INVERTIS
UNIVERSITY BAREILLY

Scheme of Instruction & Syllabi

For

Master of Science

In

Physics

Two Years CBCS M.Sc. Course in Physics

(Academic Session: 2020-21)

Department of Applied Sciences & Humanities INVERTIS UNIVERSITY

Invertis Village

Bareilly-Lucknow NH-24, Bareilly-243123, India

Dean
Faculty of Science
Invertis University, Bareilly (U.P.)

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M.Sc. (Physics)

This program provides an ability to identify and solve significant problems across a broad range of application areas, to develop the aptitude to apply the principles of Physics and to articulate an in depth understanding of advanced knowledge on various areas of Physics. It is designed to help students understand the importance of physical advancements in industry and the role of these in improving the quality of human life.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The program acts as the advanced degree and helps to develop critical, analytical and problem-solving skills at advanced level. The foundation degree makes the students employable in scientific organizations and also to assume administrative positions in various types of organizations. It also helps the students to pursue a career in academics or scientific organizations as a researcher.

The Program Educational Objectives are to prepare the students to:

PEO-1. Work independently or in team with engineering, medical, ICT professionals and scientists in scientific problem solving.

PEO-2. Act as administrators in public, private and government organizations or business administrator with further training and education.

PEO-3. Pursue Doctoral research degrees to work in colleges, universities as professors or as scientists in research establishments.

Dean
Faculty of Science
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Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

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BAREILLY

15/10/2020

15/10/2020

Program Outcomes of M.Sc. (Physics)

PO1: Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in different areas of Physics.

PO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

PO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.

PO4: Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

PO5: Students will be able to explore new areas of research in both physics and allied fields of science and technology.

PO6: Students will appreciate the pivotal role of physics in our society and use this as a basis for ethical behavior.

PO7: Students will be able to function as a member of an interdisciplinary problem-solving team.

PO8: The graduate has specific skills in planning and conducting advanced experiments and applying structural-physical characterization techniques.

PO9: Are able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.

PO10: Are able to use modern library searching and retrieval methods to obtain information about a topic, techniques, or an issue relating to physics.

PO11: Students should be able to communicate scientific results in writing and in oral presentation.

PO12: Students should become proficient in their specialized area of physics and acquire the basic tools needed to carry out independent cutting-edge research in physics.

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15-10-2020

M.Sc. Final (PHYSICS)
Proposed Course Structure

FOR SPECILIZATION IN **ELECTRONICS**

Semester – III

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 1	MPY -301	Laser Physics	3	1	0	30	70	100	4
2	Paper 2	MPY -302	Computational Physics	3	1	0	30	70	100	4
3	Paper 3	MPY -303	Electronic Devices	3	1	0	30	70	100	4
4	Lab 3	MPY -351	Electronics Lab	0	0	6	50	100	150	6
5	Lab 4	MPY -352	Computational Technique Lab	0	0	6	25	75	100	6
6	Field Lab	MPY-353*	Field Project/Internship	0	0	2	30	70	100	2
	Total			**9**	**3**	**14**	**195**	**455**	**650**	**26**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

Semester – IV

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 1	MPY -401	Digital Electronics	3	1	0	30	70	100	4
2	Paper 2	MPY -402	Communication Electronics & OP-amp	3	1	0	30	70	100	4
3	Lab 5	MPY -451	Advanced Electronics Lab	0	0	6	50	100	150	6
4	Project	MPY -452	Project work	0	0	6	100	100	200	6
	Total			**6**	**2**	**12**	**210**	**340**	**550**	**20**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

***Student will carry out Field Project/Internship during first year session break of the program**

15/10/20

15/10/20

(Dr. S.K. Jain)

15/10/2020

Head
Department of Applied Science
Invertis University, Bareilly (U.P.)

Dean

M.Sc. (Physics)

FOR SPECILIZATION IN **MATERIAL SCIENCES**

Semester - III

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 1	MPY -301	Laser Physics	3	1	0	30	70	100	4
2	Paper 2	MPY -302	Computational Physics	3	1	0	30	70	100	4
3	Paper 3	MPY -304	Structure of Materials	3	1	0	30	70	100	4
4	Lab 3	MPY -353	Material Science Lab	0	0	6	50	100	150	6
5	Lab 4	MPY -352	Computational Technique Lab	0	0	6	25	75	100	6
6	Field Lab	MPY -355 *	Field Project/Internship	0	0	2	30	70	100	2
	Total			**9**	**3**	**14**	**195**	**455**	**650**	**26**

L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.

Semester – IV

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 1	MPY -403	Properties of Materials	3	1	0	30	70	100	4
2	Paper 2	MPY -404	Nano Materials	3	1	0	30	70	100	4
3	Lab 5	MPY -453	Advanced Material Science Lab	0	0	6	50	100	150	6
4	Project	MPY -454	Project work	0	0	6	100	100	200	6
	Total			**6**	**2**	**12**	**210**	**340**	**550**	**20**

L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.

***Student will carry out Field Project/Internship during first year session break of the program**

10/10/20

Head
Department of Applied Science 15/10/20
Invertis University, Bareilly (U.P.)

15/10/20
(Dr. S.K. Jain)

Dean
Faculty of Science
Invertis University, Bareilly (U.P.)

15/10/2020
(Mr. Arun Kaushik)

INVERTIS UNIVERSITY BAREILLY

FOR SPECILIZATION IN ELECTRONICS

Semester-III

MPY 301: Laser Physics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week Tutorials: 1 hrs./Week Credits: 4	Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: - Properties of Lasers, Types of Lasers, Holography and Fibre Optics, Lasers in Science, Lasers in industry

Course Objectives:

1. To describe the basic laser physics, working of lasers, holography and principle of propagation of light in optical fibers.
2. To describe fundamentals of light-matter interaction

Detailed Syllabus:

Unit-1

Properties of Lasers - *Laser Fundamentals:* spontaneous and stimulated emission; Einstein coefficients; Population inversion, pumping, gain, optical cavities, *Properties:* Temporal and Spatial Coherence, directionality, Main components of Laser, Principle of Laser action, Introduction to general lasers and their types, Three & four level Lasers, CW & Pulsed Lasers.

Unit-2

Types of Lasers - Atomic, Ionic, Molecular, Excimer, Liquid, Solid State, Semiconductor and fibre laser.

Unit-3

Holography and Fibre Optics - Holography – Basic principle of holography, construction and reconstruction of hologram, Applications of holography, HNDT (Holographic Non-Destructive Testing), Holographic storage, Optical fibre principle, Types of fibres, Fiber optical communication, Fibre amplifiers, Fiberoptic, sensors.

Unit-4

Lasers in Science - Saturation spectroscopy, Excited state spectroscopy, Nonlinearspectroscopy, Time domain spectroscopy and its applications, Stimulated Raman Emission, Laser fusion, Medical applications of lasers, Photo-chemical applications.

Unit-5

Lasers in industry - Materials processing; Drilling; Cutting; Welding; Alloying; Thermal Deposition, Laser Chemical Vapour Deposition (LCVD), Laser Hardening, Annealing, LIDAR.

Text and Reference Books:

J.T. Cuxon and D.E. Parker, *Industrial Lasers and their Applications*, Prentice Hall of India Pvt. Ltd.

F.C. Appard, *Fiber Optics Handbook*, McGraw-Hill.

