DEPARTMENT OF PHYSICS

COURSE STRUCTURE

for

B.Sc. (Hons.) (PHYSICS)

Eight Semesters (Four Years)

Programme

Based on

Choice Based Credit System (CBCS)

(As per ordinance-14)

AWADHESH PRATAP SINGH UNIVERSITY, REWA (M.P.)

PROGRAMME OUTCOMES (POs)

PO #	PROGRAMME OUTCOME
PO 1	**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and look at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO 2	**Effective Communication**: Speak, read, write and listen clearly in personand through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas,books, media and technology.
PO 3	**Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO 4	**Effective Citizenship**: Demonstrate empathetic social concern and equity-centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5	**Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6	**Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO 7	**Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

PROGRAMME SPECIFIC OUT COMES (PSOs) (B.Sc. (Hons)Physics)

PSO #	PROGRAMME SPECIFIC OUTCOME
PSO 1	To gain a functional knowledge of theoretical concepts and experimental aspects of Physics and their applications in the day-to-day life.
PSO 2	To integrate the gained knowledge with various contemporary and evolving areas in physical sciences like physical, analytical, synthetic, instrumental etc.
PSO 3	To understand, analyze, plan and implement qualitative as well as quantitative analytical synthetic and phenomenon-based problems in physical sciences.
PSO 4	Provide opportunities to excel in academics, research or Industry.
PSO 5	To gain opportunities to excel in scientific, research and national / International level scientific knowledge.

AWADHESH PRATAP SINGH UNIVERSITY
REWA

ACCREDIATED GRADE "B" BY NAAC

FACULTY OF SCIENCES

Syllabus for

B.Sc. (Hons.) PHYSICS

Choice Based Credit System

With Effect From 2022-23

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

Program- Structure (4 years) Semester System

B.Sc. (Hons.) Physics

UGC-CBCS System as per ordinance 14 (A)

2022-23

(First year)

Semester-I					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
101: Mechanics	Major Core	60	40 (Practical)	100	(4+2)
102: Mathematics- I	Minor core	60	40	100	6
103: Digital System and Applications	GE	60	40	100	4
104: English	AEC	60	40	100	4
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

Semester-II					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
201: Electricity and Magnetism	Major Core	60	40 (Practical)	100	(4+2)
202: Mathematics- II	Minor core	60	40	100	6
203: Analog System and Applications	GE	60	40	100	4
204: Environmental Science	AEC	60	40	100	4
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

GE: Generic Elective

AEC: Ability Enhancement Course

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

Program- Structure (4 years) Semester System

B.Sc. (Hons.) Physics

UGC-CBCS System as per ordinance 14 (A)

2022-23

(Second year)

Semester-III					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
301: Waves and Optics	Major Core	60	40 (Practical)	100	(4+2)
302: Mathematics- III	Minor core	60	40	100	6
303: Basic of Computer and Information Technology	GE	60	40	100	4
304: Computational Physics	SEC	60	40	100	4
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

Semester-IV					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
401: Modern Physics	Major Core	60	40 (Practical)	100	(4+2)
402: Operating Systems	Minor core	60	40	100	6
403: Statistical and Thermal Physics	GE	60	40	100	4
404: Introduction to PC software	SEC	60	40	100	4
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

GE: Generic Elective

SEC: Skill Enhancement Course

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

Program- Structure (4 years) Semester System

B.Sc. (Hons.) Physics

UGC-CBCS System as per ordinance 14 (A)

2022-23

(Third year)

Semester-V					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
501: Solid State Physics	Major Core	60	40 (Practical)	100	(4+2)
502: Quantum Mechanics- I	DSE	60	40	100	4
503: Computer Programming Methodology	SEC	60	40	100	4
504: Project/Internship				100	6
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

Semester-VI					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
601: Electromagnetic theory	Major Core	60	40 (Practical)	100	(4+2)
602: Quantum Mechanics- II	DSE (1)	60	40	100	4
603: Laser Physics	DSE (2)	60	40	100	4
604: Project/Internship				100	6
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

DSE: Discipline Specific Elective

SEC: Skill Enhancement Course

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

Program- Structure (4 years) Semester System

B.Sc. (Hons.) Physics

UGC-CBCS System as per ordinance 14 (A)

2022-23

(Fourth year)

Semester-VII					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
701: Communication System	Major Core	60	40 (Practical)	100	(4+2)
702: Research Methodology	Minor Core	60	40	100	4
703: Nanomaterials	DSE	60	40	100	4
704: Project/Internship				100	6
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

Semester-VIII					
Course Code And Name	**Course Type**	**Theory Paper**	**Internal Assessment**	**Maximum Marks**	**Credit**
801: Nuclear and Particle Physics	Major Core	60	40 (Tutorial)	100	(5+1)
802:Advanced Experimental Techniques	Minor Core	60	40	100	4
803: Project/Internship				200	10
SEMESTER TOTAL				400	20
CUMULATIVE TOTAL				400	20

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics I SEM.

101: MECHANICS (Major Core)

Learning Outcomes:

The emphasis of this course is to enhance the understanding of the basic of a mechanics. The course begins with the review of Newton's Laws of motion and ends with the Special Theory of Relativity.

SYLLABUS

A. Theory

Unit I: Fundamentals of Dynamics:

Inertial frames, Review of Newton's laws of motion, Momentum of variable mass system, motion of rocket, Dynamic of a system of particles, principal of conservation of momentum, Impulse Determination of centre of mass of discrete and continuous objects having cylindrical and spherical symmetry (1-D, 2-D & 3-D).

Work and Energy: Work and Kinetic Energy Theorems, Conservative and Non-conservative forces, Potential Energy, Energy diagram, Stable, Unstable and neutral equilibrium, force as gradient of potential energy, work & potential energy, Law of conservation of energy. Elastic (1-D & 2-D) and inelastic collisions centre of Mass and Laboratory frames.

Unit II: Rotational Dynamics

Angular momentum of a particle and systems of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of inertia, theorems of parallel and perpendicular axes (statements only). Determination of moment of inertia of 1-D, 2-D & 3-D (rectangular, cylindrical and spherical) objects, kinetic energy of rotation.

Non Inertial System: Reference frames, Galilean transformations, Galilean invariance, Inertial and Non-inertial frames and fictitious forces, uniformly rotating frame, centrifugal force, Coriolis force and its applications.

<u>Unit III:</u> Gravitation and Motion under a Central force field

Law of gravitation, gravitational potential energy, inertial and gravitational mass, potential and field due to spherical shell and solid sphere.

Two body problem, its reduction to a one body problem and its solution, Kepler's laws, satellite in circular orbit and escape velocities, Geosynchronous orbits.

<u>Unit IV:</u> Oscillation:

Simple Harmonic Motion, Differential Equation of SHM and its solution, Kinetic Energy, potential energy, total energy and their time-average values, compound pendulum, Damped oscillations, Forced oscillations, Transient and steady states, sharpness of resonance and quality factor (Q-factor)

<u>Unit V:</u> Special Theory of Relativity: Outcomes of Michelson-Morley Experiment, Postulates of special theory of Relativity, Lorentz Transformations, simultaneity, Length contraction, Time dilation, Relativistic transformation of velocity and acceleration, variation of mass with velocity Mass-energy equivalence, Relativistic Doppler effect. Transformation of energy and Momentum.

Text and Reference Books:

1. Mechanics, D.S. Mathur, S. Chand (2012).
2. Mechanics Berkeley Physics Course (Vol. 1) Charles Kittle, TMH (2007).
3. Physics, Resnick, Halliday & Walker (9^{th} Edn.) Wiley (2010).
4. Engineering Mechanics, Basudeb Bhattacharya (2^{nd} edn.), Oxford University Press (2015).
5. Mechanics, J.C. Upadhyay.

B. Experiments [Practicals]

1. To determine the moment of inertia of a fly wheel.
2. To determine the value of g using Bar pendulum.
3. To determine the value of g using Kater's pendulum.
4. To determine the elastic constants of a wire by Searle's method.
5. To determine Young's Modulars of a wire by optical lever method.
6. To study the motion of a spring and calculate (a) spring constant and (b) g.
7. Measurement of length (or diameter) using Vernier calliper, screw-gauge and travelling microscope.
8. Half Adder and full adder.
9. Half sabtractor and Full sabtractor
10. 4-bit binary Adder.
11. To build Flip-Flops (RS, clocked RS, D type and JK) circuits using NAND gates.
12. To build JK Master-Slave flip-flop using flip-flop IC's
13. To build a 4-bit counter using D-type/ JK flip flop IC's and study timing diagram.
14. To make a 4-bit shift register (serial and parallel) using D-type/ JK flip flop IC's.
15. To design a combinational logic system for a specific Truth table.
16. (a) To convert Boolean expressions units logic circuit and design it using logic gate ICs.

    (b) To minimize a give logic circuit.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics I SEM.

