic Hal lPress).
3. Optics 4/e by A. Ghatak (Tata Mgraw Hill).
4. Geometrical and Physical Optics by B. K. Mathur and T. P. Pandya (New Gopal Printing Press).
5. Optics (Schaum's Outline Series) by E. Hhecht (Tata Mcgraw Hill Education Private Limited).
6. A Text book of Optics 4/e by M. N Avadhanulu, N Subrahmanyam, Brij Lal (S. Chand & Company Ltd)

Semester IV, Paper- II: Electromagnetism

Unit- 1: Electrostatics in Free Space

Coulomb Law, Electric Field. Simple case of charge distributions. Gauss Flux Law (Integral and Differential forms). Electric Dipole in Electrostatic Field. Irrotational Nature of Electric Potential. Simple Cases of Charge Distributions.

Unit- 2: Electrostatics in Dielectrics

Polarization, Polarization Charges. Displacement Vector D. Gauss Flux Law (Integral and Differential forms) and simple Applications. Energy of Charge Distribution. Energy asan integral over the Field. Simple Problems (Parallel Plate Condenser, Uniformly charged spherical surface and volume).

Unit- 3: Electric Current

Current Density Vector. Equation of Continuity, Ohm and Joule's Laws (Integral and differential forms).

Unit- 4: Magnetostatics

Ampere's Law, Biot- Savart's Law, Law of force in Magnetic Field on Currents and charged particles. Magnetic Filed due to a straight infinite wire. Magnetic Field due to circular loop and solenoid at axial points. Vector potential and its evaluation for uniform Magnetic Field due to a Loop of Current. Magnetic Moment. Magnetic Materials and Magnetization. Magnetization Current density J, Magnetic Field **H**, Curl of **H** and Calculation of **H**.

Unit- 5. Time Varying Fields & Electromagnetic Waves in Free- Space

Time Varying Fields: Displacement Current, Curl **H** Faraday's Law (Integral and Differential forms). Self and Mutual Inductances. Energy of Coupled Circuits and current distribution. M

L_1L_2. Energy as an integral over the Magnetic Field. Energy of Solenoid. Electromagnetic Waves in Free- Space: Maxwell Equations, Plane polarized PlaneWave solution.Characteristics of these Electromagnetic waves.

Reference Books:

1. Introduction toElectrodynamics3/eby D. J. Griffiths (PhiLearning).
2. Berkeley Physics Course, Vol 2: Electricity and Magnetism by E. M. Purcell (McGraw-Hill).
3. Electromagnetics by B. B. Laud (New Age International Pvt. Ltd. New Delhi).

Semester IV, Paper- III: Nuclear Physics

Unit- 1. Radioactivity

Natural radioactivity, Laws of radioactive disintegration, radioactive series,

Unit- 2. Counters

Detection of radiation, GM Counter and Bubble Chamber, Scintillation Counter.

Unit- 3. Nuclear reactions and decay

Kinematics of nuclear reactions, artificial nuclear transmutation, discovery of neutron, radioactive tracers, transuranic elements. Cyclotron. Constitution of nucleus, Binding energy, liquid drop model and the semiempirical mass formula, Elementary theory of decay, decay and discovery of neutrino.

Unit- 4. Magic numbers

Magic numbers and the shell model, exchange forces in nuclei and Yukawa theory (qualitative), Fission and fusion, Nuclear reactors (qualitative), Thermo nuclear energy.

Unit- 5. Elementary Particles

Classification of Elementary Particles, Leptons, Mesons and Baryons and their quantum numbers, Conservation Laws.

Reference Books:

1. Concept of Modern Physics 6/e (SIE) by A. Beiser, S. Mahajan, S. Rai Choudhury (Tata McgrawHill Education Private Limited).
2. Atomic and Nuclear Physics- An Introduction by T. A. Little field (Little field Press).
3. Introduction to Elementary Particles2/e by D. Griffiths (Wiley- vch Verlag Gmbh).
4. Modern Physics by R. Murugeshan, Kiruthiga Sivaprasath (S. Chand Publisher).
5. Nuclear Physics by D. C. Tayal (Variety Book Depot).