K. Thyagarajan and A.K. Ghatak, *Lasers: Theory and Applications*.

K. Koebner (ed.), *Industrial Applications of Lasers*, Wiley.

Course Outcomes:

CO1.	Recognize and classify LASER Fundamental, holography and Optical Fiber, Material Processing etc.
CO2.	Develop the understanding of the difference between spontaneous and stimulated emission, types of laser, construction and reconstruction of hologram types of fibers, spectroscopy Annealing.
CO3.	Apply the different application Medical Laser, holography, photo chemical Spectroscopy etc.
CO4.	Analyze the three levels, four level, CW and pulsed Laser, Fibre amplifiers, fiber optic sensor.
CO5.	Evaluate the Einstein coefficient for spontaneous emission stimulated emission, HNDT (holographic Non-destructive Testing), Time domain Spectroscopy.
CO6.	Design the material Processing drilling, Cutting, welding, alloying, Laser action.

MPY 302: Computational Physics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - C programming, Introduction to MATLAB, MATLAB Tools, Particle-in-cell codes I, Particle-in-cell codes II

Course Objectives:

1. The aim and objective of the course on Computational Physics is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high-level language such as Fortran, C++, etc., so that they can use these in solving simple physics problems.

Detailed Syllabus:

Unit-1

C programming - C programming basics; Arithmetic operators; Library functions, Data input and output; Relational operators; Control statements; Looping arrays functions; Simple programs; User defined functions; Passing arguments; Pointer declarations; Passing pointers to functions; Structures; Array of structures; Unions; File operations.

Unit-2

Introduction to MATLAB - MATLAB environment; Working with data sets; Data input/output; Logical variables and operators; Array and X-Y Plotting; Simple graphics; Data types matrix; String; Cell and structure; Manipulating of data of different types; File input/output; Matlab files; Simple programs.

Unit-3

MATLAB Tools - Signal processing; toolbox; Digital and analog filter design; Spectral analysis; Filtering and discrete FFTs; Z-transform; DFT and FFT; MATLAB tools for wavelet transform; Instrument control toolbox; Partial differential equation toolbox; Finite element method.

Unit-4

Particle-in-cell codes I - Introduction; Use of PIC code in Plasma Physics: Compute Charge Density, Compute Electric Potential: performed by solving the Poisson equation.

Unit-5

Particle-in-cell codes II - Compute Electric Field: from the gradient of potential, Move Particles: update velocity and position from Newton's second law, Generate Particles: sample sources to add new particles.

Text and Reference Books:

Ross L. Spencer and Michael Ware, *Introduction to Matlab*, Brigham Young University. Suresh Chandra, *Applications of Numerical Techniques with C*, Narosa. Vinay K. Lngle and John G. Proakis, *Digital Signal Processing Using Matlab*, PWS Publishing Company.

Course Outcomes:

CO1.	Describe basic concepts of C like function, arrays, etc. and tools of MATLAB like signal processing, filtering, etc.
CO2.	Summarize methods used for signal processing, filtering and electric field computation of PIC code.
CO3.	Implement filtering methods like DFT, FFT, etc. on signals using MATLAB and to implement mathematical method for improvement in result like Iteration method on C.
CO4.	Differentiate PIC code using parameters such as charge density, electric potential, etc.
CO5.	Monitor processing of signals and filtering methods using MATLAB and improvement of mathematical methods using C.
CO6.	Design a program to solve computational method with more accuracy

MPY 303: Electronic Devices

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Semiconductor, Junction Devices, Bipolar Junction Transistor (BJT), Amplifiers and Oscillators

Course Objectives:

1. To understand operation of semiconductor devices.
2. To understand DC analysis and AC models of semiconductor devices.
3. To apply concepts for the design of Regulators and Amplifiers
4. To verify the theoretical concepts through laboratory and simulation experiments.
5. To implement mini projects based on concept of electronics circuit concepts

Detailed Syllabus:

Unit-1

Semiconductor - Energy Bands, Intrinsic carrier concentration, Donors and Acceptors, Direct and Indirect band semiconductors, Elemental (Si) and Compound semiconductors (GaAs), Drift velocity, Carrier Diffusion, Carrier Injection, Generation, Recombination Processes, Minority Carrier Life Time, drift and diffusion

Unit-2

Junction Devices - Junction Devices: (i) p-n junction – energy Band diagrams for homo and hetero junctions, Current flow mechanism in p-n junction, (ii) Metal semiconductor (Schottky Junction): Energy band diagram, current flow mechanisms in forward and reverse bias, (iii) Metal-Oxide-Semiconductor (MOS) diodes, Energy band diagram, depletion and inversion layer, High and low frequency Capacitance Voltage (C-V) characteristics, special diodes.

Unit-3

Bipolar Junction Transistor (BJT) - Basic principles of transistor operation; Charge transport and current in a BJT, Current transfer ratio, Terminal currents, Generalized biasing, Charge control analysis, BJT switching, Turn-on and Turnoff transients, Base narrowing, Frequency limitations of a transistor, FET, MOSFET: Principle of Operation and I-V Characteristics of FET, MOSFET, MOS Capacitor, Threshold voltage in MOSFET.

Unit-4

Amplifiers and Oscillators - Low frequency and high frequency and Power amplifiers using transistors; Sine wave generators; Wien Bridge and phase shift oscillators; Multivibrator circuits; Triangle and square wave generation; ne555timer and applications

Text and Reference Books:

Sze S.M., *Semiconductor Devices Physics and Technology*, Wiley.

Robert Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 8 Th Edition, Pearson Education, India, 2004.

A. P. Malvino, Electronic Principles, Glencoe, 1993.

Sayer M. And Mansingh A., *Measurement, Instrumentation and Experimental Design in*

Physics and Engineering, Prentice Hall of India Pvt. Ltd. Streetman Ben G., *Solid State electronics*, Prentice Hall of India Pvt. Ltd. 3. Thareja B.L. & Sedha R.S., Priciples of Electronics Devices and Circuits, S. Chand John Morris, Analog Electronics. Allen Mottershead, Electronic Circuits and Devices, PHI, 1997. Tyagi S.M.; *Introduction to Semiconductor Devices*, John Wiley & Sons

Course Outcomes:

CO1.	Recognize and classify different characteristics of semiconductor, junction device, FET, MOSFET, Energy band diagram, High and Low frequency capacitance voltage etc.
CO2.	Develop the understanding of the techniques of Vander Paw, hall coefficient high and low frequency capacitance.
CO3.	Apply the different application of integrated circuits, BJT, FET etc.
CO4.	Analyze the Alloy semiconductor band semiconductors, Doping of compounds, P-n junction-energy band diagrams for homo and hetro junctions, Defects in epitaxial.
CO5.	Evaluate the carrier concentration, Drift velocity, carrier life time Current transfer Ratio, hall coeffiecent, minority carrier lifetime.
CO6.	Design the Fabrication of integrated Circuits Flim Depostion, CVD, MOCVD.