102: MATHEMATICS -I (Minor Core)

Learning Outcomes:

The emphasis of courses is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problem.

SYLLABUS

A. Theory

Unit I: Calculus:

Plotting of functions, Approximation: Taylor and Binomial series (statement only). First order Differential Equation (variable separable, homogeneous, non- homogeneous) extract and inexact differential equation and integrating factor.

Unit II: Differential Equation:

Basic Differentiation & interaction homogeneous equations with constant coefficients, Wronskian and general solution, particular integral, method of undetermined coefficients and variation method of parameters. Euler differential equation and simultaneous differential equation of first and second order.

Unit III: Vector Algebra

Properties of vector, scale product and vector product, scalar triple product and their interpretation in terms of area and volume respectively. Scalar and vector fields.

Unit IV: Vector calculus:

Vector differentiation, directional derivations and normal derivative, gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector identities, partial differentiation.

<u>Unit V:</u> Ordinary integrals of vectors, Double and Triple integrals, change of order of integration, Jacobian, line, surface and volume elements, line, surface and volume integrals of vector fields, flux of a vector field, Gauss divergence theorem, Green's and Stoke's theorems.

Text and Reference books:

1. Mathematical method for physicists, G.B. Arfken and H.J. Weber
2. Mathematical method for physicists, Murrary R. Spiegel.
3. Mathematics for physicists and Engineers Pipes and Harvill.
4. Advance Engineering Mathematics, Erwin Kreyzig, Wiley (India).
5. Mathematical Physics; A.K. Saxena (Narosa)
6. Mathematical Physics; Goswami (1st Edition) Cengage learning.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics I SEM.
103: DIGITAL SYSTEM AND APPLICATIONS (Generic Elective)

Learning Outcomes:

This course introduces the concept of Boolean Algebra and the basic digital electronics. In this course students will be able to understand the working principle of CRO, data processing circuits, arithmetic circuits, sequential circuits like registers, counters etc., based on flip flops. In addition, students will get an overview of Intel 8085 microprocessor.

SYLLABUS

Unit-I: Introduction to CRO:

Block diagram of CRO. Electron Gun. deflection system and Time Base, Deflection Sensitivity, Applications of CRO (1) study of waveform, (2) Measurement of voltage, current, frequency and phase difference.

Digital circuit: Difference between Analog and Digital circuits. Examples of linear and digital ICs. Binary numbers, Decimal to Binary and Binary to Decimal conversion. BCD octal and Hexadecimal numbers AND, OR and NOT gates (realization using Diodes and Transistors) NAND and NOR gates as Universal Gates. XOR and XNOR gates and applications as Parity Checkers

Unit II: Boolean Algebra:

De Morgan's Theorems, Boolean Laws, simplification of logic circuit using Boolean Algebra, Fundamental products, Idea of Minterms and Maxterms. Conversions of Truth Table into Equivalent logic circuit by (1) Sum of products method and (2) Karnaugh Map.

<u>Unit III:</u> Data Processing circuits: Multiplexers, De-Multiplexers, Decoders, Encoders.

Arithmetic Circuit: Binary Addition, Binary Subtraction using 2's complements. Half and Full Adders, half and full Subtractors, 4-bit binary adder/subtractor.

Sequential Circuits: SR, D and JK Flip Flops, Clocked (Level and Edge Triggered) flip-flops, preset and clear operations, Race-around conditions in JK flip-flop. M/S JK flip-flop.

Timer: IC 555: block diagram and applications, Astable and Monostable multivibrators.

<u>Unit IV:</u> Shift registers: Serial-in-Serial-out, Serial-in-Parallel out, Parallel-in-Serial out, and Parallel-in-Parallel-out shift registers (only upto 4 bits).

Counters (4-bits): Ring counter, Asynchronous counters, Decade counter, synchronous Counter.

<u>Unit V:</u> Computer Organization:

Input/ Output devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization and addressing, Memory interfacing, Memory MAP.

Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers, ALU, Memory Stack memory, Timing and Control circuitary, timing states, instruction cycle. Timing diagram of MOV and MVI.

Introduction to Assembly Languages: 1 byte, 2 byte and 3 byte instructions.

Text and Reference books:

1. Digital principles and Applications, A.P. Malvino, D.P. Leach and Saha, TMH (7th Ed. 2011).
2. Digital Electronics, A.K. Saxena, CBS.

3. Fundamental of Digital circuits, Anand Kumar PHI (2nd Ed. 2009).

4. Logic Circuit Design, P. Shimon Vingron Springer (2012).

5. Microprocessor Architecture Programming & Application with 8085, R.S. Gaonkar PHI (2002)

6. Digital circuit and systems, Venugopal, TMH (2011)

104 (FC)/AEC: English :

The course-content will be adopted from that used in the other departments of the science faculty.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics II SEM.
201: ELECTRICITY AND MAGNETISM (Major Core)

Learning Outcomes:

The course covers static and dynamic electric and magnetic field, and the principles of electromagnetic introduction. It also includes analysis of electrical circuits and introduction of network theorems. By the end of the course student should be able to appreciate Maxwell's equations and analyze electrical circuits using network theorems.

SYLLABUS

Unit I: Electric Field and Electric Potential

Electric field lines, Electric flux, Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry, conservative nature of electrostatic field, Electrostatic potential, Laplace's and Poisson equations, the Uniqueness Theorem, Potential and Electric field of a dipole Force and Torque on a dipole.

Electrostatic energy of a system of charges, Electrostatic energy of a charged sphere, Conductors in an electrostatic field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate capacitor, capacitance of an isolated conductor, Method of images and its applications to : (1) Plane infinite sheet and (2) Sphere.

Unit II: Magnetic field :

Magnetic force between current elements and definitions of magnetic field $\vec{B}$, Biot-Savart's law, it's simple applications: straight wire and circular loops, current loop as a Magnetic Dipole and its Dipole moment (Analogy with electric dipole) Ampere's circuital law and its application to (1) Solenoid and (2) Toroid, Properties of $\vec{B}$: curl and divergence. Vector Potential, Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements, Torque on a current loop in a uniform magnetic field.

Unit III: (a) Dielectric Properties of Matter:

Electric field in matter, polarization, polarization charges, Electric susceptibility and dielectric constant, capacitor (parallel-plate spherical, cylindrical) filled with dielectric Displacement vector $\vec{D}$, Relations between $\vec{E}$, $\vec{P}$ and $\vec{D}$.

(b) Magnetic Properties of Matter: Magnetization vector $\vec{M}$, and magnetic intensity $\vec{H}$, magnetic susceptibility and permeability, Relations between $\vec{B}$, $\vec{H}$, $\vec{M}$. Ferromagnetism, $\vec{B}$-$\vec{H}$ curve and hysterisis.

Unit IV: Electromagnetic Induction:

Faraday's law, Lenz's law, Self Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a magnetic field, Maxwell's equations, charge conservation and displacement current.

Electrical Circuits: AC circuits; Kirchhoff's laws for AC circuits, Complex Reactance and Impedance. Series LCR circuit : (1) Resonance (2) Power dissipation and (3) Quality factor. Parallel LCR circuit.

Unit V: Network Theorems:

Ideal constant-voltage and constant current source Review of Kirchhoff's Current Law & and Kirchhoff's Voltage Law, Mesh and Node analysis, Thevenin's theorems, Norton theorem, Superposition Theorem, Reciprocity Theorem, Maximum Power transfer theorem. Applications to dc circuits.

Text and Reference books:

1. Fundamentals of Electricity and Magnetism, Arthur F. Kip, Mc Graw-Hill (2^{nd} Edn.) (1981).
2. Electricity and Magnetism, Edward M. Purcell, Mc Graw-Hill (1986).
3. Introduction to Electrodynamics, D.J. Griffiths, Benjamin, (3^{rd} Edn.) (1998).

4. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. 1, Oxford University Press (1991)
5. Networks, Line and Fields, John D. Ryder, Pearson (2nd Edn. 2015)
6. Electromagnetic Theory and Applications, A.K. Saxena, Narosa (2nd Edn.)
7. Schaum's Outline of Electric circuits, J. Edminister, Mc Graw-Hill (1995)

B. Practical (Experiments)

1. To determine an unknown low resistance using a potentiometer.
2. To determine an unknown low resistance using Carey Foster Bridge.
3. To compare capacitances using De Sauty's Bridge.
4. To determine self inductance of a coil by Rayleigh's method.
5. To determine self inductance of a coil by Anderson's Bridge.
6. Measurement of field strength B and its variations in a solenoid (dB/dx).
7. To verify the Thevenin and Norton Theorems.
8. To study response curve of a series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q and (d) Band width.
9. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
10. Study of V-I & power curve of solar cells and find maximum power point efficiency.
11. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
12. To study the various biasing configuration of BJT for normal class A operation.
13. To study the frequency response of voltage gain of a two stage RC transistor amplifier.
14. To investigate the use of an OP Amp as an (1) Integrator (2) Differentiator.

