Department of PHYSICS

School of Mathematical and Physical Science

Curriculum Framework Master of Science

In

(M.Sc.) Physics

Based on National Education Policy- 2020

Date of BoS 16/09/2022

Doctor Harisingh Gour Vishwavidyalaya
(A Central University)
Sagar-Madhya Pradesh-470003

Brief Introduction of the Department :

The Department of Physics was established in the year 1946 by Prof. D.R. Bhawalkar, who had studied at King's College, the University of London under the able guidance of Nobel Laureate Sir O.W.R. Richardson. He was known as the father of Luminescence. He remained the Head of the Department of Physics until 1969. It is the pioneer teaching and research department of India. In its 75 years of old history, the department has produced scores of scholars who have won laurels for themselves at both international and national levels.

Physics is the science of nature dealing with the whole universe. It mainly involves the study of matter, energy, and their interactions. Other sciences are reliant on the concepts and techniques developed through physics. Physics extends and enhances our understanding of other disciplines, such as; agricultural, chemical, biological, environmental sciences, astrophysics and cosmology, statistics, sociology, etc. which are subjects of substantial importance to all people of the world.

The department keeps itself alive with regular academic activities like seminars, workshops, conferences. It is well equipped with advanced and sophisticated instruments and laboratories. Faculty members have liaisons with research institutions of repute in India and abroad.

Post Graduate Curriculum Framework for Master of Science (M.Sc.) in Physics :

1. Name of the Programme : Master of Science (M.Sc.) in Physics

2. About the Programme : The Department of Physics offers a two year's post graduate course

(four Semesters) leading to Master of science Degree in Physics

Vision

Establish a platform for the dissemination and creation of knowledge through teaching and research in Physics at various levels. Further, it helps create a scientific society that encourages logical thinking. Physics portraits the landscape of life and this department looks forward to exploring the physics lying beneath our observations.

Mission

- To offer state-of-the-art Academic Programs in Physics and in interdisciplinary areas.
- To create intellectual property through innovations, quality research publications, and patents.
- To evolve strategies in the Department for continuous Improvement.
- Providing an exciting learning opportunity for non-physics and non-science majors that provides a basic understanding of physics and problem-solving skills.
- Maintaining a research environment, in which key scientific and technical innovation are generated.
- Providing undergraduate and master's student's research experience, through which they contribute the scientific enterprises.
- Maintain a healthy level of external research funds allowing us to provide financial support for the Ph.D. students during their thesis research and prepare them for academic, research, and industrial careers.

- Having faculty brings exciting and current research perspectives to the classroom

Objectives:

- To motivate students towards research in Physics as well as in interdisciplinary areas.
- To carry out high-quality scientific research in wide areas of Physics.
- To carry out research through collaboration with researchers of other reputed academic institutions of India and abroad.
- To bring externally sponsored funds in order to strengthen laboratory facilities and support doctoral students.
- To organize outreach activities to promote scientific culture.
- To realize the advancement of teaching and learning and discover new layers of knowledge in Engineering Physics by providing the right academic ambiance.
- To promote the department as a center of excellence.

1. Structure of the Programme:

Curriculum Framework
Syllabus – M.Sc. (Physics) 2022-23
L-8 (I & II Semester)

I-Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	Credits
L-8 I Semester	Discipline Specific: Major- 1	PHY-DSM- 121	Mathematical Physics	100	4
	Discipline Specific: Major- 2	PHY- DSM -122	Classical Mechanics	100	4
	Discipline Specific: Major- 3	PHY-DSM -123	Atomic, Molecular and Laser Physics	100	4
	Discipline Specific: Major- 4	PHY-DSM -124	Digital Electronics and Operational Amplifier	100	4
	Discipline Specific: Major- 5	PHY-DSM- 125	Laboratory Course	100	4
	Multi Discipline Major - 1	PHY-MDM- 126	Hands on Workshop Training	100	2
	Skill Enhancement Course	PHY-SEC- 127	Seminar	100	2
				Total Credit s	**24**

II-Semester

Level / Semester	Nature of Course	Courses Code	Course Title	MM	Credits
L-8 II Semester	Discipline Specific: Major- 1	PHY-DSM- 221	Quantum Mechanics	100	4
	Discipline Specific: Major- 2	PHY- DSM -222	Classical Electrodynamics	100	4
	Discipline Specific: Major- 3	PHY-DSM -223	Condensed Matter Physics	100	4
	Discipline Specific: Major-4	PHY-DSM -224	Electronics Devices	100	4
	Discipline Specific: Major- 5	PHY-DSM- 225	Laboratory Course	100	4
	Multi Discipline Major - 1	PHY-MDM- 226	Digital communication Skills Development	100	2
	Skill Enhancement Course	PHY-SEC- 227	Seminar	100	2
				Total Credit s	**24**

First Semester
Discipline Specific: Major-1
PHY-DSM-121 – Mathematical Physics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -1	**PHY-DSM-121**	**Mathematical Physics**	**4**

Course Learning Objectives:

Students will learn the basics of differential equations and various mathematical functions and can solve mathematical problems used in different branches of Physics and Engineering.

Unit wise Learning Outcomes :

Upon successful completion of the course, the student:

UO1: Will understand second order differential equations, series expansion, Legendre and Bessel equations and their application.

UO2: Will have knowledge about Laplace transform, Fourier transform and transform of delta functions and their uses.

UO3: Will understand non-homogeneous boundary value problems, Green's function and expansion of Green's function.

UO4: Will understand Green's function for electrostatic boundary value problems. Students will have idea about complex variables and Cauchy Riemann equations.

UO5: Will have knowledge about Cauchy theorem, various series like Taylor, Maclaurin and Laurent series. Students will be able to solve contour integration using theorem of residues.