B. Sc. Semester– IV: Practical Physics

List of Experiments

(OPTICS)

1. **Nodal Slides:** To locate the cardinal points of an optical systems with the help of a nodal slide and hence to determine the focal length of the system.
2. **Sextant:** With the help of a sextant to determine the following
   (i) Variation of Zero- Error of the sextant with distance.
   (ii) Height of the tower.
   (iii)Horizontal distance between two objects or points.

3. **Dispersive Power of the Prism:** To determine the refractive index (μ) of the material of the prism for a given wave lengths and dispersive power of the materials of the prism with a spectrometer.
4. **Newton's Rings:** To determine the wavelength of sodium light by Newton's ring method.
5. **Fresnel's Bi- prism:** To determine the wave length of sodium light with Fresnel's Bi-prism.
6. **Single Slit Diffraction:** To determine the width of a narrow slit by observing the diffraction bands.
7. **Plane Transmission Grating:** To determine the wavelength of different spectral lines emitted by light source with a plane transmission grating.
8. **Brewster's Law:** To measure the angle of polarization for glass and to measure the refractive index using Brewster's law.
9. **Polarimeter:** To determine the specific rotation of an optically active substance (canesugar solution) with the help of a polarimeter.

Reference Books:

1. Practical Physics by S. K. Kor, R. P. Khare &S. K. Jain (United Book Depot, Allahabad).
2. Practical Physics by Arora (S. Chand Publisher).

Semester V

Semester V, Paper- I: Quantum Mechanics- 1

Unit- 1. Quantum Theory & Schrödinger's Wave Mechanics

Need of Quantum Mechanics, Schrödinger Equation and interpretation of wave function.

Unit- 2. Operators

Observables and Operators, Hermitian, operator, Parity operator, commutation relations. Eigen values and eigen functions orthonormality and completeness. Dirac Delta function. Measurement in quantum mechanics, Non- Commutability

Unit- 3. Uncertainty Principle

Uncertainty Principle, Expectation values, Ehrenfest's Theorem.

Unit- 4. Time- Dependent Schrödinger equation

Separation of variables in Time- Dependent Schrödinger equation. Density of states, One-dimensional Potential Barrier problems. Tunneling through squire well potential.

Unit- 5. Harmonic Oscillator Problem

One- dimensional Harmonic Oscillator, Hermite Polynomials, Zero- point energy, Correspondence with Classical theory.

Reference Books:

1. Introduction to Quantum Mechanics 2/e by D. J. Griffiths (Pearson).
2. Quantum Mechanics: Concepts and Applications 2/e by N. Zettili (John Wiley & Sons).
3. Quantum Mechanics by J. L. Powell, B. Crasemann (Narosa Publishing House).
4. Quantum Mechanics 3/e by L. Schiff (TataMcgraw Hill Education Private Limited).
5. Introduction to Quantum Mechanics by A. Ghatak (Macmillan Publishers India).
6. Quantum Mechanics by H. Prakash and B. K. Agarwal (PhiLearning).
7. Modern Quantum Mechanics, 2/e by J. J. Sakurai (Pearson Education India).

Semester V, Paper- II: Statistical Mechanics

Unit- 1. Basic Concept of Statistical Mechanics

Elementary concepts of Lagrangian and Hamiltonian, Hamilton equations of Motion, Microscopic and Macroscopic systems, Phase space representation, Division of phase space into cells, Liouville theorem and its consequences,

Unit- 2: ensembles

Statistical ensembles, Equilibrium and fluctuations, Distribution probability, Equilibrium between two macroscopic systems in thermal diffusive and mechanical contacts,

Unit-3: Statistical Mechanics- I

Postulates of quantum statistical mechanics, Entropy and probability, Entropy of a perfect gas using the concept of microcanonical ensemble, Gibbs Paradox, Partition functions, Thermodynamical functions,

Unit- 4: Statistical Mechanics- II

Calculations of entropy of perfect monoatomic gas using canonical and grandcanonical ensemble. Principle of Equipartition of the energy, Maxwell's velocity distribution,

Unit- 5. Bose– Einstein and Fermi- Dirac Distribution

Distribution function for two types of quantum statistics (Bose– Einstein and Fermi- Dirac): Simple applications (Black – body radiations, and Electronic specific heat).