B.Sc. (Hons.) Physics II SEM.

202: MATHEMATICS - II (Minor Core)

***Learning Outcomes*:**

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems.

SYLLABUS

A. Theory

Unit I: Complex Analysis (1)

(1) Brief review of Complex numbers and their graphical representation formula, Euler's formula, De Moivres theorems, Roots of Complex Numbers, functions of complex variables, Analyticity and Cauchy-Riemann Conditions.

Unit II: Complex Analysis (2) Example of analytic functions, singular functions, poles and branch points, order of singularity, branch cuts, integration of a function of a complex variable, Cauchy's inequality, Cauchy's integral formula, Simply and Multiply connected Regions, Laurent and Taylor's expansion, Residues and Residue theorem.

Unit III: Fourier Series:

Periodic functions Orthogonality of Sine and Cosine functions, Dirich let conditions (statement only), Expansion of periodic functions in a series of sine and Cosine functions and determinations of Fourier coefficients, Event and Odd functions and their Fourier expansion, Parseval's Identity and its applications to summation of infinite series.

Unit IV: Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical coordinate System.

Unit V: Some Special integrals:

Beta and Gamma functions and Relations between them, Expression of integrals in terms of Gamma functions.

Dirac delta functions: Definitions and properties, Representation of Dirac delta functions as a Fourier integral, Fourier Transform of Dirac delta functions.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics II SEM.
203: ANALOG SYSTEMS AND APPLICATIONS (Generic Elective)

***Learning Outcomes*:**

This is one of the core papers in physics curriculum where students will get to learn about the physics of semiconductor p-n junction and devices such as rectifier diodes, zener diode, photodiode etc. and bipolar junction transistors. Transistor biasing and stabilization circuits are explained. The concept of feedback is discussed in amplifiers and the oscillator circuits are also studied. By the end of the syllabus, students will also have an understanding of operational amplifiers and their applications.

SYLLABUS

A. Theory

Unit I: Semiconductor Diodes:

P and N type semiconductors, Energy level diagram, Conductivity and Mobility, concept of Drift velocity, PN Junction Fabrication (simple idea) Barrier Formation in a PN Junction Diode Derivation for Barrier Potential, Barrier width and current for abrupt Junction. Equation of continuity, Current flow mechanism in Forward and Reverse biased diode.

Unit II: Two-terminal Devices and their Applications:

(1) Rectifier Diode: Half-wave Rectifiers, Bridge Full-wave Rectifiers, calculation of ripple factor and rectification efficiency, C-filter, (2) Zener Diode and voltage Regulation principle, structure and characteristics of (1) LED (2) Photodiode and (3) Solar cell, Schottky diode and Tunnel diode.

Bipolar Junction Transistors: npn and pnp transistors, I-V characteristics of CB and CE configuration, Active, Cut off and Saturation regions, current gains α and β. Relations between α and β. Load line analysis of Transistors, DC load line and Q-point, Physical Mechanism of Current Flow.

Unit III: Amplifiers:

Transistors Biasing and stabilization circuits. Fixed Bias and voltage Divider Bias. Transistor as 2-port Network, h-parameter equivalent circuit, Analysis of a single-stage CE amplifier using Hybrid model. Input and Output impedance. Current, Voltage and power gains. Classification of class A, B & C Amplifiers Two stage RC-coupled amplifier and its frequency response.

Unit IV: Feedback in Amplifiers:

Positive and Negative feedback. Effect of negative feedback on input Impedance, output Impedance Gain, Stability.

Sinusoidal Oscillators**:** Barkhausen Criterion for self-sustained Oscillations, RC phase-shift oscillator, Hartley and Colpitt oscillators.

Unit V: Operational Amplifiers:

Characteristics of an ideal and practical op- Amp. (IC741). open-loop and closed-loop gain. Frequency Response CMRR Slew Rate and concept of Virtual ground.

Applications of Op-Amp: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator (6) Log amplifier, (7) Comparator, () Wien bridge oscillator.

Conversion: D/A Resistive networks (weighted and R-2R ladder). Accuracy and Resolution.

Text and Reference books:

1. Integrated Electronics, J. Millman and C.C. Halkias, Tata Mc Graw Hill (1991)

2. Solid State Electronic Drives, B.G. Streetman & S.K. Banerjee, PHI (6th Edn. 2009).

3. Electronics Fundamentals and Applications, J.D. Ryder, Prentice Hall (2004)

4. Op-Amps. and Linear Integrated Circuit, R.A. Gayakwad, Prentice Hall (4th Edn. 2000)

5. Microelectronic Circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, Oxford University Press (6th Edn. 2014)

6. Semiconductor Devices % Physics and Technology, S.M. Sze, Wiley India (2nd Edn 2002).

7. An Introduction to Electronics, A.K. Saxena, Narosa.

8. Hand Book of Electronics, Gupta and Kumar.

204 (FC)/AEC: Environmental Science

The course content will be adopted from that used in the other departments of the science faculty.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics III SEM.
301: WAVES AND OPTICS (Major Core)

Learning Outcomes:

This is one of the core courses in Physics curriculum that begins with explaining ideas of superposition of harmonic oscillations leading to physics of travelling and standing waves. The course also provides an in depth understanding of wave phenomena of light viz. interference and diffraction with emphasis on practical applications of the same.

SYLLABUS

A. Theory

Unit I: Superposition of Harmonic Oscillations:

Simple Harmonic Motion (SHM), Linearity and Superposition Principle, Superposition of two collinear oscillation having (1) equal frequencies and (2) different frequencies (Beats) Superposition of N collinear Harmonic oscillations with (1) equal phase differences and (2) equal frequency differences.

Unit II:

Superposition of two perpendicular Harmonic oscillations, Lissajous Figures with equal and unequal frequencies and their uses.

Wave Motion: Plane and spherical waves, Longitudinal and Transverse waves, plane progressive (Travelling) waves. Wave equation, Particle and wave velocities, intensity of wave.

Unit III: Superposition of two Harmonic waves:

Standing (stationary) waves in a string: Fixed and free ends, analytical treatment, phase and group velocities, Energy of vibrating string, Transfer of Energy. Normal modes of stretched strings.

Longitudinal standing waves and Normal Modes, Superposition of N harmonic waves.

Wave Optics**:** Electromagnetic nature of light. Definitions and properties of wave front. Huygen's principle, Temporal and spatial coherence.

Unit IV: Interference:

Divisions of amplitude and wave front, Young's double slit experiment, Fresnel's biprism, phase change on Reflection, stokes treatment. Interference in Thin Films; parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Michelson Interferometer: (1) Idea of form of fringes (No theory required) (2) Determination of wavelength, (3) Refractive index (4) Visibility of Fringes. Fabry-Perot interferometer.

Unit V: Diffraction:

Fraunhoffer diffraction; single slit, Rectangular and circular aperture, Resolving power of a Telescope, Double slit, Multiple slits, Diffraction grating. Resolving power of grating

Fresnel Diffraction: Assumptions, Half-Period Zones for plane wave. Explanation of Rectilinear Propagation of Light. Theory of a Jone plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Cornu's spiral and its applications, straight edge and a slit.

Text and Reference Book:

1. Vibrations and Waves, A.P. French, CRC Press (Ist Edition, 2003).
2. Fundamental of Optics, F.A. Jenkins and H.E. White, Mc Graw Hill (2008).
3. Optics, Ajoy Ghatak, TMH (2008).
4. Optics, Brij Lal and Subrahmanyam, S. Chand.

5. Waves, Berkeley Physics Course, F. Crawford, TMH, Vol. 3, (2007).

6. The Physics of a Vibrations and Waves, H.J. Pain, John Wiley (2013).

7. Optics, Eugene Hecht, Pearson education (4^{th} Edn. 2014)

B. Practical (Experiments)

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2-T law.
2. To study Lissajous Figure.
3. Familiarization with Schuster's focusing; determinations of angle of prism.
4. To determine refractive index of the Material of a prism using sodium source.
5. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
6. To determine the wavelength of sodium source using Michelson's interferometer.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's rings.
9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
10. To determine dispersive power and resolving power of a plane diffraction grating.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics III SEM.
302: MATHEMATICS - III (Minor Core)

Learning Outcomes:

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

SYLLABUS

Unit I: Special Functions and Equations:

Legendre, Bessel, Hermite and Laguerre Differential Equations, Properties of Legendre Polynomials, Rodrigues Formula, Generating Function, Orthogonality, simple recurrence relations, Expansion of function in a series of Legendre polynomials, Bessel Functions of the first kind, Generating function, simple recurrence relations, zeros of Bessel Functions (J_0 (x) and J_1(x)) and orthogonality.