UNIT – I

Differential equations and special functions: Second order linear ODEs with variable coefficient, solutions by series expansion; Legendre, Bessel equations, generating functions, recursion relations. **(Lectures – 12)**

UNIT – II

Integral Transforms: Laplace transforms, first and second shifting theorems, Inverse LT by partial fractions, LT of derivatives, and integral of functions, Fourier transform, Fourier Integral and transform of delta functions. **(Lectures – 12)**

UNIT – III

Green's functions: Non- homogenous boundary value problems, Green's function for one dimensional problem, Eigen function expansion of Green's function. **(Lectures – 12)**

UNIT – IV

Green's function for electrostatic boundary value problems and quantum mechanical scattering problem. **Complex Variables:** Analyticity of complex functions, Cauchy Riemann equations.

(Lectures – 12)

UNIT – V

Couchy theorem, Cauchy integral formula, Taylors, Maclaurin, Laurent series. Theorem of residues, simple cases of contour integration, Jordan's lemma. **(Lectures – 12)**

Essential Readings:

1. Mathematical Methods for Physicists – G.B. Arfken & H.J. Weber, ELSEVIER Academic Press
2. Applied Mathematics for Engineers and Physicists – LA Pipes – II ed. McGraw Hill Book Company
3. Mathematical Physics – Satya Prakash –Sultan Chand and Sons,5 Ed. revised New Delhi, 2011.

Suggested Readings:

4. Mathematical Physics –B.S. Rajput, 10th Ed. Pragati Prakashan, 1994.
5. Mathematical Physics – B.D. Gupta – II Ed. ,Vikas Publishing House, 1999.
6. Advanced Engineering Mathematics – Erwin Kreyszig, Wiley International 9th Ed.
7. Mathematical Physics – P.K. Chattopadhyay 1st Edition, Wiley Eastern Limited, 1992.

Suggested e-books :

8. Introduction to methods of applied Mathemiatics by sean Mauch. Link:its.caltech.edu./sean
9. Handbook of Mathematics for Engineers and scientists by A.D. Polyanin and A.V. Manzhirov, chapman and Hall/CRC.

Link for e-Books for Physics :

- https://www.e-booksdirectory.com/listing.php?category=2
- http://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAJkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoClLsQAvD_BwE
- https://www.sciencebooksonline.info/physics.html
- http://www.cambridgeindia.org/
- https://bookboon.com/en/physics-ebooks

First Semester
Discipline Specific: Major-II
PHY-DSM-122 – Classical Mechanics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -2	**PHY-DSM-122**	**Classical Mechanics**	**4**

Course Objectives:
Students will be familiar with Newtonians mechanics and other form of mechanics based on principle of least action like Hamiltonian and Lagarangian mechanics. Students will learn four dimensional formulation, relativistic mechanics.

Unit Learning Outcomes:
Upon successful completion of the course, the student:
UO1: Will learn conservation laws, constraints, Lagrange's equations which are the basics for further study.
U O2: Will be familiar with Lagarangian, Hamiltonian, which will be helpful for learning Quantum Mechanics.
UO 3: Will be familiar with Canonical transformations, Poisson Bracket, Equation of motion which will be helpful for further study.
UO 4: Will learn about small oscillation, Inertia tensor, rigid body which will be helpful to know about the motion of our galaxy, stars etc.
UO 5: Will learn about relativistic mechanics, covariant four dimensional formulation, covariant Lagrangian, Hamiltonian.

UNIT – I
Newtonian mechanics of one and many particles systems, Conservation laws, constraints and their classification, principle of virtual work. D'Almbert's principle in generalized coordinates, The Lagrange's equation from D'Almbert's principle**.** **(Lectures – 12)**

UNIT – II
Hamilton's principle, Hamilton's principle from Lagrange's equation. Generalized momentaand Lagrangain formulation of the conservation theorems, Reduction to the equivalent one body problem; the equation of motion and first integrals, the differential equation for the orbit. (Lectures – 12)

UNIT – III
The equations of canonical transformation and generating functions. Hamilton - Jacobi theorem, Action and angle variables. Poisson's brackets, simple algebraic properties of Poisson's brackets. The equation of motion in Poisson's Brackets notation. Poissons theorem, Principle of least action. (Lectures – 12)

UNIT – IV

Theory of small oscillations, Equations of motion, Eigen frequencies and general motion, normal modes and coordinates. Elementary treatment of Eulerian coordinates and transformation matrices. Angular momentum inertia tensor, torque free motion for a rigid body. **(Lectures – 12)**

UNIT – V

Covariant four dimensional formulation, 4-vectors and 4-scalers, Relativistic generalization of Newton's laws, 4-momentum and 4-force, Variance under Lornetz transformation, relativistic mechanics, covariant Lagrangian, covariant Hamiltonian. **(Lectures -12)**

Essential Readings :

1. Classical Mechanics – Godstein, Poole and Safko, 8th ed. Pearson Ed. Ltd., 2004
2. Classical Mechanics – Rana and Joag, 11th ed. Mc Graw Hill Publication, 2003
3. Classical Mechanics – Gupta Kumar & Sharma, 11th ed. Pragati Prakashan 11th ed.1995
4. Introduction to Classic al Mechanics – R.C. Takwale and P.S. Puranik, TMH Pub.1994

Suggested Readings :

5. Classical Mechanics – John R Taylor, University Sciences book.
6. Mechanics - J.P. Dentartog, Dover Publication.
7. Classical Mechanics - R. Douglas Gregory, Cambridge Univ. Press.
8. Introduction to Classical Mechanics – David Morin, Cambridge Univ. Press.

First Semester
Discipline Specific: Major-3
PHY-DSM-123 – Atomic Molecular and Laser Physics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -3	**PHY-DSM-123**	**Atomic, Molecular and Laser Physics**	**4**

Course Objectives: To increase the level of understanding of students about the various spectra of atoms, molecules and the use of electromagnetic radiation in understanding the tiny particles and the whole universe, they can enhance the understanding of interaction of light with matter which can be used to study various properties of different kinds of materials, This is also required for NET-CSIR, JEST, GATE and other national level examinations.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1: will understand the spectrum of various kinds of atoms as well as the various models of atoms and the terminologies required to study them.