MPY 351-Electronics Lab

Teaching Scheme	Examination Scheme
Lectures: 9hrs./Week	Intenal-50
Credits: 2	End Semester Exam – 100 marks

Course Objectives:

1. To make students learn performing experiments.
2. To make students learn to the concepts of digital electronics.
3. Make students capable to work in groups to solve common problems

List of Experiments:

Note: *Minimum 8 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. Study of Diode characteristics
2.Study BJT characteristics
3. Study of characteristics of FET.
4. Study of characteristics of MOSFET.
5. Study of the characteristics of Colpitts oscillator.
6. Study of the characteristics of Hartley oscillator.
7. Study of the characteristics of phototransistor.
8. Study of Fiber optic communication.
9. Design different Clipper and Clamper circuits: positive, negative & bias (using through breadboard).
10. Design of Wein bridge oscillator using IC 741 (using through breadboard).
11. Study of multivibrator & amplifiers
12. Experiments with 555 timers IC

Reference Books:

B.K. Jones, *Electronics for Experimentation and Research*, Prentice-Hall.
P.B. Zbar and A.P. Malvino, *Basic Electronics: A Text-Lab Manual*, Tata Mc-Graw Hill.
B.K. Jones, *Electronics for Experimentation and Research,* Prentice-Hall.

Course Outcomes:

After completing the course, students will be able to achieve the following:

CO1.	Make correct measurements using laboratory instruments
CO2.	Align and setup the instrument for performing the experiment.
CO3.	Diagnose any errors in arrangement
CO4.	To analyze the observations by calculating the related physical quantities.
CO5.	Evaluate the percentage and maximum probable error.
CO6.	Minimize the sources of error and design additional related experiments

MPY 352-Computational Lab

Teaching Scheme	Examination Scheme
Lectures: 9hrs./Week	Intenal-50
Credits: 2	End Semester Exam – 100 marks

Course Objectives:

1. To make students aware of computational techniques.
2. To make students learn to solve physical problems.
3. Make students capable to work in groups to solve common problems

List of Experiments:

Note: *Minimum 10 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. To implement programs in C language
2. Time delay subroutine and a clock program.
3. Newton's and Lagrange's interpolation with algorithm, flow chart C Program and output.
4. Numerical integration by Trapezoidal/Simpson's rule with algorithm, flowchart C Program & output.
5. Solution of a polynomial equation and determination of roots by Newton Raphson method with algorithm, flowchart C Program and output.
6. Numerical solution of ordinary first order differential equation –Euler's method with algorithm, flowchart C Program and output.
7. Curve fitting - Least square fitting with algorithm, flowchart C program and output.
8. Matrix manipulation - Multiplication Transpose and Inverse with algorithm, Flow chart C program and output.
9. Iteration method, flowchart C program and output.
10. Gauss Interpolation, flowchart C program and output.
11. MATLAB – Matrix operations.
12. MATLAB: Digital Signal Processing.
13. MATLAB: Solving Ordinary Differential Equation.
14. Determination of polynomial using method of least square curve fitting.
15. Determination of time response of an R-L-C circuit.

Reference Books:

R.A. Dunlap, *Experimental Physics: Modern Methods*, Oxford University Press.
B.K. Jones, *Electronics for Experimentation and Research*, Prentice-Hall.
P.B. Zbar and A.P. Malvino, *Basic Electronics: A Text-Lab Manual*, Tata Mc-Graw Hill.
L.A. Leventhal, *Micro Computer Experimentation with the Intel SDK-85*.

Semester – IV

MPY 401: Digital Electronics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Number System and Binary Codes, Logic Gates & Boolean Algebra, Combinational Logic, Sequential Logic, Memory & Programmable logic, Introduction to Microprocessors, Logic families

Course Objectives:

1. To make students learn performing experiments.
2. To make students learn to the concepts of digital electronics.
3. Make students capable to work in groups to solve common problems.

Detailed Syllabus:

Unit-1

Number System and Binary Codes - Review of number system, binary codes, code conversion, binary addition, subtraction using 1's and 2's complement method, binary multiplication and division as done by computers

Unit-2

Logic Gates & Boolean Algebra -Review of Logic gates; realization using diodes and transistors, Boolean algebra and k- map and its reduction (upto six variables)

Unit-3

Combinational Logic- Half adder, full adder, half subtractor, full subtractor, comparator, multiplexer, de-multiplexer, encoder and decoder

Unit-4

Sequential Logic- Flip flop; R-S, J-K, J-K master slave, D, T, Asynchronous and synchronous counters, MOD counter, registers, A/D and D/A convertor

Unit-5

Memory & Programmable logic -Digital memories (ROM, PROM, RAM & PLA),

Unit-6

Introduction to Microprocessors - Basic components of a digital computer, Intel 8085 microprocessors

Unit-7

Logic families – TTL, ITL, ECL, MOS and CMOS.

Text and Reference Books:

M. Morris Mano and Michal D. Ciletti, Digital Design (4th Edition), Pearson

Donald P Leach & A.P. Malvino, Digital Principles and Applications, Glencoe (1995)

A. Anand Kumar, Fundamentals of Digital Circuits, Prentice Hall India (2004)

R.P. Jain, Modern Digital Electronics, Mc Graw Hill (2009)

Hertbert Taub and Donald L Schilling, Digital Integrated Electronics, Mc Graw Hill

Course Outcomes:

CO1.	Recognize and classify different characteristics of BJT, JFET, Kirchoof's laws, Power Amplifiers, thevinen and northen theorems. compentation theorems, operational amplifier, logic gates
CO2.	Develop the understanding of the basic principal of transistor operation, Biasing enhancement and depletion mode of operation. sine wave generators sum and difference amplifers . AC amplifiers and filters
CO3.	Apply the different application of integrated circuits, triangle and square wave generator, 555 timer applications, Basic scaling circuits, BJT, FET etc.
CO4.	Analyze the laplace transformation, convolution integral, the logic gates half adder full adder, comparators, multiplexor de multiplexor.
CO5.	Evaluate the integrating and differentiating circuits, Registers A/D and D/A conversion characteristics.
CO6.	Design the combinational circuits, Sequential circuits, Flip Flop counters. Decoders, current to voltage and voltage to current conversion.

MPY 402: Communication Electronics & OP-Amp

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Signal Analysis, Modulation, Digital Communication, Operational Amplifier

Course Objectives:

1. To impart knowledge about Electronics Communication
2. To introduce the students of M.Sc. class to the formal structure of the subject and to equip them with the knowledge of basic circuit analysis and OP-AMP based analog circuits so that they can use these in various branches of physics as per their requirement.

Detailed Syllabus:

Unit-1

Signal Analysis - Sinusoidal signals (Frequency and time Domain), Fourier series expansion of periodic sequence of impulses, Sampling function; Normalized power, Power Spectral density (of Digital data, sequence of random pulses)

Unit-2

Modulation - Amplitude Modulation, Spectrum of the modulated signal, Square law Modulator, Limitations of Amplitude Modulation. Analysis and frequency Spectrum, Generation and Detection of FM, Comparison of AM and FM. Pre-emphasis and De-emphasis, Reactance Modulator, Capture Effect

Unit-3

Digital Communication - Digital Line Waveforms: Symbols, Bits and Bauds, Functional Notation for Pulses, Line Codes and Waveforms, Pulse Modulation: Pulse Amplitude, Pulse Code, Pulse Frequency, Pulse Time, Pulse Position and Pulse Width Modulation; Differential PCM; Delta Modulation,

Unit-4

Operational Amplifier - Introduction to OP-Amp, Ideal OP-Amp and its characteristics, Linear amplifier (inverting & non-inverting), Adder & subtractor, integrator & differentiator, Comparator

Text and Reference Books:

G. Kennedy and B. Davis, *Electronic Communication Systems*, Tata mcgraw Hill.

Robert F. Coughlin and Frederick F Driscoll, Operational Amplifiers and Linear Integrated Circuits (6th Edition), Prentice Hall

Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits

Analog & Digital by R.P. Sing and S.D. Sapre, *Communication Systems*, Tata mcgraw Hill.