Unit II: Partial Differential Equations:

Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular geometry, solution of wave equation for vibrational modes of a stretched string rectangular and circular membranes, solution of one-dimensional heat flow equation (equation not to be derived)

Unit III: Fourier Transforms:

Fourier Integral theorem (Statement only). Fourier Transform. Fourier sine and cosine transform, Examples. Fourier transform of single pulse, trigonometric, exponential and Gaussianfunctions.

<u>Unit IV:</u>

Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). One dimensional Wave Equations.

<u>Unit V:</u> Laplace Transforms:

Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Toeorem, Shifting Theorem. LTs of 1^{st} and 2^{nd} order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2nd order Differential Equations: Coupled differential equations of 1^{st} order.

Text and Reference Books

1. Mathematical Methods for Physicists, Arfken and Weber (2005) Elsevier
2. Fourier Analysis by M.K. spiegel (2004) (TMH).
3. Mathematical Physics, A.K. Saxena (Narosa).
4. Differential Equations, George F. simmons (2006) TMH
5. Mathematical Physics, Pipes and Harvill.
6. Mathematical Physics, Satya Prakash.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics III SEM.
303: BASICS OF COMPUTER AND INFORMATION TECHNOLOGY
(Generic Elective)

Learning Outcomes:

This course will develop the understanding about basic of computer anatomy and operations. This will familiarise the students about Windows and PC software.

SYLLABUS

Unit I:

History, Generation of Computers Characteristics, Capabilities and Limitations, Classification of Computers and types of Digital computes. Hardware, Software, Types of software, Generations of Computer, Languages: High and low level languages, Types of Translators, Component of Computer System

Unit- II:

Introduction of various input/ output devices: Keyboard, mouse, MICR, OCR, OMR, Bar Code, Scanner, VDU, Plotter, Impact and Nonimpact printers, storage units: Bits and Bytes ; Primary and secondary Memories.

Unit- III: Windows:

Introduction, windows desktop, start button, taskbar, switching between programs and windows, managing files, folders and objects, windows explorer, creating shortcuts, control panel; windows accessories: paintbrush, word pad, customizing windows, Internet Explorer.

Unit- IV: MS Word:

Working with Headers, Footers, Endnotes, Footnotes, tabs, tables, sorting, Working with graphics: Importing graphics, Drawing objects, Text in Drawings (Word Art), Pictures using Drawing objects, Rotating and Flipping Objects, Spelling and Grammar Checker, Auto Correct, Auto Text, Creating Tables, Mail Merge.

Unit- V: MS Powerpoint:

Creating presentations, Auto content wizard, editing slides, Working with Text in Power Point, Formatting and Aligning Text; Working with graphics in Power Point; Importing images from the outside and drawing in power point, creating organizational charts, inserting clip arts & picture/photos in Power Point Presentation, Excel Charts in Power Point, Inserting Table from Word.

Text and Reference Book:

1. Sinha, P.K.: Computer Fundamentals, BPB Publ.
2. Rapidex Computer Courses
3. Jain, Satish: Introduction to Computer Science, BPB Publ.
4. Mansfield R.: The Compact guide to MS- OFFICE, BPB

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics III SEM.
304: COMPUTATIONAL PHYSICS (SEC)

Learning Outcomes:

.The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics and Science. this course highlights the use of computational methods to solve physical problems, and use of computer language as a tool in solving physics/science problems.

SYLLABUS

Unit I: Algorithms and Flowcharts:

Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin (x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal

Unit II: Scientific Programming:

Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types Variables and their types, Keywords, Variable Declaration and concept of instruction and program, Operators: Arithmetic, Relational, Logical and Assignment Operators, Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

Unit III: **Control Statements:**

Types of Logic (Sequential Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements),

Unit- IV: **Scientific word processing: Introduction to LaTeX:**

TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.

Unit- V: **Equation representation:**

Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citatión, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

Visualization: Introduction to graphical analysis and its limitations. Introduction to Gnuplot importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot .

Text and Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.

2. Computer Programming in Fortran 77 ". V. Rajaraman (Publisher: PHI).

3. LaTeX-A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).

4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)

5. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986 Mc-Graw Hill Book Co.

6. Computational Physics: An Introduction, R.C. Verma, etal New Age International Publishers, New Delhi (1999)

7. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics IV SEM.
401: MODERN PHYSICS (Major Core)

Learning Outcomes:

This course introduces modern development in Physics. Starting from Radiations Laws, it develops the idea of De Broglie matter waves, probability interpretation and uncertainty principle. It also introduces basic concepts of nuclear physics and elementary particles.

SYLLABUS

A. Theory

Unit I: Theory of Radiation:

Black body radiation, Kirchhoff's law, Stefen Boltzmann law, Wien's Displacement Law, Rayleigh Jean's Law, ultraviolet catastrophe, Planck's Radiation Law, Wien's Law and Rayleigh Jeams law as special cases of Planck's law, Deduction of Wien's law and Stefan's law from Planck's Formula.

Unit II: Light :

Waves vs Particle and wave function, Planck's quantum, light as wave versus particle, quantum theory of light, Photoelectric effect and Compton scattering, De Broglie matter waves, Davisson-Germer experiment, wave description of particles by wave-packets, group and phase velocity, Two slit experiment with electrons, Probability and wave function, physical interpretation of wave function, Heisenberg's uncertainty principle.

Unit III: Basic Nuclear Concepts:

Size and structure of atomic nucleus, and its relation with atomic weight, Impossibility of an electron being the nucleus as a consequence of uncertainty principle, Nature of nuclear force, NZ graph, Liquid Drop model, semiempirical mass formula and binding energy.

Fission and fusion-mass defect, relativity and generation of energy Liquid drop model of the nucleus, Fission, Fusion and thermonuclear reactions producing stellar energy.

<u>Unit IV:</u> Radioactivity :

Stability of the nucleus, Laws of Radioactivity decay, Mean life and half life, Alpha decay, Beta decay-energy released, spectrum and Pauli's prediction of neutrino, Gamma ray emission, energy-momentum conservation, electron-positron pair creation by Gamma photons.

<u>Unit V:</u> Elementary Particles:

Fundamental particles; Discovery of Elementary particles, classifications of elementary particle (Photons, Leptons and Hadrons) strange particles, Quantum Numbers of Elementary Particles, Gell Mann-Nishijima Formula The τ-θ Puzzle. Particles and Antiparticles, Concept of Quarks, Quark structure of proton neutron and Pion.

Text and Reference book

1. Concepts of Modern Physics, Arthur Beiser, Mc Graw-Hill (2002)
2. Principle of Modern Physics, A.K. Saxena, Narosa (4^{th} Edn. 2014)
3. Introduction to Modern Physics, Ritch Meyer, Kennard and Cooper, Tata Mc Graw Hill (2002)
4. Theory and Problems of Modern Physics, Schaums outline, R. Gantreau & W. Savin, Tata Mc Graw-Hill (2^{nd} Edn.)
5. Perspectives of Modern Physics, Arthur Beiser.

B. Practical (Experiment):

1. Measurement of Planck's Constant using black body radiation and photo-detector.
2. To determine work function of material of filament of directly heated vacuum diode.
3. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of a photo-electrons versus frequency of light.
4. To determine ionization potential of Mercury (Hg)
5. To determine the wavelength of H_α emission line of Hydrogen atom.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To show the tunneling effect of tunnel diode using I-V characteristics.
8. To determine the Planck's constant using LEDs of at least 4 different colours.
9. To determine the wavelength of laser source using diffraction of single slit.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics IV SEM.
402: OPERATING SYSTEMS (Minor Core)

Learning Outcomes:

This course provide information regarding operating systems and their structure for communicating with Input-Output systems and standard case studies about design of peripherals.

SYLLABUS

Unit I: Operating Systems Overview:

Introduction to operating systems: Computer system organization, architecture: Operating system structure, operations: Process, memory, storage management Protection and security Distributed systems, Computing Environments, Open-source operating systems, OS services: User operating-system interface, System calls, System programs, OS structure: OS generation, System Boot: Process concept, scheduling: Operations on processes, Cooperating processes, Inter-process communication, Examples: Multithreading models, Thread Libraries, Threading issues, OS examples.

Unit II: Process Management:

Basic concepts: Scheduling criteria, Scheduling algorithms, Thread scheduling, Multiple processor scheduling, Algorithm Evaluation: The critical section problem Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization Critical regions, Monitors, Synchronization examples, Deadlocks, System model, Deadlock characterization, Methods for handling deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock detection, Recovery from deadlock.

Unit III: Storage Management:

Memory Management: Swapping, Contiguous memory allocation, Paging, Segmentation Example: The Intel Pentium, Virtual Memory: Background, Demand paging, Copy on write, Page replacement, Allocation of frames, Thrashing.

<u>Unit IV:</u> I/O Systems:

File concept, Access methods, Directory structure, File- system mounting, Protection Directory implementation, Allocation methods, Free-space management, Disk scheduling Disk management, Swap-space management-Protection.