UO2: will understand about the splitting of the energy levels of atoms in presence of electric and magnetic fields and the selection rules governing transitions. Various spectrums of diatomic molecules and their selection rules.

UO3: will have in-depth knowledge about the molecular structure

UO4: will be able to answer about various spectroscopic techniques and their modern developments

UO5: will have deep knowledge about the fundamentals, principles of laser and knowledge of the various kinds of lasers,

UNIT – I

Review of one-electron and two-electron atoms: spectrum of hydrogen, helium and alkali atoms; Many electron atoms: central field approximation, Thomas-Fermi model, Slater determinant, Hartee Fock and self-consistent field methods, Hund's rule, L-S and j-j coupling, Equivalent and nonequivalent electrons, Spectroscopic terms, Lande interval rule. **(Lectures – 12)**

UNIT – II

Interaction with Electromagnetic fields: Zeeman, Paschen Back and Stark effects; Hyperfine structure and isotope shift, selection rules; Lamb shift; Molecular spectra: rotational, vibrational, electronic, Raman and Infra-red spectra of diatomic molecules; electronic and nuclear spin, Hund's rule, Frank–Condon principle and selection rules. **(Lectures – 12)**

UNIT – III

Molecular structure: molecular potential; Born-Oppenheimer approximation, diatomic molecules, electronic angular momenta; Approximation methods; linear combination of atomic orbitals (LCAO) approach; states for hydrogen molecular ion; shapes and term symbols for simple molecules

(Lectures – 12)

UNIT – IV

Spectroscopic techniques: Infrared, Raman spectroscopy, NMR, ESR and Mossbauer spectroscopy (Principles and instrumentation) Modern developments: optical cooling and trapping of atoms, time resolved spectroscopy in the femto second regime **(Lectures – 12)**

UNIT – V

Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping; population inversion, three level and four level laser system and rate equation. Optical resonators, Stability of resonators, Characteristics of Gaussian beam, He-Ne and Ruby Lasers. (Lectures – 12)

Essential Readings :

1. Physics of Atoms and Molecules, B. H. Bransden and C. J. Joachain, 2nd Ed. Pearson (2008).
2. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash, 4th Ed.,Tata McGraw 2004.
3. Elementary Atomic Structure, G. K. Woodgate, Clarendon Press 1989.
4. Quantum Chemistry, I. N. Levine, PHI 2009.
5. Elementary Quantum Chemistry, F. L. Pilar, McGraw Hill 1990.
6. Essentials of Lasers and Non-Linear Optics,G.D. Baruach, Ist Ed. Pragati Prakashan, 2000.
7. Lasers and Non-Linear Optics- B.B. Laud, 2nd Ed., New age International (P) Ltd. 1996.

Suggested Readings :

8. Introduction to Atomic Spectra, H. E. White, Tata McGraw Hill 1934.
9. Atoms, Molecules and Photons, W. Demtroder, 2nd Ed., Springer 2010.
10. Atomic Physics, C. J. Foot, Oxford, 2005.
11. Principles of Laser, O. Svelto, 4th Ed. ,Springer , 2008

First Semester
Discipline Specific: Major-4
PHY-DSM-124 – Digital Electronics and Operational Amplifier

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -4	**PHY-DSM-124**	**Digital Electronics and Operational Amplifier**	**4**

Course Objectives:

The major objective of this paper is to build a strong foundation in the Digital electronics, the importance of operational amplifiers in digital circuit. Its general properties and the economic importance in electronic devices.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1: Will able to solve problems based on different number system such as Binary, octal and Hexa decimal number and their inter-conversion and basic knowledge of Logic gates, Adders, Multiplexer and Demultiplexer, Encoders and Decoders.

UO 2 : Will be able to understand the basic electronic equipment such as FLIP-FLOPS, Shift, Counters and combination of modular counters.

UO3: Will get depth knowledge about the Differential Amplifier: DC and AC analysis**,** CMRR Inverting and Non-inverting**,** Block Diagram of operational amplifier, Operational amplifiers with negative feedback.

UO4: Will get understanding about the Practical operational Amplifier: Input off set voltage, input offset current**,** output off voltage**,** Input Bias current and slew rate. Oscillator: Principle**,** Phase shift & Wein bridge**.**

UO5: Will understand the Basic comparator, fixed voltage regulator and Adjustable regulator. D/A Conversions: Binary weighted Resistors, R-2R ladder, A/D Conversions : Successive Approximation Resister method, Dual slope, and counter method etc.

UNIT – I

Number system and digital combinational circuits:

Binary, octal and Hexa decimal number and their inter-conversion, Addition and subtraction, Logic gates:AND, OR, NOT, NAND, NOR, XOR, XNOR, AOI gates. Binary adders: Half adder, Full adder and parallel adders. Multiplexer and Demultiplexer, Encoders and Decoders. **(Lectures –12)**

UNIT – II

Digital Sequential Circuits: FLIP-FLOPS : RS-FF, JK-FF, TFF, D-FF and Master Slave flip-flop, Shift Registers : SISO, SIPO, PISO, PIPO, Left / Right shift Registers, Counters: classification of counters, Ripple counter, parallel counters, BCD counters, combination of modular counters. **(Lectures –12)**

UNIT – III

Operational Amplifiers:

Differential Amplifier: DC and AC analysis**,** CMRR Inverting and Non-inverting**,** Block Diagram of operational amplifier, Operational amplifiers with negative feedback: Voltage Series and Voltage shunt.