Course Outcomes:

CO1.	Describe and define the Sinusoidal signals (Frequency and time Domain), Sampling function; Normalized power, Power Spectral density (of Digital data, sequence of random pulses), Amplitude Modulation, Frequency Modulation Digital Communication, Fiber Optic Communication,
CO2.	Develop the understanding of Fourier series expansion of periodic sequence of impulses, Spectrum of the modulated signal, frequency Spectrum, Digital Line Waveforms: Symbols, Bits and Bauds, Functional Notation for Pulses, Line Codes and Waveforms, Pulse Modulation: Principle of light transmission in a fiber
CO3.	Determine Effect of Transfer function on power spectral density, Fourier transform (example: v(t) = cos *wt*); Convolution, Power and Energy Transfer through a network Square law Modulator, Balanced Modulator, DSBSC, SSB and vestigial sideband modulation, Generation and Detection of FM, Comparison of AM and FM. Pre-emphasis and De- emphasis, Reactance Modulator
CO4.	Differentiate Pulse Modulation: Pulse Amplitude, Pulse Code, Pulse Frequency, Pulse Time, Pulse Position and Pulse Width Modulation; Differential PCM; Delta Modulation, Digital Communication Systems, Digital Carrier System, Frequency Shift Keying, Phase Shift Keying, (Difference between Amplitude Modulation and Frequency Modulation)
CO5.	Evaluate the Numerical on Sinusoidal signals (Frequency and time Domain), Sampling function; Normalized power, Power Spectral density A.M., F.M., optical fiber and Digital communications.
CO6.	Classify Amplitude Modulation, Frequency Modulation, Digital Communication

MPY 451-Advanced Electronics Lab

Teaching Scheme	Examination Scheme
Lectures: 9hrs./Week	Intenal-50
Credits: 2	End Semester Exam – 100 marks

Course Objectives:

1. To make students learn performing experiments.
2. To make students learn to the concepts of analog and digital electronics.
3. Make students capable to work in groups to solve common problems.

List of Experiments:

Note: *Minimum 8 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. Study of OP-AMP as summing and inverting amplifier.
2. Study of OP-AMP as Emitter Follower.
3. Study of OP-AMP as Difference Amplifier.
4. Study of OP-AMP as differentiator and integrator.
5. Study of OP-AMP as Schmitt Trigger.
6. Study of frequency response of OP-AMP.
7. Study of SR and JK flip flop circuits using logic gates.
8. Study of JK Flip-Flop and up-down counter.
9. Study of IC 7400 as Half adder, Full adder.
10. Study of IC 7400 as Half subtractor, Full subtractor.
11. Study of IC 555 as a stable multivibrator and Voltage Controlled Oscillator.
12. Study of Addition and subtraction using 8086.
13. Study of Multiplication and division using 8086.
14. Study of Addition, Subtraction and Binary to BCD conversion
15. Study of PAM, PWM and PPM Modulation and demodulation.
16. Study of PCM / delta modulation and demodulation.
17. Study of Arithmetic operations using microprocessors 8085 / 8086.
18. D/A converter interfacing and frequency / temperature measurement with microprocessor
8085 / 8086.
19. A/D converter interfacing and AC/DC voltage / current measurement using microprocessor
8085/8086.

Reference Books:

B.K. Jones, *Electronics for Experimentation and Research*, Prentice-Hall.
P.B. Zbar and A.P. Malvino, *Basic Electronics: A Text-Lab Manual*, Tata Mc-Graw Hill.
B.K. Jones, *Electronics for Experimentation and Research*, Prentice-Hall.
P.B. Zbar and A.P. Malvino, *Basic Electronics: A Text-Lab Manual*, Tata Mc-Graw Hill

Course Outcomes:

After completing the course, students will be able to achieve the following

CO1.	Make correct measurements using laboratory instruments
CO2.	Align and setup the instrument for performing the experiment.
CO3.	Diagnose any errors in arrangement
CO4.	To analyze the observations by calculating the related physical quantities.
CO5.	Evaluate the percentage and maximum probable error.
CO6.	Minimize the sources of error and design additional related experiments

(FOR SPECILIZATION IN MATERIAL SCIENCES)
Semester – III

MPY 301: Laser Physics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Properties of Lasers, Types of Lasers, Holography and Fibre Optics, Lasers in Science, Lasers in industry

Course Objectives:

1. To present various aspects of the foundations, design, operation and application of lasers.

Detailed Syllabus:

Unit-1

Properties of Lasers - *Laser Fundamentals:* spontaneous and stimulated emission; Einstein coefficients; Population inversion, pumping, gain, optical cavities, *Properties:* Temporal and Spatial Coherence, directionality, Main components of Laser, Principle of Laser action, Introduction to general lasers and their types, Three & four level Lasers, CW & Pulsed Lasers.

Unit-2

Types of Lasers - Atomic, Ionic, Molecular, Excimer, Liquid, Solid State, Semiconductor and fibre laser.

Unit-3

Holography and Fibre Optics - Holography – Basic principle of holography, construction and reconstruction of hologram, Applications of holography, HNDT (Holographic Non-Destructive Testing), Holographic storage, Optical fibre principle, Types of fibres, Fiber optical communication, Fibre amplifiers, Fiberoptic, sensors.

Unit-4

Lasers in Science - Saturation spectroscopy, Excited state spectroscopy, Nonlinear spectroscopy, Time domain spectroscopy and its applications, Stimulated Raman Emission,Laser fusion, Medical applications of lasers, Photo-chemical applications.

Unit-5

Lasers in industry - Materials processing; Drilling; Cutting; Welding; Alloying; Thermal Deposition, Laser Chemical Vapour Deposition (LCVD), Laser Hardening, Annealing, LIDAR.

Text and Reference Books:

J.T. Cuxon and D.E. Parker, *Industrial Lasers and their Applications*, Prentice Hall of India Pvt. Ltd.

F.C. Appard, *Fiber Optics Handbook*, McGraw-Hill.

K. Thyagarajan and A.K. Ghatak, *Lasers: Theory and Applications*.

K. Koebner (ed.), *Industrial Applications of Lasers*, Wiley.

Course Outcomes:

CO1.	Rrecognize and classify LASER Fundamental, holography and Optical Fiber, Material Processing etc.
CO2.	Develop the understanding of the difference between spontaneous and stimulated emission, types of laser, construction and reconstruction of hologram types of fibers, spectroscopy Annealing.
CO3.	Apply the different application Medical Laser, holography, photo chemical Spectroscopy etc.
CO4.	**A**nalyze the three levels, four level, CW and pulsed Laser, Fibre amplifiers, fiber optic sensor
CO5.	Evaluate the Einstein coefficient for spontaneous emission stimulated emission, HNDT (holographic Non-destructive Testing), Time domain Spectroscopy.
CO6.	Design the material Processing Driling, Cutting, welding, alloying, Laser action

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MPY 302: Computational Physics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - C programming, Introduction to MATLAB, MATLAB Tools, Particle-in-cell codes I, Particle-in-cell codes II

Course Objectives:

1. The aim and objective of the course on Computational Physics is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high-level language such as Fortran, C++, etc., so that they can use these in solving simple physics problems.