<u>Unit V:</u> Case Study :

The Linux System: History, Design Principles, Kernel Modules, Process Management Scheduling, Memory management, File systems, Input and Output, Inter- process Communication, Network Structure, Security, Windows 7: History, Design Principles, System Components, Terminal Services and Fast User, File system, Networking.

Text and Reference Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 2010. 50
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.
3. D M Dhamdhere, "Operating Systems: A Concept-based Approach", Second Edition, Tata McGraw-Hill Education, 2007.
4. William Stallings, "Operating Systems: Internals and Design Principles", Seventh Edition, Prentice Hall, 2011. CS8452 S

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics IV SEM.
403: STATISTICAL AND THERMAL PHYSICS (General Elective)

Learning Outcomes:

The primary goal of thermal physics is to understand the fundamental laws of thermodynamics and its applications to various thermo-dynamical systems and processes. It also given exposure to students about the Kinetic theory of gases, phase transitions and behaviour of real gases.

The statistical mechanics deals with the derivation of the macroscopic parameters (internal energy, pressure, specific heat etc.) of a physical system consisting of a large number of particles (solid, liquid or gas) from knowledge of the understanding microscopic behaviour of atoms and molecules that comprise it. The main objective is to introduce the techniques of statistical mechanics which has applications in various fields such as Astrophysics, semiconductors, plasma physics, chemistry and many others directions.

SYLLABUS

Unit I: Zeroth and First Law of thermodynamics:

Extensive and intensive variables, Thermodynamic Equilibrium, Zeroth law of Thermodynamics & concept of Temperature, concept of work and Heat, State functions, First Law of Thermodynamics and its differential form, Internal Energy, Applications of First Law : General relation between C_p and C_v, work done during Isothermal and Adiabatic processes,

Second Law of Thermodynamics**:** Reversible and Irreversible process with examples. Conversions of work into Heat and Heat into work, Heat Engines. Carnot's cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2^{nd} Law of Thermodynamics : Kelvin Planck and Clausius statements of their Equivalence. Carnot's theorem. Applications of Second law of thermodynamics. Thermodynamics scale of Temperature and its Equivalence to perfect Gas scale.

<u>Unit II:</u> Entropy:

Concept of Entropy, Clausius Theorem, Clausius Inequality, Second Law of Thermodynamics in terms of Entropy, Entropy of a perfect gas. Principle of Increase of Entropy. Entropy changes in Reversible and in Irreversible process with examples. Entropy of the universe. Temperature-Entropy diagrams for Carnot's cycle. Third Law of Thermodynamics Unattainability of Absolute zero.

Thermodynamics Potentials**:** Thermodynamics Potentials, Internal Energy, Entropy, Helmholtz Free Energy, Gibb's Free Energy, their definitions, properties and Applications. Magnetic Work; Cooling due to adiabatic demagnetization; First and second order phase transmissions with examples, Clausius Clapeyron Equation and Ehrenfest equations.

Maxwell's Thermodynamic Relations: Derivation of Maxwell's thermodynamic Relations and their applications. Maxwell's Relations : (1) Clausius Clapeyron equation, (2) Valve of C_p-C_v, (3) Tds Equation, (4) Energy equations.

<u>Unit III:</u> Kinetic Theory of Gases:

Distribution of Velocities : Maxwell-Boltzmann Law of distribution of velocities in an ideal gas and its Experimental verification. Mean, RMS and Most probable speeds. Degrees of Freedom. Law of Equipartition of energy (No proof required). Specific Heat of Gases.

Real Gases: Behaviour of Real Gases; Deviation from the Ideal Gas Equation. Virial Andrews Experiments on CO_2 gas. Virial equation. Critical constants. Continuity of Liquid and gaseous state. Vapour and Gas. Boyle temperature. Vander Waal's Equation of state for real Gases. Values of critical constants. Law of corresponding states. Comparison with Experimental curves. p-V diagrams.

Free Adiabatic Expansion of a perfect Gas, Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for real and Vander Waals Gases, Temperature of Inversion.

<u>Unit- IV:</u> Classical statistics:

Macrostate and Microstate, Phase space, Elementary concept of Ensemble, Entropy, Linear Harmonic Oscillator as an Example of phase space, The phase space and Quantum states. Microcanonical, Canomical and Gandcanonical Ensembles, The Thermodynamic probability and Expression for Thermodynamic probability, Intensive and Extensive parameters, Boltzmann Theorm and statistical interpretation of Entropy, Maxwell-Boltzmann distribution Law, partition function. Entropy of a perfect Gas in Microcanonical Ensemble, Gibbs paradox, Sackur Tetrode equation.

<u>Unit V:</u> Statistics:

B-E distributions law, Thermodynamics functions of a strongly Degenerated Bose Gas, Bose-Einstein condensation, Black Body Radiation (Photon Gas), Derivation of Planck's Radiation Law.

Fermi-Dirac Distributions Law. Thermodynamics Functions of a strongly Degenerate Fermi-Gas, Fermi Energy, Electron Gas in a Metal Richardson-Dushmanm Equation for Thermionic Emission, Pauli Paramagnetism.

Text and Reference book:

1. Heat Thermodynamics & Statistical Physics, Brij Lal and Subrahmanyan, S. Chand (1st Edn. 2008)
2. Heat and Thermodynamics, A.K. Saxena and C.M. Tiwari, Narosa
3. Heat and Thermodynamics, M.W. Zemansky Mc Graw-Hill (1981)

4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger, Narosa (1998).

5. An Introduction to Thermodynamics and Statistical Mechanics, A.K. Saxena, Narosa (2010)

6. A treatise on Heat, M.N. Saha and B.N. Srivastava.

7. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann, Oxford University Press (2^{nd} Edn. 1996).

8. Statistical Physics, Reif

9. Statistical Physics, F. Mandl, Wiley (2^{nd} Edn. 2003)

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics IV SEM.
404: INTRODUCTION TO COMPUTER AND PC SOFTWARE
(General Elective)

Learning Outcomes:

The aims of this course is to make students aware about computer anatomy and characteristics of peripheral devices with operating systems and use of PC package in Physics/ science and communicate with internet

SYLLABUS

Unit I: Introduction to Computers:

Computer system characteristics and capabilities, types of computers, Introduction to IBM PC, Input Devices, Keyboard, Scanner and Mouse, Output Devices Impact and nonimpact printers, DMP, inkjet, Laser Printers, Storage Devices, Floppy Disks, Hard disk, CD-ROM, Introduction to Windows XP. Control Panel & Accessories.

Unit II: Windows-Operating System:

Operating system and operating environment, Graphic user interface, Documents, Drives, My Computer, Setting: Control Panel & control switches, taskbar & printers, Display properties: Background and screensaver; Recycle bin, Icon & icon creation. Shortcut to programs, basic of folder and files, concept of CUT, COPY, PASTE; Clipboard, Window Explorer, Paint and word pad facility.

Unit III: MS-Word:

Introduction to MS- OFFICE & MS- WORD, Concept of File Toolbar & active window, formatted output: Font & Font size, page setup, alignment, bold, italic & underline, Paint and word pad facility.

<u>Unit IV:</u> MS Excel:

Introduction to MS Excel, concept of file, charts, macros, forms, spreadsheet, cell toolbar and active window, row, column, Expressions and formulas, Data manipulation, filtering of data, use of financials and statistical functions.

<u>Unit V:</u> Power Point:

Elementary idea of Power Point, Presentation in Power Point, Presentation type, output, presentation style, presentation option, On Screen presentation, view Slides, Rehearse Timing, different types of slides and Slides making, setup shows.

Internet: Introduction of Internet, History, Advantages & Disadvantages, Uses, Browsers, Search Engine, Using Internet.

Text and Reference book:

1. Fundamental computer : Nitin K. Naik.
2. V.K. Jain : Fundamental of Computer.
3. Raj Kamal, internet & Web Design, Tata Mc Graw hill
5. PC-Software : R.K. Taxali.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics V SEM.
501: SOLID STATE PHYSICS (Major Core)

Learning Outcomes:

The syllabus gives an introduction to the basic phenomena in Solid State Physics. This aims to provide a general introduction to theoretical and experimental topics in solid state physics. On successful completion of the module, students should be able to elucidate the main features of crystal lattices and phonons, understand the elementary lattice dynamics and its influence on the properties of materials, describe the main features of the physics of electrons in solids; explain the dielectric, ferroelectric and magnetic properties of solids and understanding the basic concepts in superconductivity.

SYLLABUS

A. Theory

Unit I: Crystal structure of solids:

Amorphous and crystalline materials, Lattice Translation vector, Lattice with a Basis, unit cell, primitive cell, symmetry elements in crystals, simple cubic, BCC and FCC structures NaCl, CsCl and diamond structures, Miller Indices, reciprocal Lattice Wigner Seitz cell and Brillouin Zone, Diffraction of X Rays properties of reciprocal Lattice, Braggs law, Braggs Law in Reciprocal Lattice, Laue condition, Atomic Scattering Factor, Geometrical structure factor.