(Lectures –12)

UNIT – IV

Practical operational Amplifier: Input off set voltage, input offset current**,** output off voltage**,** Input Bias current and slew rate. Oscillator: Principle**,** Phase shift & Wein bridge**.** **(Lectures – 12)**

UNIT – V

Basic comparator, fixed voltage regulator and Adjustable regulator. D/A Conversions : Binary weighted Resistors, R-2R ladder, A/D Conversions : Successive Approximation Resister method, Dual slope, and counter method. **(Lectures – 12)**

Essential Readings :

1. Opamp & Linear Integrated Ciruits – Ramakant Gayakwad , 4th ed.. PHI, New Delhi.,2003.
2. Integrated Electronic – Milliman & Halkias, 10th Ed., TMH,1991
3. Digital Principle and Applications – Malvino and Leach, 5th Ed.,TMH interval,2007

Suggested Readings :

1. Fundamental of Digital Electronic – C. Floyd. Pearson Education Pub.,4th Ed., 2005
2. Modern Digital Electronic – R.P. Jain, 8th Ed. , TMH Pub.2000.
3. Digital Electronics – Shiv Shankar Mishra, Salya Prakashan, Delhi

First Semester
Discipline Specific: Major-5
PHY-DSM-125 – Lab. Course

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -5	**PHY-DSM-125**	**Laboratories Course**	**4**

Course Objectives: Major objective of this paper is to instill students with the basic knowledge of Solid state practicals and make students aware of properties of LASER, optical Fiber, resistivity, Band gap of materials, Hall effect etc. To understand the concept of basic and universal Gates. To have basic idea about flip flop, timer, digital to analog converter, OPAMP, Power supply.

Course Learning Outcomes:
PART A:
Upon successful completion of the course, the student:
Will become aware with properties of Optical fibre and how the light propagate through it along with their application. Students will also learn about LASER and its different types, and how different LASERs are used in different walks of life.

PART B :

Upon successful completion of the course, the student:
Will become how to construct basic gates with the help of universal gates, will have idea about the characteristics of various Gates, their practical use. Student will have understanding about circuits and operation of flip flop, timer, converter, OPAMP, power supply and their use in practical applications

Students have to perform of at least six practicals from the following list:

1. To measure the numerical aperture of an optical fiber.
2. To measure the diameter of the laser beam.
3. To measure the bending loss in a multimode fiber.
4. To determine the resistivity of semiconductor by four probe methods and determine band gap.
5. Measurement of Curie temperature for Ferro electric material.

6. To determine Brewster's angle by the polarization of light and to verify the cosine square law (Malu's law) for plane polarized.
7. To determine the wavelength of He-Ne laser using vernier caliper.
8. To measure Hall coefficient of given semiconductor.

PART B

1. To study the input and transfer characteristics of AND, NOT and NAND gates using IC.
2. Construction of basic gates (AND, OR & NOT) using universal gates.
3. To construct circuits of Half and Full adders and draw the truth table.
4. To verify Boolean identities.
5. To study R-S, J-K and M/S flip-flops.
6. To study of an Astable multivibrator using 555 timer.
7. To study the characteristics of R-2R ladder type D/A converter.
8. Study of inverting and Non-inverting OPAMP.
9. Study of addition and subtraction using OPAMP.
10. Study of integration and differentiation using OPAMP.
11. Study of operational amplifier 741
    (A) To conduct input bias current measurement.
    (B) To conduct input offset current measurement.
12. To determine the frequency of Wein-Bridge oscillator.
13. Study of regulated power supply using IC 723.

Outcomes :

1. Learn the basics of gate. 2. Construct basic combinational circuits. 3. Construct Flip Flop and converters 4. Learn the basics of opamp.. 5. Construct various application of opamp.

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- https://www.e-booksdirectory.com/listing.php?category=2
- http://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAJkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCllLsQAvD_BwE
- https://www.sciencebooksonline.info/physics.html
- http://www.cambridgeindia.org/
- https://bookboon.com/en/physics-ebooks

First Semester

Multi Discipline Major –I

PHY-MDM-126 – Hands on Workshop Training

(Credits 2; 30 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Multi Discipline Major -I	**PHY-MDM-126**	**Hands on Workshop Training**	**2**

Course objectives :

A workshop is way for someone to pass on the idea and methods. In workshop practices the information of tools and various machine used in workshop. To design and development of PCB for fabrication the simple circuitry .

UNIT LEARNING OUTCOMES :

The completion of course :

UO 1 : The students learn the entry rules and safety rules of workshop and follow the precaution during workshop practices

UO2 : The students learn the cutting process of iron rod with the help of hex saw and smooth the iron piece by using the different type of files .

UO2 : The students learn the operation of Lathe machine Shaper machine and single phase and three phase welding plant .

UO3 : The students learn the knowledge of resistance and its combination and testing by the multi-meter .The use of CRO to measure the frequency and amplitude and testing of components like diode, transistor , capacitor, inductance.

UO4 : The students learn making of Printed Circuit board with help of graph paper design and software design technique and made the simple circuitry .

UO5 : In over all the student get expertise in electronics instrumentation and measuring and testing the components and tools .