Detailed Syllabus:

Unit-1

C programming - C programming basics; Arithmetic operators; Library functions, Data input and output; Relational operators; Control statements; Looping arrays functions; Simple programs; User defined functions; Passing arguments; Pointer declarations; Passing pointers to functions; Structures; Array of structures; Unions; File operations.

Unit-2

Introduction to MATLAB - MATLAB environment; Working with data sets; Data input/output; Logical variables and operators; Array and X-Y Plotting; Simple graphics; Data types matrix; String; Cell and structure; Manipulating of data of different types; File input/output; Matlab files; Simple programs.

Unit-3

MATLAB Tools - Signal processing; toolbox; Digital and analog filter design; Spectral analysis; Filtering and discrete FFTs; Z-transform; DFT and FFT; MATLAB tools for wavelet transform; Instrument control toolbox; Partial differential equation toolbox; Finite element
method.

Unit-4

Particle-in-cell codes I - Introduction; Use of PIC code in Plasma Physics: Compute Charge Density, Compute Electric Potential: performed by solving the Poisson equation.

Unit-5

Particle-in-cell codes II - Compute Electric Field: from the gradient of potential, Move Particles: update velocity and position from Newton's second law, Generate Particles: sample sources to add new particles.

Text and Reference Books:

Ross L. Spencer and Michael Ware, *Introduction to Matlab*, Brigham Young University.
Suresh Chandra, *Applications of Numerical Techniques with C*, Narosa.Vinay K. Lngle and John G. Proakis, *Digital Signal Processing Using Matlab*, PWS Publishing Company.

Course Outcomes:

CO1.	Describe basic concepts of C like function, arrays, etc. and tools of MATLAB like signal processing, filtering, etc.
CO2.	Summarize methods used for signal processing, filtering and electric field computation of PIC code.
CO3.	Implement filtering methods like DFT, FFT, etc. on signals using MATLAB and to implement mathematical method for improvement in result like Iteration method on C.
CO4.	Differentiate PIC code using parameters such as charge density, electric potential, etc.
CO5.	Monitor processing of signals and filtering methods using MATLAB and improvement of mathematical methods using C.
CO6.	Design a program to solve computational method with more accuracy.

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MPY 304: Structure of Materials

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Crystal Structure & bonding, Crystal Diffraction, Reciprocal Lattice and Experimental X-ray Diffraction Techniques, Lattice Vibrations, Disorder in Solids

Course Objectives:

1. To describe the Crystal Structure and different types of bonding in solids, and the physical ramifications of these differences.
2. To describe and demonstrate diffraction, including interpretation of basic X-ray data.
3. Give an introduction to metals, ceramics, polymers, and electronic materials in the context of a molecular level understanding of bonding.
4. Give an introduction to the relation between processing, structure, and physical properties of material.
5. Give the beginning student an appreciation of recent developments in materials science & engineering within the framework of this class.

Detailed Syllabus:

Unit-1

Crystal Structure & bonding - Review of crystal structure & symmetry operations Types of bonding, Van der waals bond, Cohesive energy of inert gas solids, Ionic bond, Cohesive energy and bulk modulus of ionic crystals, Madelung constant, Covalent bond, Metallic bond

Unit-2

Crystal Diffraction - X-ray diffraction by crystals, Laue theory, Interpretation of Laue equations, Bragg's law, Reciprocal lattice, Ewald sphere construction, Atomic scattering factor, Experimental methods of X-ray diffraction, Neutron and electron diffraction (brief discussion)

Unit-3

Reciprocal Lattice and Experimental X-ray Diffraction Techniques - Reciprocal lattices and its applications to diffraction techniques, Interaction of X-rays with matter, absorption of X- rays, Experimental diffraction techniques-Laue's diffraction technique, Powder X-ray diffraction technique, Indexing of powder photographs and lattice parameter determination, Applications of powder method, General concept of atomic scattering factor and Structure factor.

Unit-4

Lattice Vibrations - Vibrations of one-dimensional monatomic and diatomic lattices, Infrared absorption in ionic crystals (one-dimensional model), Normal modes and phonons, Frequency distribution function. Review of Debye's theory of lattice specific heat, Anharmonic effects.

Unit-4 **Disorder in Solids** - Point defects (Frenkel & Schottky), Line defects (slip, plastic deformation, edge dislocation, Screw dislocation, Burger's vector, Concentration of line defects, Estimation of dislocation density, Frank-Reid mechanism of dislocation multiplication (dislocation reaction), Surface (Planar) defects, Grain boundaries and Stacking faults.
Text and Reference Books: Solid State Physics by C. Kittel Solid State Physics (Structure and Properties of Materials) – M.A. Wahab F.C. Phillips: An introduction to crystallography (wiley) (3rd edition) Charles A. Wert and Robb M. Thonson: Physics of Solids J. P. Srivastava: Elements of solid-state physics (Prentice Hall India; 2nd edition). B.D. Cullity, Elements of X-ray diffraction, Addison-Wesley. Massachusetts S.O. Pillai, 1997, Solid State Physics, New Age International, New Delhi. Christmaan-Solid State Physics (Academic Press)

Course Outcomes:

CO1.	Define the structure of different types of materials; amorphous, crystalline.
CO2.	Develop the understanding of the basic methods for the characterization of crystalline materials
CO3.	Apply the different methods for solving numerical questions on structural determination.
CO4.	Analyze the behavior of structural changes on the properties of the materials.
CO5.	Evaluate the structure of materials using different experimental techniques such as x-ray diffraction and electron microscopy.
CO6.	Create their own data base for the x-ray diffraction analysis of different type of materials using JCPDS data base.

MPY 353-Material Science Lab

Teaching Scheme	Examination Scheme
Lectures: 9hrs./Week	Intenal-50
Credits: 2	

Course Objectives:

1. To learn the principles of materials science and engineering though lab investigation
2. To learn the basic skills required to properly use materials science instruments
3. To learn to organize the lab results into a logic, concise and accurate report
4. To develop writing and communications skills for a persuasive presentation of technical materials.

List of Experiments:

Note: *Minimum 8 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. To study the temperature dependence of Hall coefficient of a given semiconductor.
2. Determination of Band gap of a given semiconductor material by four probe technique.
3. To study the effect of magneto-striction of a given material.
4. Measurements of Brewster angle of a substance and hence determine the refractive index.
5. Measurement of absorption coefficient of a material (supplied) using laser light.
6. Determination of numerical aperture of a fiber by measuring the diameter of laser beam.
7. To verify the Malus law.
8. Study of porosity and grain size of thin film and powder sample by SEM.
9. Two probe d.c. conductivity and carrier density evalution of a pellet prepared through cold pressing.
10. Preparation of thin film deposition technique and determination of film thickness by fibre optic spectrophotometer.
11. Determination of band gap of semiconductor sample using UV-VIS spectroscopy.