Reference Books:

1. Berkeley Physics Course, Vol 5: Statistical Physics by F. Rief (McGraw- Hill).
2. Elementary Statistical Physics by C. Kittel (Dover).
3. Fundamentals of Statistical Mechanics by B. B. Laud (New Age International Publishers Ltd.- New Delhi).
4. Statistical Physics by Hermann (Springer India).
5. Statistical Mechanics 2/e by B. K. Agarwal (New Age International (p)Limited).
6. Introduction to Solid State Physics7/e by C. Kittel (Wiley India Pvt Ltd).
7. Solid State Physics by A. J. Dekker (Macmillan India Limited).
8. Solid State Physics 6/e by S. O. Pillai (New Age International (p) Limited)

Semester V, Paper- III: Basic Digital Electronics

Unit- 1. RTL, DTL & TTL

The diode- transistor gate, fanout, I/O characteristics. The transistor-transistor logic, caparison between TTL and DTL. The active pull- up, I/O characteristics. The Resistance- transistor logic, RTL- OR gates, pull- up resistors, fan out. I/O characteristics, noise margin, rise time, RTL, Ex.- OR gate.

Unit- 2: Basic Logic Gates

AND, OR, NOR, NOT, NAND and Ex- OR operation. Truth tables, their representations,

Unit- 3. Boolean algebra

Venn diagrams. Binary Notation, Boolean algebra,

Unit- 4. Karnaugh mapping

Karnaugh mapping., Min and Max terms

Unit- 5. Combinational logic circuits

Half- Adder, Full- Adder, Parallel and Series addition. Half and full subtractor. BCD adder.

Reference Books:

1. Digital Integrated Electronics by H .Taub and D. Schilling (Mc Graw- Hill

International Editions).
2. Millman's Integrated Electronics: Analog & Digital Circuits & Systems 2/e by J. Millman,C. Halkias,C. D. Parikh (Tata Mc graw Hill Education Private Limited).
3. Digital Logic And Computer Design by M. M. Mano (Prentice- Hall of India Pvt. Ltd.).
4. Electronic Devices and Circuits: An Introduction by A. Motters head (PHI Learning)
5. Millman's Electronic Devices and Circuits by J. Millman (Tata Mgraw Hill)
6. Electronic Fundamentals and Applications: Integrated and Discrete Systems 5/e by J. D. Ryder (Phi Learning).
7. Electronic Devices and Circuits Theory 10/e by R. L. Boylestad, L. Nashelsky (Pearson).
8. Physics of Semiconductor Devices 2/e by S. M. Sze (Wiley).
9. Physics of Photonic Devices 2/e by S. L. Chuang (John Wiley& Sons).
10. Modern Digital Electronics 4/e by R. P. Jain (Tata Mcgraw Hill Education Private Limited).
11. Basic Electronics and Linear Circuits by N. Bhargava, D. Kulshreshtha, S. Gupta (Tata McgrawHill Education Private Limited).

Semester V, Paper-IV: Elective- I- Electromagnetic Theory

Unit-I: Electrostatics

Electrostatic potential due to a charge distribution, Multipoles and their interaction with electrostatic field, Solution of Lapalce equation by separation of variables in Cartesian Spherical and Polar Coordinates.

Unit-II: Electromagnetic Energy

Poynting's Theorem, Conservation of energy and momentum for a system of charged particles and electromagnetic fields, Maxwell's stress tensor.

Unit-III: Solution of Electromagnetic Wave

Plane wave solution of Maxwell's equations in source free space and simple dielectrics.

Unit-IV: Electromagnetic Dispersion

Polarization of electromagnetic waves. Plane wave propagation in metal and plasma. Elementary theory of dispersion.