(A) Objective is to learn the various process of

Workshop Practice: (any two)

1. Cutting and filling of iron rod.
2. Operation of Shaping machine
3. Operation of Lathe machine.
4. Welding practice.

(B) To equated with Electronic Instrumentation practical's

Electronics Instrumentation : (any three)

1. Measurement of resistance in series and parallel combination by colour code and multi-meter.
2. Testing of components and pin identification of capacitor diode and transistors by multi-meter.
3. Familiar with CRO to measure frequency and amplitude of AF signal.
4. Making of PCB.
5. Design and fabrication of simple circuitry.
6. Software based electronic circuit design and simulation

Note: More skills may be added during the progression of the course

OUTCOME OF COURSE: Get expertise with electronics Instrumentation experiments

- Get expertise in cutting, fitting, shaping machine ,lathe machine, capillary tube, T cutting and grinding
- To get master in measuring and testing to components & tools

Outcomes :

- *Design various objects using tool of workshop.*
- *Learn the various machined used in workshop.*

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- https://www.e-booksdirectory.com/listing.php?category=2
- http://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAJkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoClLsQAvD_BwE
- https://www.sciencebooksonline.info/physics.html

First Semester

Skill Enhancement Course – I

PHY-SEC-127 – Seminar

(Credits 2; 30 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Skill Enhancement Course –I	**PHY-SEC-127**	**Seminar**	**2**

Course Objectives: Main objective of this course is to give students exposure and make them courageous facing questions from the audience. They will learn to express their views in scientific vernacular and present themselves in an understandable manner.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO : Will be able to present themselves in front of an audience. It will help them to develop skills like speaking ability, gain and express knowledge in different fields and presentation capability. They will also learn to defend themselves in front of a panel of Seminar Committee.

Second Semester
Discipline Specific: Major-1
PHY-DSM-221 – Quantum Mechanics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester II			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -1	**PHY-DSM-221**	**Quantum Mechanics**	**4**

Course Objectives:

This course primarily aims to provide the basic concepts of quantum mechanics and various formalism of quantum mechanics with simple examples. The angular momentum and spin dynamics of the quantum systems will be discussed. Some standard approximation techniques such as time independent perturbation, Variational method and WKB approximation for solving quantum static systems will be discussed.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1: Will be able to understand the basic concepts and principles of quantum mechanics and its applications to simple systems like simple harmonic oscillator.

UO2: Will be able to understand angular momentum and spin dynamics of quantum systems. Will be able to solve angular momentum using CG coefficients.

UO3: Will be able to distinguish odd half and integral spin particles. Can understand the symmetric and antisymmetric particles.

UO4: Will be able to find the energy and wave functions of quantum conservative systems.

UO5: Will understand various approximation techniques and solve simple systems.

UNIT – I

General Formalism of Quantum Mechanics:

Linear vector space, basis and expansion theorem, Hilbert space, linear operators, eigen values and eigen functions, Hermitian operators and their properties, postulates of quantum mechanics, simultaneous eigen functions, general uncertainty relation, Dirac's notation for state vectors, Application of operator method: simple harmonic oscillator, creation and annihilation operators.

Matrix representation of state vectors and operators, change of basis: unitary transformation, Application of matrix method: simple harmonic oscillator. **(Lectures – 12)**

UNIT – II

Angular Momentum and Spin:

Angular momentum operators, angular momentum commutation relations, eigenvalues of L^2 and L_z. General angular momentum, eigenvalues of J^2 and J_z , angular momentum matrices, spin angular momentum, spin – (½) systems, spin vectors for spin – (½) system, Addition of angular momenta ,

Clebsch - Gordan coefficients. **(Lectures – 12)**

UNIT – III

Identical Particles:

Identical Particles, symmetric and anti symmetric wave functions, Pauli's exclusion principle, Slater determinant, inclusion of spin, spin functions for many electron systems. (Two and three electron systems), spin statistics connection. **(Lectures – 12)**

UNIT – IV

Time-Independent Approximation Method – I:

Basic concepts, non-degenerate and degenerate energy levels, Applications: ground state of He-atom, An-harmonic oscillator, Stark effect in hydrogen. **(Lectures – 12)**

UNIT – V

Time-Independent Approximation Method – II:

The Variation method: The variational principle, Rayleigh – Ritz method, Applications: ground state of He-atom, hydrogen-molecular ion and deuteron. **The WKB approximation method:** WKB method, validity of WKB method, connection formula penetration of a barrier, Application: α–decay. **(Lectures – 12)**

Essential Readings :

1. Quantum Mechanics, G. Aruldhas, PHI, 2Ed. ,2011.
2. Quantum Mechanics, E. Merzbacher, Wiley.
3. Quantum mechanics:Theory and Applications, A.K. Ghatak and S. lokanathan, Kluwer Academic Publishers.
4. Quantum Mechanics, D.J. Griffith,Prentice Hall.
5. Quantum Mechanics, L.I. Schiff, McGraw-Hill. 3rd Edition.

Suggested Readings :

1. Principles of Quantum Mechanics, R. Shankar, Springer.
2. Quantum Mechanics, A. Messiah, Dover.
3. Modern Quantum mechanics, J.J. Sakurai, Pearson Addison-Wesley.
4. Principles of Quantum mechanics- P.A.M. Dirac, Oxford University Press.
5. Quantum Mechanics – PM Mathew and K Venkatesan, Mc Graw Hill 2nd Ed.
6. Advance Quntum Mechanics- Satya Prakash, Kedar Nath Ram nath 5th Ed.,2003.
7. Quantum Mechanics- SL Gupta & V. Kumar 3rd Ed. Jai Prakash Nath KG, 1976.

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Second Semester
Discipline Specific: Major-2
PHY-DSM-222 – Classical Electrodynamics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester II			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -2	**PHY-DSM-222**	**Classical Electrodynamics**	**4**

Course Objectives:

The most important objects of this paper are to study the fundamental facts about the electrodynamics and plasma physics. The present era is digital era so the basic knowledge about the fundamentals is more essentials. The course is elaborated many facts, general properties and state-of-art of the subject.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1:The students able to describe the fundamentals of classical electrodynamics and quantum mechanics. The details of scaler and vector potentials, Maxwell's equations and fields of charged particles in uniform motion. The Maxwell's equations are the basic tool to under stand the electrostatic and electromagnetic theory of waves.

UO2: In this unit the extended study of Maxwell's equations is able to understand the fields study, particle velocity, review of four vectors and Lorentz transformation in 4-dimension spaces. This will give the depth knowledge about the invariance of electric charge.