Reference Books:

B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Course Objectives:

After completing the course, students will be able to achieve the following:

CO1.	Make correct measurements using laboratory instruments
CO2.	Align and setup the instrument for performing the experiment.
CO3.	Diagnose any errors in arrangement
CO4.	To analyze the observations by calculating the related physical quantities.
CO5.	Evaluate the percentage and maximum probable error.
CO6.	Minimize the sources of error and design additional related experiments

Semester – IV

MPY 403: Properties of materials

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Lattice Dynamics and thermal properties of solids, Optical Properties, Dielectric Properties, Electronic Properties of Solids, Magnetic Properties of Solids.

Course Objectives:

1. To review physics and chemistry in the context of materials science & engineering
2. To describe the Lattice Dynamics and thermal properties of solids, Optical Properties, Dielectric Properties, Electronic Properties and Magnetic Properties of materials.
3. To introduce the physical origin of and demonstrate the correlation between structure and properties of materials.
4. To describe the Crystal Diffraction.
5. To give student broad introductory knowledge of how materials properties ultimately affect engineering design in their respective disciplines, and how such properties lead to limitations.

Detailed Syllabus:

Unit-1

Lattice Dynamics and thermal properties of solids - Review of lattice Vibrations, Lattice optical properties in ionic crystal, Quantization of Lattice vibrations-concept of phonon, Inelastic scattering of neutrons and X-rays by phonon, Debye's model of specific heat, Thermal expansion, Thermal conductivity, Mean-free path of phonons.

Unit-2

Crystal Diffraction - X-ray diffraction by crystals, Laue theory, Interpretation of Laue equations, Bragg's law, Reciprocal lattice, Ewald sphere construction, Atomic scattering factor, Experimental methods of X-ray diffraction, Neutron and electron diffraction (brief discussion)

Unit-3

Optical Properties - Color centers, Photo conductivity, electronic transitions in photo conductors, Trap, Capture, recombination centers; General mechanism - Luminescence, Excitation and emission; Decay mechanisms - Thallium activate, Alkali halides, Sulfide phosphorous; Kramers-Kronig relations sum rule for oscillator strengths, Direct and indirect inter band transitions, Optical absorption in Semi-conductors and Mott-Wannier excitations

Unit-4

Dielectric Properties - The Dielectric constant and polarizability, Internal electric field in a dielectric: Clausius–Mossotti relation and Lorentz - Lorentz equations, Dielectric dispersion and loss, Measurement of dielectric constant, Dipolar polarization in solids, Ionic polarizability, electronic polarizability. Ferroelectrics, Ferro electricity and piezoelectricity General properties, Dipole theory, Ionic displacements and the behaviors of batio3 -Spontaneous polarization of batio3, Thermodynamics of Ferro electric transitions.

Unit-5

Electronic Properties of Solids - Electrons in periodic lattice: Bloch theorem, the Kroning Penny model, classification of solids on the basis of band theory, effective mass, Fermi surface and Fermi gas, Hall Effect, Superconductivity and its historical perspective, critical temperature, persistent current, effect of magnetic fields, Meissner effect ,Josephson's tunneling effect (a.c and d.c).

Unit-6

Magnetic Properties of Solids - Elementary ideas of dia, Para and Ferro magnetism - Langevin theory of diamagnetism, quantum theory of paramagnetic, Rare earth ion, Hund's rule, Quenching of orbital angular momentum, Adiabatic demagnetization, Quantum theory of ferromagnetism, Curie point, Exchange integral, Heisenberg's interpretation of Weiss field -ferromagnetic domains - Bloch Wall, Curie temperature and susceptibility of ferrimagnetisms, Theory of ant ferromagnetism - Neel temperature.

Text and Reference Books:

Principals of Condensed Matter Physics by Chaikin and Lubensky Solid State Physics by C. Kittle

S. O. Pillai, 1997, Solid State Physics, New Age International, New Delhi. Introduction to Solids by Azaroff

Crystallography for Solid State Physics by Verma and Srivastava

Solid State Physics (Structure and Properties of Materials) – M.A. Wahab Elementary Solid-State Physics (Principles and Application) – M.A. Omar Crystal Structure Determination by G.H. Stout, L.H. Jensen

D. Pines: Elementary excitations in solids

Course Outcomes:

CO1.	Define or describe Lattice waves, Vibrations of one –dimensional monatomic lattice, Linear diatomic lattice, Color centres , Photo conductivity, electronic transitions in photo conductors, Trap, Capture, recombination centers; The Dielectric constant Elementary ideas of dia, para and ferro magnetism rizability
CO2.	Develop the understanding of Lattice optical properties in ionic crystal, Quantization of Lattice vibrations-concept of phonon, Inelastic scattering of neutrons and X-rays by phonon, Trap, Capture, recombination centers; General mechanism - Luminescence, Excitation and emission.
CO3.	Apply Debye's model of specific heat, Thermal expansion, Thermal

	conductivity, Mean-free path of phonons Clausius–Mossotti relation and Lorentz - Lorentz equations, Dielectric dispersion and loss
CO4.	Analyse magnetic properties (Langevin theory of diamagnetism, quantum theory of paramagnetism, Quantum theory of ferromagnetism, Langevin theory of ferrimagnetisms, Theory of antiferro magnetism - Neel temperature, Electronic Properties, Dielectric Properties
CO5.	Evaluate numerical on X-rays diffraction phonon, Clausius – Mossotti relation lattice Vibration, Langevin theory, Magnetic susceptibility.
CO6.	Classify Dielectric Properties, Electronic Properties of Solids, Magnetic Properties of Solids. Optical Properties

MPY 404: Nano-Materials

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers Assessment – 6 Marks Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: - Introduction, Introduction to Physics of Solid State, Quantum Theory for Nano Science, Quantum Theory for Nano Science, Growth Techniques for Nano-materials, Methods of Measuring Properties, Applications.

Course Objectives:

1. To foundational knowledge of the Nanoscience and related fields.

2.To make the students acquire an understanding the Nanoscience and Applications

3. To help them understand in broad outline of Nanoscience and Nanotechnology

Detailed Syllabus:

Unit-1

Introduction - Definition of Nano-Science and Nano-Technology, Applications of Nano-Technology

Unit-2

Introduction to Physics of Solid-State Structure- Size dependence of properties, Crystal structures, Face centered cubic nano particles, Tetrahedral bounded semiconductor structures, Lattice vibrations. **Energy Bands:** Insulators, Semiconductor and conductors, Reciprocal space, Energy bands and gaps of semiconductors, Effective masses, Fermi Surfaces. **Localized Particles:** Acceptors and deep taps, Mobility, Excitons

Unit-3

Quantum Theory for Nano Science - Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak), Penetration of Barrier, Potential box (Trapped particle in 3D: Nano dot), Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nano materials.

Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure, Size and Dimensionality effect, Fermi gas, Potential wells, Partial confinement, Excitons, Single electron Tunneling, Infrared detectors, Quantum dot laser Superconductivity.

Unit-4

Properties of Individual Nano particles - Metal Nano clusters: Magic Numbers, Theoretical Modelling of Nanopraticles, Geometric structure, Electronic structure, Reactivity, Fluctuations Magnetic Clusters, Bulk to Nano structure. **Semi conducting Nanoparticles:** Optical Properties, Photo fragmentation, Columbic explosion. **Rare Gas & Molecular Clusters:** Inert gas clusters, Superfluid clusters molecular clusters

Unit-5

Growth Techniques for Nano-materials - Lithograpahic and Nonlithograpahic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-cualo$_2$ deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition (CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitoxy, Sol-Gel Techniuqe (No chemistry required), Synthesis of nanowires/rods, Electrodeposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid –Solid (VLS) method of nanowires.