Unit II: Elementary Lattice Dynamics:

Lattice vibrations and phonons, Linear Monoatomic and Diatomic chains (Acrostic and Optics Branches) Dulong and Petits Law. Einstein and Debye theories of specific heat of solid, T^3 Law.

Unit III: Electrons in Solids:

Electronics in metals, Drude Model, Density of states, Fermi Energy and Fermi level, Elementary Band Theory, Energy Bands in Diamond Bloch Theorem Kronig Penney model, Effective Mass, Hall effect in metals and mobility, concept of Holes, Hall effect in semiconductors.

Unit IV: Magnetic and Didectric Properties:

Dia-, Para-, Ferri- and Ferromagnetic materials, classical Langevin theory of dia- and para- magnetism, Quantum mechanical treatment of Paramagnetism, Curie- and Weiss law, Weiss theory of Ferromagnetism, Ferromagnetic Domains, B-H curve & Hysteresis. Antiferromagnetism.

Polarization, Macroscopic Dielectric constant, Molecular Polarizability Mechanism of polarization, The static Electronic polarizability of Atoms, Ionic and Dipolar Polarizability, Depolarization Field, Molecular Field in a Dielectric, Clausius-Mossotti Equation, permanent polarization and Ferro-electricity, Ferroelectric dominants. Antiferroelectricity, Piezoelectricity, Debye Equations.

Unit V: Superconductivity:

experimental results of K, Onnes, critical Temperature, Isotope Effect. Critical Magnetic Field, Meissner Effect. Specific Heat Density of States and Energy Gap. London equations and Penetration Depth, Coherence Length, Type I and Type II superconductors. The Mixed State in Type II superconductor. Gnzberg-Landau Theory, The Bardeen-Cooper Schrieffer Theory (Qualitative Ideas only) DC- and AC- Josephson Effects, Applications of superconductivity.

Text and Reference book:

1. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd. (8^{th} edition 2004)
2. Introduction to Solids, Leomid V. Azaroff TMH (2004).
3. Solid State Physics, Ashcroft and Mermin, Cengage Learning (1976).
4. Solid State Physics, Ajay Kumar Saxena, Trinity Press (Laxmi Publication) (3^{rd} Edn. 2014)

Practical (Experiments):

1. Measurement of susceptibility of paramagnetic solutions (Quincks Tube Method)
2. To measure the Dielectric constant of a dielectric material with frequency.
3. To determine the Half coefficient of a semiconductor sample.
4. To measure the resistivity of a semiconductor (Ge) with temperature by two probe method and to determine its band gap.
5. To study the PE Hysterisis lop of a Ferroelectric crystal.
6. To draw the BH curve of Fe using Solenoid and determine energy loss from Hysterisis.
7. To determine the refractive index of a dielectric using SPR technique. (Surface Plasmon Resonance).
8. To determine the coupling coefficient of a piezoelectric crystal.
9. Measurement of change in resistance of a semiconductor with magnetic field.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics V SEM.
502: QUANTUM MECHANIS-I (DSE)

Learning Outcomes:

In continuation with modern physics, this course is an application of Schrodinger equation to various quantum mechanical problems. This gives fair idea of formulation of eigenvalues and enginfunctions, operator formalism, and atoms in electric and magnetic fields.

SYLLABUS

Unit I: Time dependent Schrodinger Equation:

The wave Function and Necessity to associate a wave function with a particle, conditions to be satisfied by a wave function, Normalization, Time dependent Schrodinger Equation, Position Momentum and Energy operators, Eigenvalues and Eigenfunctions, expectation values, probability current density, wave function of a Free Particle.

Unit II: Time Independent Schrodinger Equation & Wave Packets:

Hamiltoman, stationary states and energy Eigenvalues expansion of an arbitrary wave function as a linear combination of energy eigenfunctions. Fourier transform of a wave functions (no derivation required) a localized wave packet, Group velocity of a wave packet, constructions of a wave packet, the Gaussian wave packet.

Solution of Schrodinger Time Independent Equation for some Bound States:

(1) A free particle in a Box

(2) Practical in a Box : Momentum Quantization

(3) Infinite square potential well

(4) A Potential step

(5) Potential Barrier (Tunnelling)

(6) The Harmonic Oscillators Ehrenfest Theorem, Schwartz Inequality and Derivation of Uncertainty Principle

Unit III: Quantum Theory of Hydrogen-like Atoms:

Schrodinger Equation in spherical co-ordinate (no derivation) solution by separation of Variables (Radial and Angular Parts), The ground state of the H-atom. Discussion of Hydrogen-Like Radical Functions, The Four Quantum Numbers, The Radial Motion of the Electron and orbital quantum number.

Unit IV: Operator Formalism:.

What is an operator?, Basic properties of operators, Linear operators, Operator Postulate; simple operators in Quantum Mechanics (Position, Momentum, Angular Momentum and Energy), Commentator, Adjoint operators, Hermitian operator, self adjoint operator, Orthogonality and orthonormality, Dirac Notation, Need for a Dual space. Solution of simple Harmonic Oscillator problems using Raising and Lowering operators.

Unit V: Atoms in Electric and Magnetic Fields:

Stern Gerlach Experimental and Spin Electron angular momentum and spin Angular Momentum, Larmor theorem, spin magnetic moment, normal Zeeman Effect.

Many Electron Atoms**:** Symmetrical and Anti-symmetric wave Functions, spin-orbit coupling spectral Notations for Atomic States, Total Angular Momentum, L-S and J-J coupling spin-orbit coupling in atoms.

Text and Reference Book :

1. Quantum Mechanics, L.I. Schiff, Tata Mc Graw Hill (3rd Edn. 2010)
2. A Text Book of Quantum Mechanics P.M. Mathews and K. Venkatesan, Mc Grew Hill, (2nd Edn 2010).
3. Introduction to Quantum Mechanics, D.J. Girffith, Pearson (2nd Edn.2005)
4. Text Book of Quantum Mechanics, A.K. Saxena, CBS, Delhi.
5. Quantum Mechanics: Concepts and Applications, A.K. Saxena, IK international.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics V SEM.

503: COMPUTER PROGRAMMING METHODOLOGY (SEC)

Learning Outcomes:

This course will enable the students:

1. Learn to develop simple algorithms and flow charts to solve a problem.

2. Write programs to learn the use of strings and string handling operations.

3. Learn problems which can effectively demonstrate use of Arrays, structures and Union.

4. Write programs using pointers

5. Write programs to use files for data input and output

6. Write Programs to t implement search algorithms.

SYLLABUS

UNIT I:

Introduction to Programming Program Concept, Characteristics of Programming, Stages in Program Development, Conceptual Framework of programming languages, Algorithms, Notations, Design, Flowcharts, Types of Programming Methodologies, Introduction to C++ Programming-, Basic Program Structure In C++, Variables and Assignments, Input and Output, Selection and Repetition Statements.

UNIT II:

Top-Down Design, Predefined Functions, Programmer-defined Function, Local Variable, Function Overloading, Functions with Default Arguments, Call-By- Value and Call- By- Reference Parameters, Recursion. control statements, string and String handling functions.

UNIT III:

Introduction to Arrays, Declaration and Referring Arrays, Arrays in Memory, Initializing Arrays, Arrays in Functions, Multi- Dimensional Arrays.

UNIT IV:

Structure Member Accessing, Pointers to Structures, Structures and Functions, Arrays of Structures, Unions.

UNIT V:

Declaration and Initialization, Reading and Writing Strings, Arrays of Strings, String and Function, Strings and Structure, Standard String Library Functions, Searching Algorithms- Linear Search, Binary Search, Use of files for data input and output, merging and copy files.

Text and References books:

1. Problem solving and Program design in C, J.R. Hanly and E.B. Koffman, Pearson, 2015

2. Programming and problem solving with C++: brief edition, N. Dale and C. Weems. Jones & Bartlett Learning, 2010.

504 : Project or internship

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VI SEM.

601: ELECTROMAGNETIC THEORY (Major Core)

Learning Outcomes:

This is a core course in B.Sc (Honours) physics curriculum. The course covers Maxwell's equations, propagation of electromagnetic (e.m.) waves in different homogeneous-isotropic as well as anisotropic unbounded and bounded media, production and detection of different type of polarized em waves, general information of wave guides and fibre optics.

SYLLABUS

A. Theory

Unit I: Maxwell Equations:

Review of Maxwell's equations Displacement current, Vector and scalar potentials, Gauge Transformations : Lorentz and Coulomb Gauge, Wave Equations; Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector, Electromagnetic Energy Density; Physical Concept of Electromagnetic Field, Energy Density; Momentum Density.