Unit-V: Boundary condition

Boundary condition at a discontinuity, Fresnel's formula. Total internal reflection, Metallic reflection and skin depth.

Reference Books:

1. Electromagnetic Wave and Radiating Systems 2/e by E. C Jordan, K. G Balmain (PHI Learning).
2. Introduction to Electrodynamics 3/e by D. J. Griffiths (Phi Learning).
3. Berkeley Physics Course, Vol 2: Electricity and Magnetism by E. M. Purcell (McGraw-Hill).
4. Electromagnetics by B. B. Laud (New Age International (p) Ltd N Delhi).

Semester V, Paper-IV: Elective- II- Mathematical Methods

UNIT I Vector Calculus: Vector Calculus and Curvilinear Coordinates, Differential vector operators: Gradient, divergence and curl. Gauss's theorem, Green's theorem, Stoke's theorem and its examples.

UNIT II Linear Algebra and Matrices: Determinants for linear algebraic equations, Laplace development, Cramer's rule, anti- symmetry, Gauss elimination. Matrices– basic definition, classification and operations, orthogonal matrices, Hermitian matrices, unitary matrices, Rank of matrices, eigenvalues and eigenvectors.

UNIT III Complex Variable and Complex Integration: Complex variable, analytic function, Cauchy- Riemann equation in cartetian and polar coordinates, harmonic function, residue theorem, cauchy's integral theorem, cauchy's integral formula.

UNIT IV Statistics and Probability: Statistics and Probability: Statistical distributions, second moments and standard Deviations, definition of probability, fundamental laws of probability, discrete probability distributions, combinations and permutations, continuous distributions: expectation, moments and standard deviation, Binomial, Poisson andGaussian distributions

UNIT V Special Functions: Bessel's differential equations, Legendre's differential equations, Hermite's differential equations, Basics of Dirac delta functions and its properties.

Text and Reference Books:

1. Mathematical Physics by H K Dass, S. Chand Publication
2. Mathematical Physics by satyaprakash, S. Chand Publication
3. Mathematical Physics by B S Rajput Edt. 8, Pragti Prakashan
4. Mathematical Methods for Physicists: G. Arfken and H. J. Weber (Academic Press, San Diego) 7th edition, 2012.
5. Mathematical Methods in the Physical Sciences, M.L. Boas (Wiley) 2002.
6. Applied Mathematics for Engineers and Physicists, L. A. Pipes & L. R. Harvill (McGraw- Hill), 1971.
7. Mathematical Methods for Physics and Engineering, K. F. Riley, M.P. Hobson and S.J. Bence (Cambridge University Press), 1998.

Semester V: PracticalPhysics

List of Experiments - (Optics)

1. **Spectrometer:** Refractive index of water and of prism material by (a)Total internal reflection (b) grazing incidence methods.
2. **Michelson Interferometer:** Determination of wave length and separation of wave length of sodium light by Michelson Interferometer.
3. **Ultrasonic:** Determinationofvelocityofultrasonicinkeroseneoilbydiffractionmethod.
4. **Babinet Compensator:** To determine (1) phase difference in two orthogonal plane polarized components, (2) Orientation and ratio of axis of elliptically polarized light by (a) □,□□ method (b) direct method.
5. **Carnues fringe:** To determine the Young's modulus of a rectangular glass- plate by Carnues fringe method.

6. **Thickness of mica sheet:** To determine the thickness of mica sheet using Fresnel's Bi-Prism.
7. **Plane Reflection Grating:** To determine wavelength of laser light using plane reflection grating (inchscale & cm scale).
8. **Refractive Index Gradient:** Gradient of refractive in dexinamixture of two liquids, to find,
   (a) Difference Between refractive eindeces of two liquids
   (b) Variation of refractive index and refractive index gradient with height.
   (c) Maximum (dN/dy) and
   (d) Width of transition region at half maximum.
9. **Fraunhoffer Diffraction:** Fraunhoffer Diffraction at double slit.
   (a) Plotting the intensity variation in diffraction pattern.
   (b) To determine the wavelength of He- Ne/ Diode laser.
   (c) Finding the ratio of maximum intensity and observation of missing order.