UO3: Students will get the knowledge about the electromagnetic field's tensors in 4-dimensional Maxwellian equations. They will also gain the deep knowledge about the Lorentz transformation, Langragian and Hamiltonian transformations which are able to explain the motion of charged particles in Electro Magnetic fields.

UO4: Students can understand the basic concept of plasma physics and theory of astrophysical plasma as well as space plasma. Present era is digital and satellite era so the deep knowledge about the transient phenomena occur in space is too much essential to know every student. This unit provide the deep understanding about the space, astrophysics and plasma physics.

UO5: Will get working knowledge of electromagnetism using the tools of magneto hydro dynamics and plasma physics. To improved the skill of solving mathematical problems related to magneto hydro dynamics concepts.

UNIT – I

Maxwell's equations, Scalar and vector potentials, gauge transformation, Lorentz gauge, Coulomb Gauge, radiations by moving charges, retarded potentials, Lienard Wiechrt potentials, fields of charged particles in uniform motion, fields of arbitrarily moving charged particle. **(Lectures – 12)**

UNIT – II

Fields of an accelerated charged particles at low velocity and high velocity, angular distribution of power radiated, Review of four vector and Lorentz transformation in 4-dimensional spaces, Invariance of electric charge, relativistic transformation properties of E and H fields. . **(Lectures – 12)**

UNIT – III

Electromagnetic fields tensor in 4- dimensional Maxwell equation, Four Vector current and potential and their invariance under Lorentz transformation, convariance of electrodynamics. Langragian and Hamiltonian for a relativistic charged particle in external EM field. **(Lectures –12)**

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UNIT – IV

Elementary concept of occurrence of plasma, Gaseous and solid state plasma, Production of gaseous and solid state plasma, Plasma parameters, Plasma confinement pinch effect, instability in a pinched-plasma column, Electrical neutrality in a plasma, Debye screening distance. Plasma oscillations: Transverse oscillations and longitudinal oscillations. **(Lectures – 12)**

UNIT – V

Domain of Magnetohydordynamics and plasma Physics : Magnetohydrodynamic equations, magneto hydrodynamic waves: Magneto-sonic and Alfven waves, particle orbits motion of charged particles in electromagnetic fields, (uniform E and B Fields) and drift motion in a plasmas. **(Lectures – 12)**

Essential Readings :

1. Introduction to Electrodynamics - David J. Griffiths: Benjamin Cummings 2nd Ed. Prentice Hall of India, 1993.
2. Introduction to Plasma Physics – Chen Francis F, Springer Pub.2nd Ed.
3. Electrodynamics - Gupta, Kumar & Singh,

Suggested Readings :

1. Fundamentals of Plasma Physics - J.A. Bittencourt, Springer Pub. 3rd Ed.
2. Plasma Physics (Plasma State of Matter) – S.N. Sen, Pragati Prakashan, 2006
3. Classical Electrodynamics – Jackson: Wiley
4. Classical Electricity and Magnetism - Pnofsky & Philips: Dover Publications.
5. Principle of Plasma Mechanics- B.Chakraborty, Wiley Eastern Ltd. 1978.
6. Electromagnetic theory & Electrodynamics- Satya Prakash New Edition, Kedar Nath Ram Nath, 2004-05.

Suggested e-books:

1. Classical Electrodynamics by K. Lechnes, Springer publication.
2. Classical Electrodynamics by Xin Tao.
3. Classical Electrodynamics by W. Greiner, Springer Pub.
4. Fundamentals of Plasma Physics by P.M. Bellan.

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Second Semester
Discipline Specific: Major-3
PHY-DSM-223 – Condensed Matter Physics

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -3	**PHY-DSM-223**	**Condensed Matter Physics**	**4**

Course Objectives:

The students will learn about various crystal systems and related properties, theory of band formation, properties of matter like lattice vibrations, magnetic, dielectric, semiconducting, and super-conducting etc. They also get familiar with structural, electrical, thermal and optical properties of matter

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1: Will be able to describe the properties of crystal structure like Symmetry of crystal, crystal system, Bravais lattice, the concept of point group, space group, Miller indices, Unit cell, Wigner-Seitz unit, reciprocal lattice, closed packed structure, (BCC, FCC, HCP, DC) coordination number & coordination geometry this concept help to differentiate the different type of crystal structure. Also, they will gain about the characteristic of crystals using the principle of powder diffraction method; Elementary idea about interpretation of power XRD Types of Crystal binding: Ionic, Covalent, Metallic, Vander walls bonding.

UO2: Will get knowledge about the Free electron theory of metals. Hall Effect, Elementary ideas of quantum Hall effect, Thermal and transport properties. Thermal conductivity in metals. Vibration in solid, normal modes, phonons, normal and unklopb processes, Mobility of charge carriers and Seeback coefficient, Wiedmann Franz law. Electronics-specific heat. Bloch functions. Nearly free electron approximation. Also, they will gain the Formation of energy bands, gaps at Brillouin zone boundaries, Effective mass, and the concept of holes. Fermi surface.

UO3: Will get knowledge about the Superconductivity of materials because Superconductivity is the ability of certain materials to conduct electric current with practically zero resistance. They will survey of important experimental result; critical temperature, persistent current, Meissner effect; the Basic idea of BCS theory, Type I and Type II superconductor super conducting Materials, and their application. High Tc superconductivity.

UO4: Will get the knowledge about the Dielectric properties of solids. Before understanding the dielectric properties of solids, we need to have a clear understanding of what dielectric materials are and their characteristics. So, first, we discussed dielectric materials in brief before explaining of dielectric properties of solids. Also describe Complex dielectric and dielectric losses, relaxation time, and Debye equation for orientational polarizability; theory of electronic and ionic polarization, Ferroelectricity-dipole theory, classifications of ferroelectric material

UO5: Will get the knowledge about the Diamagnetic susceptibility. Quantum theory of paramagnetism. Transition metal ions and rare earth ions in solids. Crystal field effect and orbital quenching.