Unit II: EM Wave Propagation in Unbounded Media:

Plane EM Wave thought vacuum and isotropic dielectric medium, transverse nature of plane EM Wave, refractive index and dielectric constant, wave impedance, Propagation through conducting media relaxation time, skin depth. Wave propagation thorugh dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

Unit III: EM Waves in Bounded Media:

Boundary conditions at a plane interface between two media. Reflection and Refraction of plane waves at plane inference between two dielectric media- Laws of Reflection and Refraction. Fresnel's formulae for perpendicular &

parallel polarization cases, Brewster's law, Reflection & Transmission coefficients. Total internal reflection, Metallic reflection (normal internal).

Unit IV: Polarization of Electromagnetic Waves:

Description of Linear, Circular and Elliptical Polarization, Propagation of EM waves in Anisotropic media. Fresnel's formula, Uniaxial and Biaxial crystals; Light propagation in uniaxial crystal, Double Refraction, Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly, and Elliptically Polarized Light. Phase Retardation plates (Quarter-Wave and Half-Wave Plates). Babinet compensator and its uses Analysis of Polarized Light.

Rotary Polarization**:** Optical Rotation, Biot's Laws for Rotary Polarization. Fresnel's Theory of optical rotation. Experimental verification of Fresnel's theory, specific rotation Laurent's half- shade Polorimetre.

Unit V: Wave Guides:

Type of Propagation : TM, TE and TEM Modes, Mathematical Analysis of Rectangular wave-guide, propagation of TM waves in Rectangular wave-guide, propagation, properties and cut off frequencies. Field distribution; TE waves, lmpossibility of TEM waves in Hollow Rectangular Wave Guide. Cut off wavelength and wave lmpedance.

Optical Fibres**:** Advantage of Optical Fibre over wire system, Basic structure of an optical fibre and propagation of light waves through it, stepped index and Graded index Fibre, Ray propagation in an optical fibre. Waveguide Equations for an optical fibre.

Text and Reference Book:

1. Introduction to Electrodynamics, D.J. Griffiths, Benjamin Cummings (3rd Edn. 1998).
2. Classical Electrodynamics, J.D. Jackson, Wiley (3rd Edition 2010).
3. Principle of Optics, M. Born and E. Wolf, Pergamon Press, (6th Edition 1980).

4. Electromagnetic Theory and Applications, A.K. Saxena Narosa (2009)
5. Engineering Electro-magnetics, William H. Hayt, Mc Graw Hill (8th Edition 2012)
6. Fundamental of Electromagnetics, M.A. Wajed Miah, Tata Mc Graw Hill (1982)
7. Electromagnetics, J.A. Edminster, Schaum Series, Tata Mc Graw Hill (2006)

Practicals (Experiments):

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using polarimeter.
3. To study the reflection, refraction of microwaves.
4. To determine the refractive index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
5. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
6. To verify the Stefan's law of radiation and determine Stefan's constant.
7. To analyze elliptically polarized light by using a Babinet's compensator.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine Boltzmann constant using V-I characteristics of PN junction diode.
10. To verify Brewster's law and to find the Brewster's angle.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VI SEM.
602: QUANTUM MECHANICS-II (DSE)

Learning Outcomes:

This syllabus is in continuation of quantum mechanics-I and is an advanced course in quantum mechanics which presents the students approximation methods, (where problems cannot be solved exactly by directly using the Schrodinger's equation), such as time independent and time dependent perturbation theory, variation method, and WKB method. The syllabus also deals with the theory of scattering, the relativistic theory (where we have to consider the effect of speeds approaching that of light (c)) and the Aharonov Bohm effect, which shows that (for local effects), in presence of em fields, it is the electromagnetic and not the fields that are of importance in quantum mechanics.

SYLLABUS

Unit I:

Approximation method for bound states, Rayleigh-Schrodinger Perturbation theory of non-degenerate and degenerate levels and their application to perturbation of an oscillator normal helium atom and first order Stark effect in hydrogen, W K B Approximation method, connection formulae, ideas on potential barrier with applications to theory of alpha decay.

Unit II:

Time dependant perturbation theory: Methods of variation of constants and transition probability, adiabatic and sudden approximation, wave equation for a system of charged particles under the influence of external electromagnetic field, absorption and induced emission, Einstein's A and B coefficients and transition probability.

Unit III:

Theory of Scattering, Physical concepts, scattering amplitude, scattering cross section. Born Approximation and partial waves, scattering by perfectly rigid sphere, complex potential and absorption, scattering by spherically symmetric potential.

Unit IV:

Schrodinger's relativistic equation (Klein- Gordon equation), Probability and current density, Klein-Gordon equation in presence of electromagnetic field, hydrogen atom, short comings of Klein-Gordon equation, Dirac's relativistic equation for free electron, Dirac's Matrices. Dirac's relativistic equation in electromagnetic field, negative energy states and their interpretation.

Unit V:

Aharonov-Bohm experiment, variational method. Applcation to H-atom and H_2^+ ion, Hydrogen molecule, Partial waves, Determination of phase-shifts, Hard sphere scattering, Low energy scattering,

Text and Reference Books:

1. LI Schiff, Quantum Mechanics
2. S. Gasiorowicz , Quantum Physics
3. B. Craseman and J J Powell, Quantum Mechanies (Addison Wessley)
4. A. Messiah, Quantum Mechanics
5. J.J. Sakurai, Modern Quantum Mechanics
6. Mathews and Venkatesan, Quantum Mechanics
7. A.K. Ghatak and Loknathan, Quantum Mechanics
8. A.K. Saxena Textbook of Quantum Mechanics (CBS)
9. Quantum Mechanics, Concepts and Applications, A.K. Saxena, IK International.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VI SEM.

603: LASER PHYSICS (DSE)

Learning Outcomes:

Student shall understand through this course about concepts of laser and their application in development of lasing systems. Also, students shall learn about basic concept of non-linear optics for laser technology.

SYLLABUS

Unit I: Basic principles of laser:

Introduction to laser, spontaneous and stimulated emission, Einstein coefficients. Idea of light amplification. Population inversion, laser pumping schemes for two and three level system with threshold condition for laser oscillation.

Unit II: Properties of Laser Beams and Resonators:

Properties of Laser Temporal coherence, spatial coherence, directionality and monochromatic of laser beam, resonators, vibrational mode of resonators, laser amplification, open resonator.

Unit III: Types of lasers:

Solid state lasers i.e. Ruby Laser, Nd- Yag Laser, Semiconductor laser, Gas laser i.e. Carbon dioxide Laser, He- Ne Laser, Basic idea about liquid laser, Dye laser and chemical laser i.e. HCl and HF lasers.

Unit IV: Application of Lasers:

Holography and its principle, theory of holograms, reconstruction of image, characteristics of Holographs, Application of lasers in chemistry and optics, laser in Industry i.e. laser welding. Hole drilling, laser cutting, applications of lasers in medicine.

Unit V: Basic idea about non-linear optics:

Harmonic generation, second and third harmonic generation, phase matching, optical mixing, parametric generation of light, self- focusing of light.

Text and References Books:

1. Laser-Swelto

2. Optical electronics- Yarive

3. Laser spectroscopy Demtroder

4. Laser spectroscopy and Instrumentation Demotroder

5. Molecular spectroscopy- King

6. Non linear optics by B.B. Laud

604: Project/ Internship

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VII SEM.

701: COMMUNICATION SYSTEM (Major Core)

Learning Outcomes:

This paper aims to describe the concepts of electronics in communication. Communication techniques based on Analog Modulation, Analog and digital Pulse Modulation including PAM, PWM, PPM, ASK, PSK, FSK are described in detail. Communication and Navigation systems such as GPS and mobile telephony system are introduced.

SYLLABUS

A. Theory

Unit-I: Electronic communication:

Introduction to communication-means and modes. Need for modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage, Channels and base-band signals.

Unit-II: Analog Modulation:

Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single Side Band generation and detection, Frequency Moltulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver.

<u>Unit-III:</u> Analog Pulse Modulation:

Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

Digital Pulse Modulation: Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

<u>Unit-IV:</u> Introduction to Communication and Navigation systems: Satellite Communication

Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C-Band), path loss, ground station, simplified block diagram of earthstation. Uplink and downlink.

<u>Unit-V:</u> Mobile Telephony System

Basic concept of mobile communication, frequency bands used in mobile communication, concept of cell sectoring and cell splitting. SIM number, IMEI number, need for data encryption, Architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only), GPS navigation system (qualitative idea only).

Text and Reference Books:

1. Electronic Communications, D. Roddy and J. Conlen, Pearson Education India.
2. Advanced Electronics Communication Systems Tomasi, 6th edition, Prentice Hall.
3. Modern Digital and Analog Communication Systems, B.P. Lathi 4th Edition, 2011 Oxford University Press.