Reference Book:

1. Advanced Practical Physics by H. B. Lal, U. S. Pandey & R. B. Singh (United Book Depot, Allahabad).

B. Sc. (PHYSICS) - Semester VI
Paper- I: Quantum Mechanics- 2

Unit- 1. Angular Momentum & H- Atom Problem

Angular Momentum, Commutation Relations. Eigen Values and Eigen functions of L_2, L_1 ladder (L_+L_-) operators.

Unit- 2. H- Atom Problem

Spherically symmetric potentials, complete solutions of the Hydrogen- Atom Problem, Hydrogen Spectrum.

Unit- 3.Time- Independent Perturbation Theory

Time- independent , non- degenerate, first order Perturbation theory, Spin Orbit coupling. Ground and excited states of helium atom and exchange degeneracy. Qualitative and elementary idea about Lamb shift.

Unit- 4: Spin

Elementary concept of spin, Pauli Matrices and spin wave functions. Total angular momentum

Unit- 5: Identical Particles.

Identical Particles, Symmetric and Anti-symmetric wave function, Pauli's Exclusion Principle.

Reference Books:

1. Introduction to Quantum Mechanics 2/e by D. J. Griffiths (Pearson).
2. Quantum Mechanics: Concepts and Applications 2/e by N. Zettili (John Wiley & Sons).
3. Quantum Mechanics by J. L. Powell, B. Crasemann (Narosa Publishing House).
4. Quantum Mechanics 3/e by L. Schiff (Tata Mcgraw Hill Education Private Limited).
5. Introduction to Quantum Mechanics by A. Ghatak(Macmillan Publishers India).
6. Quantum Mechanics by H. Prakash and B. K. Agarwal (Phi Learning).
7. Modern Quantum Mechanics, 2/e by J. J. Sakurai (Pearson Education India).

Paper- II: Solid State Physics

Unit- 1: Basics of Solid State Physics

Crystalline, amorphous and glassy state of solids, Lattices translation vector, Crystal lattices, Primitive lattice cell, Miller indices, inter planer spacing, Bravais lattices, Crystal structures of s.c., b.c.c., f.c.c., diamond and h.c.p.

Unit- 2. Reciprocal Lattice:

s.c., b.c.c. and f.c.c. lattices, Brillouin Diffraction conditions in reciprocal lattice, Bragg's law.

Unit- 3: Interatomic forces and classification of solids

Inert gas solids, Vander Waals-London interaction, Repulsive interaction and equilibrium lattice constant, Compressibility and Bulk modulus, Lattice energy of ionic crystals. Madelung constant, Cohesive energy, Generalized Hooke's law, Elastic constant of cubic crystals, Vibrations of monatomic linear chain, Dispersion relation, density of modes, Group Velocity, Vibrational Spectrum of lattice with two atoms per primitive cell, acoustic and optical modes. Lattice specific heat, Einstein and Debye models.

Unit- 4: Free electron theory

Free electron gas in one dimension, Energy levels and density of states, Fermi Energy, Electrical conductivity, Pauli paramagnetism, Hall effect.

Unit- 5: Band theory of solids

Energy Bands ; Kronig-Penny model in one dimension, Energy gap, Number of state in a branch, Distinction between metal, Semi-conductor and insulator. Intrinsic semiconductors. Variation of Fermi level with temperature, Effective mass.

Reference Books:

1. *Berkeley Physics Course, Vol5: Statistical Physics by F. Rief (McGraw-Hill).*
2. *Elementary Statistical Physics by C. Kittel (Dover).*
3. *Fundamentals of Statistical Mechanics by B. B. Laud (New Age International Publishers Ltd.- New Delhi).*
4. *Statistical Physics by Hermann (Springer India).*
5. *Statistical Mechanics 2/e by B. K. Agarwal (New Age International (p) Limited).*

Paper- III: Photonic Devices

Unit-1.: Diode & BJT

Review of characteristics of a semiconductor diode: cut in voltage, explanation of storage and transition capacitances.