Ferromagnetic and antiferromagnetic ordering. Curie-Weiss theory, Heisenberg theory, Curie and Neel temperatures. Optical properties of solids: band to band absorption, excitions. Polarons, Colour centres. Luminescence. Photoconductivity.

UNIT – I

Crystal Structure: Symmetry, crystal system, Bravais lattice, concept of point group, space group, Miller indices, Unit cell, Wigner-Seitz unit, reciprocal lattice, closed packed structure, (BCC,FCC, HCP, DC) coordination number & coordination geometry. Principle of powder diffraction method; Elementary idea about interpretation of power XRD Types of Crystal binding: Ionic, Covalent, Metalic , Vander walls bonding,

(Lectures –12)

UNIT – II

Free electron theory: Free electron theory of metals. Hall Effect, Elementary ideas of quantum Hall effect, Thermal and transport properties. Thermal conductivity in metals. Vibration in solid, normal modes, phonons, normal and unklopb processes, Mobility of charge carriers and Seeback coefficient, Wiedmann Franz law. Electronics specific heat. Bloch functions. Nearly free electron approximation. Formation of energy bands. gaps at Brillouin zone boundaries. Effective mass and concept of holes. Fermi surface. **(Lectures –12)**

UNIT – III

Super Conductivity: Survey of important experimental result; critical temperature, persistent current, Meissner effect; Basic idea of BCS theory, Type I and Type II superconductor super conducting Material and their application. High Tc super conductivity. **(Lectures – 12)**

UNIT – IV

Dielectric properties of solids: Complex dielectric and dielectric losses, relaxation time and Debye equation for orientational polarizabiltiy; theory of electronic and ionic polarization, Ferroelectricity-diplole theory, classifications of ferroelectric material. **(Lectures -12)**

UNIT – V

Diamagnetic susceptibility. Quantum theory of paramagnetism. Transition metal ions and rare earth ions in solids. Crystal field effect and orbital quenching. Ferromagnetic and antiferromagnetic ordering. Curie-Weiss theory, Heisenberg theory, Curie and Neel temperatures. Optical properties of solids: band to band absorption, excitions. Polarons, Colour centres. Luminescence. Photoconductivity. **(Lectures – 12)**

Essential Readings :

1. Introduction to Condensed Matter Physics – K.C. Barua (Alpha Science International Ltd.)
2. A Basic Course in Crystallography – JAK. Tareen & TRN Kutly. (Universities Press, India Pvt.)
3. An Introduction to Crystallography, F.C. Phillips, Longman Higher Education.

4. Crystallography Applied to Solid State Physics – A.R. Verma and O. N. Srivastava, New Age International limt., 2nd Ed. Reprint 2005.
5. Elements of Solid state Physics, M. Ali omor Peasson Education 3rd Indian reprient, 2002

Suggested Readings :

1. Solid state Physics, C. Kittel, Wiley. 5th Edition.
2. Solid state Physics, A.J. Dekkar, Macmillan.
3. Elementary Solid state Physics: Principles and Applications, M. Ali Omar, Addison-Wesley.
4. Introduction to Solids, L.V. Azaroff, Tata Mc-Graw Hill.
5. Solid state Physics: An introduction to Principles of Materials Science, H. Ibach and H. Luth, Springer.
6. Solid state Physics, S.O. Pillai, New Age International.
7. Condensed matter Physics, M.P. Mardar,Wiley.
8. Physics of solids, C.A. Wert and R. M. Thomson, McGraw-Hill.
9. Fundamentals of Solid state Physics, J. R. Christmaan, Wiley.
10. Solid State Physics- Structure and Properties of materials, M.A. Wahab, Narosa Publishing House
11. Solid State Physics – N.W. Ashcroft and N.D. Mermin, New York : Holt, Rinehart and Winston.
12. Solid State Physics, J.S. Blakemore, Cambridge University Press.
13. Solid State Theory, Mendel Sachs, McGraw-Hill.

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- https://www.sciencebooksonline.info/physics.html
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Second Semester
Discipline Specific: Major-4
PHY-DSM-224 – Electronics Devices

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -4	**PHY-DSM-224**	**Electronics Devices**	**4**

Course Objectives: The major objective of this paper is to develop a strong foundation in the field of Electronic devices. It provides an insight to the knowledge of essential electronic devices like transistors, microprocessors, microcontrollers, photonic devices, sensor and transducers. This course will ddemonstrate proficiency in the use of electronic equipment and devices solve electronic devices and systems.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO1: It will help students know about various types of transistors and their applications.

UO2: It will help students know different applications of photonic devices in day-to-day life

UO3: It will develop research aptitude in students towards electronics by discussing the advances in computer technology and semiconductor memories

UO4:Students will be able to know how semiconductors can be fabricated to form new electronic devices. They will come to know how transducers were introduced and what are their applications

UO5:Students will learn the evolution in the field of electronics over time. They will also know about different types of filters and their applications .

UNIT – I

BJT: Construction, transistor biasing in active region, transistor operation in active.

JFET: Construction, Biased JFET, JFET characteristics.

MOSFET: Depletion and Enhancement type MOSFET, MESFET.

Basics of microprocessor and Microcontroller. **(Lectures –12)**

UNIT – II

Photonic Devices: Light dependent resistor (LDR), diode photo detectors, Solar cell (I-V characteristics, Spectral response, fill factor), LED, diode lasers. **(Lectures – 12)**

UNIT – III

Semiconductor Memories: Memory organization, Expanding memory size, classification of memories. ROM and RAM chip. Charged compiled device (CCD) memory, content addressable memory. **(Lectures-12)**

UNIT - IV

Transducers – Temperature, pressure and vibration. Measurement and control, signal conditioning system AC and DC, instrumentation amplifier. Lock in amplifier. **(Lectures – 12)**

UNIT – V

Filters: passive and active, first order, second order. Types of filters: Butterworth, elliptic, Bessel and allpass filters, Network analysis. **(Lectures – 12)**

Essential Readings :

1. Instrumentation (Devices and systems) : Rangan, Mani and Sharma – Tata McGraw Hill, 2nd Ed. , 2000 New Delhi.
2. Electronic Instrumentation: H.S. Kalsi- Tata McGraw Hill, New Delhi.1995 16th reprint 2003.
3. Electronic Devices and Circuits – Millmant Halkia McGraw Hill, New Delhi 2002.
4. Electronic Devices and Circuits – Raju – I.K. International.