4. Electronic Communication systems, G. Kennedy, 3rd Edn, 1999, Tata McCaw Hill.

5. Principles of Electronic communication systems- Frenzel, 3rd edition, McGraw Hill.

6. Communication Systems, S. Haykin, 2006, Wiley India

7. Electronic Communication system, Blake, Cengage, 5th edition

8. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Pres

B. Practicals (Experiments):

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM- Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Text and Reference Books:

1. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.

2. Electronic Communication Blake, Cengage 5th Edn.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VII SEM.
702: RESEARCH METHODOLOGY (Minor Core)

Learning Outcomes:

This paper aims to describe the concept of Research in Physics based on the different Mathematical, Statistical and Theoretical modelling methods including XRD, SEM, NMR etc. Ground based and Satellite observations and Simulation techniques related to general physics problem.

SYLLABUS

Unit I: Concepts in Research:

Definition and Objective, Research Approach & Types of Research, Criteria of Good Research, Defining Research Problems. Research Design: Features of Good Research Design, Research Design with reference to Physics, Basic Principles of Experimental Research Designs. Structure and components of scientific presentations, Research reports/ paper etc.

Unit II:

Nature and Purpose of Mathematical Statistics, Tabulation and Statistical Inference, Tabular and Graphical Representation of Data, Mean, Median, Mode & Variance, Co-relation and Regression, Random Sampling, X^2-Test, Method of Least squares curve, Fitting of Straight Lines & Polynomials, Data analysis using Fourier Techniques and applications.

Unit III:

Theoretical Modelling Methods: Bisection Method, General Idea of Mathematical Modelling and Simulation- Random Walk Problem, Newton Raphson Method, Least Square Fitting of Linear and Exponential Functions, Numerical Differentiations & Integration. Simpson's Rule, Runga Kutta Method.

Unit IV:

General Idea of Preparation of Materials: Solid State Reaction Method and Wet Chemical Method, Electro Deposition Methods (Basics only), Elementary Idea of Vacuum Coating Methods, Basic Principles & Applications of XRD, SEM, and NMR. Methodology of Space Research Ground Based & Satellite Observations, Nuclear Detectors, Methods of Extracting Scientific Information from Space Data.

Unit V:

Simulation techniques related to general physics. Physics of a body that falls freely in viscous medium, physics of two dimensional motions: Projectiles objects thrown horizontally, Physics of motion of a satellite, Physics of oscillatory motion. Ideal simple harmonic oscillator damped oscillator forced oscillations, nuclear Radioactivity: simulation of Radioactivity.

Text and Reference Books:

1. Research Methodology: Methods & Techniques: C.R. Kothari, New Age International Publisher, N. Delhi (2009).
2. How to Write and Publish: R.A. Dayand, B. Gastel, Cambridge University Press.
3. How to Research: L., Blaxter, C. Hughes and M. Tight Viva Books.
4. A Student Guide to Methodology: P. Clough &, C. Mutbrown, Sage Publications.
5. Fundamentals of Computers: V. Rajaraman (PHI)
6. Probability & Statistics For Engineers & Scientists: Shelder Ren Elsevier Academic Press.
7. Principles of Instrumental Analysis: Skoog & Leary.
8. Astronomy: Baker
9. Phydser through C- programming: S. Palaniswamy.

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VII SEM.
703: NANOMATERIALS (DSE)

Learning Outcomes:

This course introduces the essence of nano materials, their synthesis, and characterization. On successful completion of the module, students should also be able to understand the optical properties and electron transport phenomenon in nanostructures. It also covers few important applications of nano materials used in this technological era.

SYLLABUS

Unit I: Nanoscale Systems:

Density of states (1-D, 2-D, 3-D). Length scales in physics, Nanostructures: ID, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems, Applications of Schrodinger equation-Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, ID nanostructures and its consequences.

Unit II: Synthesis of Nanostructure Materials:

Metals, Metal Oxide, Carbon based nanomaterials CNT, C_{60}. graphene. Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, Chemical vapor deposition (CVD).Sol- Gel. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods, MBE growth of quantum dots.

Characterization:

X- Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy, Atomic Force Microscopy. Scanning Tunneling Microscopy.

<u>Unit III:</u> Optical Properties:

Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi- particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi- particles and excitons, charging effects. Radiative processes: General formalization- absorption, emission and luminescence. Optical properties of heterostretures and nanostructures.

<u>Unit IV:</u> Electron Transport:

Carrier transport in nanostructures, Coulomb blockade effect, thermionic emission, tunneling and hopping conductivity. Defects and impurities: Deep level and surface defects.

<u>Unit V:</u> Applications:

Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots-magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

Text and Reference Books:

1. C.P. Poole, Jr. Frank J. Owens Introduction to Nanotechnology (Wiley, India)
2. S.K. Kulkarni, Nanotechnology, Principles & Practices (Capital Publishing company)
3. K.K. Chattopadhyay and A.N. Banerjie Introduction to Nanoscience and Technology (PHI Learning)
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley)

704: Project/Internship

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VIII SEM.
801: NUCLEAR AND PARTICLE PHYSICS (Major Core)

Learning Outcomes:

1. *Understand the basic nuclear properties and phenomena.*
2. *Understand the nuclear transformations.*
3. *Understand the nuclear reactions mechanism.*
4. *Understand about the elementary particles and their quantum number.*
5. *Understand accelerator technology applied to high energy physics*.

A. SYLLABUS

Unit I: Nuclear Interaction and Nuclear reaction:

Nuclear forces, exchange and tensor forces, meson theory of nuclear forces, Low-energy n-p scattering and spin dependence of n-p forces. Direct and compound nuclear reaction mechanism, reciprocity theorem.

Unit II: Accelerators of charged particles:

Study of cyclotron, phase stability, frequency modulated cyclotron (synchorocyclotron) magnetic induction accelerator (Betatron), Electron synchrotron and linear accelerator (Linac),

Unit III: Nuclear models:

Liquid drop model, Bohr-Wheeler's theory of nuclear fission, shell model, spin orbit interaction, magic number, spin and angular momenta of nuclear ground state, nuclear quadrupole moment.

Unit IV: Nuclear decay and elementary particles:

β Decay, general features of β ray spectrum, Fermi theory of β decay, selection rules, parity in β decay, multipole radiation, internal conversion, nuclear isomerism.

<u>Unit V:</u> Elementary particles:

Classification of elementary particles, fundamental interaction, parameters of elementary particles. Symmetry and conservation laws, symmetry schemes of elementary particles SU (3).

B. TUTORIALS:

Text & Reference Books:

1. Introduction to Nuclear physics: H.A. Enge
2. Nuclear radiation detectors: S.S. Kapoor and V.S. Ramamurthy
3. Atomic and Nuclear Physics: S.N. Ghoshal
4. Nuclear and Particle Physics: D.C. Tayal
5. Nuclear Physics: R.C. Sharma
6. Introduction to Nuclear Physics: Krane
7. Nuclear physics Principles & Application: Lilley

DEPARTMENT OF PHYSICS

AWADHESH PRATAP SINGH UNIVERSITY REWA (M.P.)

B.Sc. (Hons.) Physics VIII SEM.
802: ADVANCED EXPERIMENTAL TECHNIQUES (Minor Core)

Learning Outcomes:

1. *Capability of students in experiments as tools for research activities shall be developed.*

2. *Various types of analylitical techniques would be learned by the students like, nuclear techniques, Condensed matter techniques and spectroscopic techniques.*

SYLLABUS

Unit I:

Radiation sources, Radiation interactions, Radiation detectors-gas filled detectors-scintillation detectors-semiconductor detectors

Unit II:

Introduction to production of X-ray & X-ray spectra, Instrumentation, X-ray generation, collimators, filters, detectors, X-ray absorption methods, X-ray fluorescence methods, XF-Spectrometer (XFS), Electron spectroscopy for chemical analysis (ESCA)

Unit III:

Nuclear Magnetic Resonance (NMR) spectroscopy, basic principles, nuclear magnetic energy levels, magnetic resonance, NMR Spectrometer Electron Spin Resonance spectroscopy, ESR spectrometer, ESR spectra, Hyperfine interactions.

Unit IV:

Mass spectroscopy-principle, spectrometer, and its operation, resolution, Mass spectrum, applications Infrared Spectroscopy, correlation of IR spectra with molecular structure, Instrumentation

Unit V:

Mossbauer Spectroscopy-Mossbauer effect, spectrometer, 57 Fe Mossbauer spectroscopy, nuclear hyperfine interactions Neutron diffraction, neutron diffractometer (position sensitive diffractometer)

Text and Reference Books:

1. Instrumentation Methods of analysis: VII Edition, Willard Meritt, Dean, Settle, CBS publishers & distributors.
2. Mossbauer Spectroscopy: Leopold May, Plenum Press, N.Y.
3. Neutron Diffraction: G.C. Becon.
4. X-Ray diffraction: B.D. Culity, Edison Weseley.
5. Radiation Detection & Measurement: Glenn F. Knoll, McGraw Hill

803: Project/Internship