BJT as a switch, Analytic expression using Ebers- Moll model, saturation properties for normal, inverse and emitter follower mode and their comparisons. Switching speed of diode, storage and transition time, switching speed of a BJT. Metal - semiconductor junction, Schottky diode and transistor.

Unit- 2: FET

Field effect transistor, principle of operation, a practical FET structure,

Unit- 3: MOSFET

MOSFET, enhancement and depletion modes, their representations. The MOS switch.

Unit- 4: Integrated Circuits

Various techniques of fabrication, LSI and MSI, metal semi- conductor contact.

Unit-5: Photonic Devices

Photonic Devices: Photoelectric effect in semiconductors, photoresisters and photoconductor, visible light emitting diodes and displays, Photodiode, Phototransistor, PN- Junction, solar cell and its characteristics.

Reference Books:

1. *Digital Integrated Electronics by H. Tauband D. Schilling (McGraw-Hill International Editions).*
2. *Millman's Integrated Electronics: Analog & Digital Circuits & Systems 2/e by J. Millman, C. Halkias,C.D. Parikh (Tata Mcgraw Hill Education Private Limited).*
3. *Digital Logic And Computer Design by M. M. Mano (Prentice-Hall of India Pvt. Ltd.).*
4. *Electronic Devices and Circuits: An* Introduction by A. Mottershead (PHI Learning)
5. *Millman's Electronic Devices and Circuits by J.Millman (TataMgrawHill)*
6. *Electronic Fundamentals and Applications: Integrated and Discrete Systems 5/e by J.*
    a. *D. Ryder (PhiLearning).*
7. *Electronic Devices and Circuits Theory 10/e by R. L. Boylestad, L. Nashelsky (Pearson).*
8. *Physics of Semiconductor Devices 2/e by S.M. Sze (Wiley).*
9. *Physics of Photonic Devices 2/e by S. L.Chuang (John Wiley & Sons).*
10. *Modern Digital Electronics 4/e by R.P.Jain (Tata Mcgraw Hill Education Private Limit).*

Paper- IV: Elective – I - Laser, Holography and Optical Instruments

Unit- I: Laser Emission

Stimulated and spontaneous emission. Einstein's coefficients, relative contribution of stimulated and spontaneous emission,

Unit- II: Laser Action Conditions

Population inversion, Laser emission, characteristic of Laser light (including temporal), Amplification in an inverted medium, threshold condition for lasing.

Unit- III: Holography

Basic principles, Recording a Hologram, Viewing a hologram, Thick hologram, Multiple holograms, white light reflection holograms.

Unit- IV: Optical Instruments- I

Introduction of multiple beam interferomety, Fabry- Perot interferometer and etalon (resolving power and determination of wavelengths),

Unit- V: Optical Instruments- II

Resolving power of Lummer- Gehreck plate, Grating and prisms, spectrograph for visible, IR and UV regions.

Reference Books:

1. Fundamentals of Optics 4/e by F. A. Jenkins and F. E. White (McGraw-Hill International Editions).

2. Geometrical & Physical Optics by R. S. Longhurst (Ol).

3. Optics 4/e by A. Ghatak (Tata Mgraw Hill).

4. Geometrical and Physical Optics by B. K. Mathur and T. P. Pandya (New Gopal Printing Press).

5. Optics (schaum's Outline Series) by E. Hhecht (Tata Mcgraw Hill Education Private

Limited).
6. Introduction to Optics by F. L. Pedrotti, L. M. Pedrotti, L. S. Pedrotti (Pearson).
7. Lasers: Theory and Applications by K. Thyagarajan and A. K. Ghatak (Macmillan Publishers India Ltd

Elective Paper- II
Paper- IV: Renewable Energy Source, Energy Harvesting and its Application