Unit-6

Methods of Measuring Properties Structure - Crystallography, particle size determination, surface structure, **Microscopy:** Scanning Prob Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy (TEM) **Spectroscopy:** Infrared and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy, Luminescence. **Buckey Ball:** Nano structures of carbon (fullerene) **Carbon nano-tubes:** Fabrication, structure, electrical, mechanical, and vibrational properties and applications, Nano diamond, Boron Nitride Nano-tubes, single electron transistors, Molecular machine, Nano-Biometrics, Nano Robots.

Unit-7

Applications - Micromechanical systems - Robots, Ageless materials, Nanomechanics, Nano electronics, Optoelectronic devices – LED, Applications, Colourants and pigments, Nano biotechnology - DNA chips, DNA array devices, Drug delivery systems.

Text and Reference Books:

C. P. Poole Jr. F.J. Owens, “Introduction to Nanotechnology”
A. K. Bandyopadhyay, “Nano Materials” New Age International
Charles Little “Introduction to Solid State Physics” - (7thedn.) Wiley 1996
S. Sugano & H. Koizuoni, “Microcluster Physics” –Springer 1998
Edited by Hari Singh Nalwa “Handbook of Nanostructured Materials & Nanotechnology” vol.-
5. Academic Press 2000

Course Outcomes:

CO1.	Recognize and classify different characteristics of nanomaterials; such surface area, electrical, electronic, mechanical and chemical properties etc.
CO2.	Distinguish between the properties of nanomaterials and bulk materials.
CO3.	Apply different experimental methods of synthesis and characterization of nanomaterials such as x-ray diffraction, scanning and transmission electron microscopy etc.
CO4.	Analyze the behaviour of nanomaterials in view of their bulk counterpart.
CO5.	Evaluate their individual particle size, average particle size and distribution.
CO6.	Design and fabricate simple experiments based on the applications of these materials.

MPY 453-Advanced Material Science Lab

Teaching Scheme	Examination Scheme
Lectures: 9hrs./Week Credits: 2	Intenal-50 End Semester Exam – 100 marks

List of Experiments

Note: ***Minimum 8 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)***

1. To determine the coefficient of thermal conductivity of copper by Searle's apparatus.
2. To verify Stefan's law and to determine the value of Stefan's constant.
3. To determine the wavelength and the angular spread of a He-Ne laser.
4. To determine the value of Planck's constant by using LEDs of at least 4 different wavelengths.
5. To study the characteristics of a Photo-diode.
6. To verify inverse square law for light using a photocell as a photometer.
7. To determine the conductivity of the material by LCR method.
8. To determine the curie temperature of a given ferroelectric material.
9. Preparation of nano-crystalline powder specimen by chemical route: analysis of their x-ray spectra and particle size estimation by sherrer formula.
10. Measurement of variation of micro-hardness of sintered specimens with sintering temperatures.
11. Determination of Miller indices and lattice parameter of an unknown powder material by x-ray diffraction.
12. Phase identification of an unknown sample by an x-ray diffraction.
13. Synthesis by chemical route and sol-gel and characterization of thin film by x-ray diffraction.

Reference Books:

1. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

2. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

3. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Course Outcomes:

After completing the course, students will be able to achieve the following:

CO1.	Make correct measurements using laboratory instruments
CO2.	Align and setup the instrument for performing the experiment.
CO3.	Diagnose any errors in arrangement
CO4.	To analyze the observations by calculating the related physical quantities.
CO5.	Evaluate the percentage and maximum probable error.
CO6.	Minimize the sources of error and design additional related experiments

Project Work
(MPY 452 & MPY 454)
(Seminar & Viva)

For students to enter into preliminary research field both in theory and experiment the concept of Project has been introduced in the final Semester. In the Project the student will explore new developments from the books and journals, collecting literature / data and write a Dissertation based on his / her work and studies. The Project Work can also be based on experimental work in industries / research laboratories.

Selection of Topic:

1. Students will make project which should be preferably a working of the thoughts based on their subject.
2. The student will be assigned a faculty guide who guides the supervisor of the students. The faculty would be identified before the end of the III semester.
3. The assessment of performance of the students should be made at least twice in the semester. The students shall present the final project live using overhead projector PowerPoint presentation on LCD to the internal committee and the external examiner in the form of seminar.
4. The evaluation committee shall consists of faculty members constituted by the college which would be comprised of at least three members comprising of the department Coordinator's Class Coordinator and a nominee of the Dirtier. The students guide would be special in bitted to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each members of the committee separately to the director in a sealed envelope.

The Marking shall be as follows.

Internal: 100 marks

By the Supervisor – 50 marks

By Committee appointed by the Director – 50 marks

External: 100 marks By External examiner –100

Dissertation

Selection of Topic:

1. All students pursuing M.Sc. shall select and propose a topic of dissertation in the first week of the semester. Care should be taken that the topic selected is

not directly related to the subjects of the course being pursued or thesis work, if any. The proposed topic should be submitted to the course coordinator.

2. The course coordinator shall forward the list of the topics to the coordinator of concerned department, who will consolidate the list including some more topics, in consultation with the faculty of the department. The topics will then be allocated to the students along with the name of the faculty guide and also forwarded to the director for approval.
3. On approval by the Director, the list shall be displayed on the notice board and the students will also be accordingly informed by the course coordinator within three weeks of the commencement of the semester.

Preparation of Dissertation:

1. The student shall meet the supervisor for the necessary guidance for their preparation for the seminar.
2. During the next two to four weeks the student will read the primary literature related to the topic under the guidance of supervisor.
3. After necessary collection of data and literature survey, the students must prepare a report. The report shall be arranged in the sequence as per following format & lay out plan: -

a. Top Sheet of transparent plastic.

b. Top cover.

c. Preliminary pages.

(i) Title page

(ii) Certification page.

(iii) Acknowledgment.

(iv) Abstract.

(v) Table of Content.

(vi) List of Figures and Tables.

(vii) Nomenclature.

d. Chapters (Main Material).

e. Appendices, If any.

f. Bibliography/ References.

g. Evaluation Form.

h. Back Cover (Blank sheet).

i. Back Sheet of Plastic (May be opaque or transparent).

(a). Title Page: - The Title Page cover shall be as Under:

……………………………Title of Dissertation……………………………

Submitted in Partial fulfilment of the requirement for the degree of

Master of Science

In

Physics

By

Name of Student in capital Letters
(Roll No.)