Suggested Readings :

1. Digital Electronics – Gothman – PHI, 2nd Edition, 1998.
2. Digital Electronics – Jain (TMH-Eduction)
3. Electronics Devices & circuits – J.S. Katre-Tech-Max Pub., Pune.

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Second Semester
Discipline Specific: Major-5
PHY-DSM-225 – Laboratory Course

(Credits 4; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester I			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Discipline Specific Major -5	**PHY-DSM-225**	**Laboratory Course**	**4**

Course Objectives:

Major objective of this paper is to instill students with the basic knowledge of Solid state practicals and make students aware of Fourier's analysis, Qurie Temperature , Temperature dependant, Hall effect, Electron spin resonance etc. To know the concept of RC coupled amplifier, FETs, MOSFETs. Filters and Oscillator.

Unit Learning Outcomes:

Upon successful completion of the course, the student:

UO : Will become aware with ESR apparatus find the G factor Students will also learn about Curie Temperature of Ferro magnetic material and find the even and odd harmonics of wave from Fourier analysis Kit .

PART B:

Upon successful completion of the course, the student:

UO : Will learn how to construct the circuits of RC coupled amplifier, FETS, MOSFETS, Filters, Oscillators and their characteristics, frequency response

PART -A

1. To study the g-factor by the ESR spectrometer.
2. To study the B-H curve of a given sample.
3. To study the effect of temperature on the resistivity of semiconductor.
4. To study the Fourier analysis of signals (Sine & Square).
5. To determine the dielectric constant of a given sample.
6. To determine the Curie temperature of Ferro-magnetic material.
7. Measurement of Hall coefficient in Metals.
8. To measure the bending loss in a multimode fiber.

PART –B

1. Study the frequency response of two-stage R-C coupled amplifier with and without negative feedback.
2. Study the characteristics of field effect transistor (FET).
3. Study the frequency response, input and output impedance of FET amplifier.
4. Study of characteristics of MOSFET.
5. Study the frequency response of MOSFET amplifier.
6. Study of low pass, high pass and band pass passive filters.
7. Study of low pass, high pass, band pass and notch active filters.
8. Study of Harley's & Colpitt's oscillators.
9. Study of multivibrators using timer (IC 555).
10. Study of phase shift oscillator using transistor.

Outcomes:

1. Construct the circuits to study the two stage RC coupled amplifier.
2. Construct the circuits for FETs and MOSETs to study characteristics and amplifier.
3. Construct the circuits for filters.
4. Construct the circuits for Oscillators.

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Second Semester

Multi Discipline Major –I

PHY-MDM-226 – Digital Communication Skills Development

(Credits 2; 30 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester II			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Multi Discipline Major -I	**PHY-MDM-226**	**Digital Communication Skills Development**	**2**

The objective of the course is understanding the students to design and trouble shoot the digital communication circuits .The aim of the course to equip the students with in electronics communication to know how the signal travel in digital and optical forms .

UNIT LEARNING OUTCOMES :

The completion of course :

UO1 : The students learn how to convert the continues analogue signal in sample form with the help of sampling frequency and reconstruct the analogue signal with the help of active filter .

UO 2 : The student learn the modulation of signal with pulse amplitude ,Pulse width and pulse position . In demodulation method the students know the working of second order and fourth order active low pass filter .

UO3 : The pulse code modulation technique the students learn how the sampled signal is digitally coded with the help of pulse code modulation circuits . In demodulation technique decode the coded signal with the help of parity bit , and know the drawback of PCM technique.

UO4 : By the delta & adaptive delta modulation and demodulation students learn how to remove the drawback of PCM technique .

UO5 : The students learn the method of multiplexing technique like frequency division and time division multiplexing. In overall students will get expertise in Digital communication system .

Essential Readings :

1. Communication Systems-Simon Haykin Third Edition, John Wiley & Sons.
2. Advanced Electronics Communication Systems by Wayne Tomasi, Phi Edu.
3. Principles of communication systems, by Taub and Schilling, Second Edition TMH
4. Communication Electronics by George Kannedy.

Suggested Readings :

1. Operating manuals of experiments.

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- https://www.sciencebooksonline.info/physics.html
- http://www.cambridgeindia.org/
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Second Semester

Skill Enhancement Course –I

PHY-SEC-227 – Seminar

(Credits 2; 60 Hrs; M.M. 100 = 60 end sem. + 40 sessional)

Semester II			
Nature of Course	**Course Code**	**Course Title**	**Credits**
Skill Enhancement Course – I	**PHY-SEC-227**	**Seminar**	**2**

Course Objectives: *Objective of the seminar is to get student present themselves in front of audience and keep their views.*

Unit Learning Outcomes:

The course every student compulsorily delivered a seminar of approximately 30 minutes duration on a topic as decided by the Departmental Seminar Committee.

Upon successful completion of the course, the student:

- Will be able to represent himself/herself in front of the audience.
- Will be able to learn how to defend the questions of audience?
- Will be able to learn the importance of the suggestions of audience.
- Will be able to developed better communication skill.
- Will be able to achieve higher level of confidence.

Students will be ready for the future interviews.

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Department of Applied Geology, Dr. Harisingh Gour V.V., Sagar

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