UNIT- I: Fossil fuels and Alternate Sources of energy: Fossil fuels and their limitation, Nuclear Energy and its limitations Conventional and non-conventional energy sources, need of renewable energy,. Introduction of various renewable energy sources; Solar energy, Ocean thermal energy, Wind Energy, Tidal Energy, Wave energy systems.
UNIT-II: Biomass, biochemical conversion, biogas generation, geothermal energy tidal energy. Wind Energy harvesting: Fundamentals of Wind energy. Wind Turbines and different electrical machines in wind turbines,
UNIT – III: Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.
UNIT-IV: Ocean Energy: Ocean Thermal Energy, Ocean Thermal Energy Conversion, Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Geothermal Energy: Geothermal Resources, Geothermal Technologies.
UNIT – V: Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources, Hydroelectricity. Carbon captured technologies, cell, batteries, power consumption Environmental issues and Renewable sources of energy, sustainability.

Text and Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi,2011
2. Solar energy-MP Agarwal - S Chand and Co. Ltd., 1983
3. Solar energy-Suhas P Sukhative Tata McGraw-Hill Publishing Company Ltd., 1996 Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
4. Suggested Readings: Dr. P Jayakumar, Solar Energy: Resource Assessment Handbook, 2009

Link for e-Books for Physics:
https://www.e-booksdirectory.com/listing.php?category=2
http://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_ElwAJkNDp5v8Yy6xK150Kma0VROAWGlichRwFFCCO
vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BWE
• https://www.sciencebooksonline.info/physics.html
http://www.cambridgeindia.org/ https://bookboon.com/en/physics-ebooks

Semester VI: Practical Physics

List of Experiments
(Electronics)

1. **Photo- transistor and photo- diode:** (1) Calibration of OPAMP (2) To draw characteristic of photodiode/transistor for at least three different distances (3) Verification of inverse square law.
2. **e/m :**To determine e/m of electron and also check from graph and calculation(plot B vs. l/i, I vs. l, B vs. i).
3. **CE Amplifier :** To (1) trace the circuit and write the value of resistances by color code, (2) Note D.C. Voltages and currents, (3) Study input- output characteristics at 1KHz, (4) Study frequency response & obtain mid frequency gain and cut off frequencies.
4. **FET :** To (1) trace the circuit for amplifier with value of resistance by colour code and note D. C. voltages and currents, (2) find the voltage amplification 'A' given 0.2V A. C. voltage of 1khz, (3) Find Q point, (4) Draw characteristic curves at different gate voltages taking care that curves near Q point is also plotted, (5) Draw A. C. & D. C. load lines (6) Find 'A' from A. C. load line also (7) Calculate saturation current for different Vgs, Plot a graph & obtain out of voltages, (8) Calculate g (m), R (on) &
    a. Rd (9) verify I(ds)= I(dss) $(1- V_{gs}/V_p)^2$
5. **RTL gate:** To verify (1)Truth table for NOR- NOT gates, (2) switching action of transistor & draw VLVO, IBIc, VsV, R switch Vs VCE curves, (3) To find out the fan out using driver driven condition in (a) single input RTL gate (b) double input RTL gate.
6. **DTL:** (1) To verify truth table for DTL gates, (2) To draw input- output characteristic
    a. & voltages at different points for DTL gates, (3) To find fan out.
7. **TTL:** (1)To verify truth table for TTL gates, (2) To draw input- output characteristic
    a. & voltages at different points for TTL gates, (3) To find fan out.
8. **Hysteresis:** To draw hysteresis loop for the material of given anchorring and to find:
    (i) Hysteresis loss (ii) Retentivity (iii) Coercivity (iv) Bmax (v)Hmax
9. **Bias Stabilization:**

    (i) To calculate the band gap by plotting IB Vs (IB+IC) for collector biasing case at two temperatures: (1) at room temperature (2) at 55°C

    (ii) To calculate stability factor for fixed biasing, collector biasing, emitter biasing and potential divider biasing.

    (iii) To study the variation of IB, IC, VCC and VBE with temperature for different biasing.

    (iv) Plot temperature Vs VCE, VBE, IB, IC (at room temperature).

Reference Book:

1. Advanced Practical Physics by H. B. Lal, U. S. Pandey & R. B. Singh (United Book Depot, Allahabad).