Under the Supervision of
(Name of Supervisor with designation)

Department of Physics

Invertis Institute of Applied Sciences & Humanities

Invertis University

Bareilly (U.P.)-243123, India

MONTH AND YEAR

Department of Physics

Invertis Institute of Applied Sciences & Humanities

(b). Certification page: - This shall be as under

The dissertation Report and Title "Name of the Topic of Dissertation" submitted by Mr./Ms. (Name of the student) (Roll No.) may be accepted for being evaluated-

Date: **Signature Place:**

(Name of Supervisor)

Note:

For Supervisor: If you choose not to sign the acceptance certificate above, please indicate reasons for the same from amongst those given below:

I. The amount of time and effort put in by the student is not sufficient;

II. The amount of work put in by the student is not adequate;

III. The report does not represent the actual work that was done / expected to be done;

IV. Any other objection (Please elaborate)

(c)- Abstract: - A portion of dissertation grade will be based on the abstract. The abstract will be graded according to the adherence to accepted principles of English grammar and according to the adherence to the format described below. The dissertation abstract is an important record of the coverage of your topic and provides a valuable source of leading references for students and faculty alike. Accordingly, the abstract must serve as an introduction to your dissertation topic. It will include the key hypotheses, the major scientific findings and a brief conclusion. **The abstract will be limited to 500 words, excluding figures, tables and references.** The abstract will include references to the research articles upon which the dissertation is based as well as research articles that have served as key background material.

(d). Table of Content: - This shall be

as under SAMPLE SHEET FOR

TABLE OF CONTENTS

TABLE OF CONTENTS

1 Introduction
1.1 ....
1.2 ....
1.3 ....
2 …………………..
3 …………………..
4 References/Bibliography

(e). List of Figures and Tables: - This will be as under
List of Figures and Tables - sample entries are given below:
List of Figures

Figure No.	Caption / Title Page No.
2.1 Schematic representation of a double layered droplet	... 21
…………..	
3.2 Variation in rate versus concentration	... 32

List of Tables - sample entries are given below:
List of Tables

Table No.		Caption / Title Page No.
2.1	Thickness of a double layered droplet	... 22
…………….		
3.2	Variation in rate versus concentration	...

3
4

(f). Main Pages- The Main report should be divided in chapters (1, 2, 3 ….. etc.) and structured into sections (1.1, 1.2 ……..etc) and subsections (1.2.1, 1.2.2, ….. etc). Suitable title should be given for sections and subsections, where necessary. Referencing style- wherever reference is given in the main pages it should have the following format.

The values of thermal conductivities for a variety of substances have been reported by Varma (1982). For polymers, however, the information is more limited and some recent reviews have attempted to fill the gaps (Batchelor and Shah, 1985).
For two authors - (Batchelor and Kapur, 1985)
For more than two authors - (Batchelor et al., 1986)
By same author/combination of authors in the same year – (Batchelor, 1978a; Batchelor, 1978b; Batchelor et al., 1978)

(g) Bibliography/References- In the bibliography/ references list standard formats must be used. The typical formats are given blow-

Journal articles: - David, A.B., Pandit, M.M. and Sinha, B.K., 1991, "Measurement of surface viscosity by tensiometric methods", Chem. Engng Sci.47, 931-945.

Books: - Doraiswamy, L.K. and Sharma, M.M., 1984, "Heterogeneous Reactions-Vol 1", Wiley, New York, *pp* 89-90.

Edited books/Compilations/Handbooks: - Patel, A.B., 1989, "Liquid -liquid dispersions", in Dispersed Systems Handbook, Hardy, L.C. and Jameson, P.B. (Eds.), McGraw Hill, Tokyo, *pp* 165-178. Lynch, A.B. (Ed.), 1972, "Technical Writing", Prentice Hall, London.

Theses/Dissertations: - Pradhan, S.S., 1992, "Hydrodynamic and mass transfer characteristics of packed extraction columns", Ph.D. Thesis, University of Manchester, Manchester, U.K.

Citations from abstracts: - Lee, S. and Demlow, B.X., 1985, US Patent 5,657,543, *Cf* C.A. *56*, 845674.

Personal Communications: - Reddy, A.R., 1993, personal communication at private meeting on 22 October 1992 at Physics Department, Indian Institute of Technology, Delhi.

Electronic sources (web material and the like)- For citing web pages and electronic documents, use the APA style given at:
http://www.apastyle.org/elecsource.html

(h) Evaluation Form:- Three sheets of evaluation form should be attached in the report as under.

a. Evaluation form for supervisor and other Internal Examiner.

b. Evaluation form for external examiners.

c. Summary Sheet.

(i). Evaluation form for Guide & Internal

- EVALUATION SHEET

(To be filled by Supervisor & Internal Examiners only)

Name of Candidate:

Roll No:

Class and Section:

S. No.	**Details**	**Marks (10)**	**Marks (10)**
		Supervisor	**Internal Examiner**
1.	OBJECTIVE IDENTIFIED UNDERSTOOD		
2.	LITERATURE REVIEW Organization, Critical review)		
3.	DISCUSSION/CONCLUSIONS (Clarity, Exhaustive)		
4.	SLIDES/PRESENTATION SUBMITTED (Readable, Adequate)		
5.	FREQUENCY OF INTERACTION (Timely submission, Interest shown, Depth, Attitude)		
	Total (Out of 50)		
	Total (Out of 100)		

Name & Signature: **Name & Signature:**

Date: **Date:**

EVALUATION SHEET FOR EXTERNAL EXAMINER

(To be filled by the External Examiner only)

Name of Candidate:

Roll No:

I. For use by **External Examiner ONLY**

S.No.	**Details**	**Marks (10)**
1.	OBJECTIVE IDENTIFIED & UNDERSTOOD	
2.	LITERATURE REVIEW / BACKGROUND WORK (Coverage, Organization, Critical review)	
3.	DISCUSSION/CONCLUSIONS (Clarity, Exhaustive)	
4.	POWER POINT PRESENTATION (Clear, Structured)	
5.	SLIDES (Readable, Adequate)	

	Total (Out of 50)	

Name & Signature:
Date:

EVALUATION SUMMARY SHEET (To be filled by External Examiner)

Name and Roll No.	**Internal Examiner (100)**	**External Examiner (100)**	**Total (200) Result**	**(Pass/Fail)**

Note: - The summary sheet is to be completed for all students and the same shall also be compiled for all students examined by External Examiner. The Format shall be provided by the course coordinator.

(j). General Points for Dissertation

1. The report should be typed on A4 sheet. The Paper should be of 70-90 GSM.
2. Each page should have minimum margins as under-
a. Left 1.5 inches
b. Right 0.5 Inches
c. Top 1 Inch
d. Bottom 1 Inch (Excluding Footer, If any)
3. The printing should be only on one side of the paper
4. The font for normal text should Times New Roman, 14size for text and 16size for heading and should be typed in double space. The references may be printed in Italics or in different fonts.
5. The Total Report should not exceed 50 pages including top cover and blank pages.
6. A CD of the report should be pasted/ attached on the bottom page of the report.
7. Similarly, a hard copy of the presentation (Two slides per page) should be attached along with the report and a soft copy should be included in the CD.
8. Three copies completed in all respect as given above are to be submitted to the Supervisor. One copy will be kept in departmental/University Library, one will be return to the student and third copy will be for the Supervisor.
9. The power point presentation should not exceed 30 minutes which include 10 minutes for discussion/Viva.

Viva- voce Students will prepare the viva, which should be based on their subject. The student will be assigned a faculty guide who good the supervisor of the students. The faculty would be identified before the end of the III semester. The faculty will take the full responsibility for preparing the viva to the students.
The evaluation committee shall consist of faculty members constituted by the college which would be comprised of at least three members comprising of the department Coordinator's Class Coordinator and a nominee of the Director. The student's supervisor would be special invitee to the viva. The viva session shall be an open house session. The internal marks would be the average of the marks given by each

members of the committee in a sealed envelope.