M.Sc. Physics

Employability **Entrepreneurship** **Skill Development**

Name of the Programme	Course code	Title of The Course	Employability	Entrepreneurship	Skill development
M.Sc Physics	PGPD	Methods of Spectroscopy			✓
	PGPE1	Microprocessor and Microcontroller	✓		
	PGPE2	Numerical Methods and C++ Programming		✓	
	PGPE3	Nano Materials and Applications			✓
	PGPE4	Communication Physics			✓
	PGPE5	Advanced Experimental Physics			✓
	PGPA	Mathematical Physics	✓		
	PGPD	Classical Dynamics and relativity	✓	✓	
	PGPC	Electronics		✓	✓
	PGPF	Electromagnetic Theory	✓		
	PGPG	Quantum Mechanics	✓		
	PGPI	Statistical Mechanics		✓	✓
	PGPJ	Solid state Physics	✓		
	PGPL	Nuclear and Particle Physics	✓		
	PGPM	Advanced Physics		✓	✓

M.Sc., Physics
Employability

Course & Title	**ELECTIVE COURSE I / MICROPROCESSOR AND MICROCONTROLLER**		
Class	**I MSc Physics**	**Semester**	**II**
Internal Marks -25	External Marks-75	Total Marks: 100	

Course Objectives

- To understand the basic concept of microprocessor.
- To understand techniques for faster execution of instructions and improve speed of operation and performance microprocessors.
- To learn the fundamental programming concept and methodologies.
- To understand the basic architecture of intel 8085 microprocessor.
- To practice the fundamental programming methodologies in c programming language.

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
UNIT	**CONTENT**	**NO OF HOURS**
I	**MICROPROCESSOR ARCHITECTURE AND INTERFACING** Intel 8085 microprocessor architecture – Pin configuration – Instruction cycle – Timing diagram – Instruction and data formats – Addressing modes -- Memory mapping and I/O mapping I/O scheme-- Memory mapping I/O interfacing --Data transfer schemes -- Synchronous and asynchronous data transfer – Interrupt driven data transfer - Interrupts of Intel 8085.	**15 Hrs**
II	**UNIT II ASSEMBLY LANGUAGE PROGRAMS (8085 ONLY)** BCD arithmetic –Addition and subtraction two 8-bit and 16-bit numbers--Largest and smallest numbers in a data set – Ascending order and descending order –Sum of a series of a 8-bit numbers – Sum of a series of multibyte decimal numbers – Square root of a number – Block movement of data -- Time delay –Square-wave generator.	**15 Hrs**

III	**PERIPHERAL DEVICES AND MICROPROCESSOR APPLICATIONS** Generation of control signals for memory and I/O devices - I/O ports -- Programmable peripheral interface – Architecture of 8255A -Control word—Programmable interrupt controller (8259) 8279- Key board interfacing- Programmable counter- Intel 8253 -Architecture, control word and operation – Block diagram and interfacing of analog to digital converter (ADC 0800) – Digital to analog converter (DAC 0800)– Stepper motor – Traffic control.	**15 Hrs**
IV	**MICROCONTROLLER 8051** Features of 8051– Architecture –Pin configuration –Memory organization External data and program memory -- Counters and timers – Serial data input/output– Interrupt structure – External interrupts – Addressing modes -- Comparison between microprocessor and microcontroller.	**15 Hrs**
V	**8051 INSTRUCTION SET AND PROGRAMMING** Instruction set – Data transfer, arithmetic and logical instructions – Boolean variable manipulation instructions – Program and machine control instructions – Simple programs – Addition and subtraction of two 8-bit and 16-bit numbers – Division – Multiplication -- Largest number in a set – Sum of a set of numbers.	**15 Hrs**

Text Books:

1. 1.B.Ram, Fundamentals of Microprocessor and Microcomputers (DhanpatRaiPub., New Delhi,2006).
2. R. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085

Reference Books:

1. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, The 8051 Microcontroller and Embbeded
2. Systems using Assembly and C (Dorling Kindersley, New Delhi, 2013).
3. A.P. Godse and D.A.Godse, Microprocessors and Microcontrollers (Technical Pub., Pune, 2008).

Web-Resources:

1. https://www.javatpoint.com/microprocessor-vs-microcontroller
2. https://www.vssut.ac.in/lecture_notes/lecture1423813120.pdf

Course Outcome:

CO1: Write programs to run on 8085 microprocessor.

CO2: Understand and device techniques for faster execution of instruction, improve speed of operations.

CO3: Understand microprocessor and its advantage.

CO4: Describe the fundamental components of a C program e.g source file, header file, main function , functions and libraries.

CO5: Explain and apply fundamental syntax rules for identifies , declarations, expressions, statements and functions.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	M	S	S	S	S	M	M	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

Course & Title	Elective Course I **/ DATA COMMUNICATION AND COMPUTER NETWORKS**		
Class	**I MSc Physics**	**Semester**	**II**
Internal Marks -25	External Marks-75	Total Marks: 100	

Course Objectives

- Become familiar with layered communication architectures (OSI and TCP/IP).
- Understand the client/server model and key application layer protocols.
- Learn sockets programming and how to implement client/server programs.
- Understand the concepts of reliable data transfer and how TCP implements these concepts.
- Know the principles of congestion control and trade-offs in fairness and efficiency.

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
UNIT	**CONTENT**	**NO OF HOURS**
I	Data transmission and encoding Concepts: Analog and Digital transmission, Transmission impairments-Transmission media-Synchronous / Asynchronous transmission-Line configurations-interfacing. Digital data digital signals-Variations of NRZ and bi-phase-Digital data Analog signals-ASK, FSK, PSK, QPSK-Analog data digital signals-PCM, DM.	**15 Hrs**
II	Introduction and services - Error detection and correction - Multiple access protocols - LANs o Addressing & ARP - Link virtualization o MPLS • Data center networking - Web request processing - Data Link Control Flow control, Error control-HDLC, Multiplexing.	**15 Hrs**
III	Introduction to Computer Networks and the Physical Layer Introduction: The uses of computer networks-Network hardware-Network software-Reference models, Example of networks-Network standardization. The physical layer: The theoretical basis for data communication-Guided	**15 Hrs**

	Transmission media-Wireless transmission.	
IV	Error detection and correction-Elementary data link protocols-Sliding window protocols-Example of data link protocols-ETHERNET. The network layer: Network layer design issues-Routing algorithms-Congestion control algorithms- - Ethernet o Switches o VLANs o PPP	**15 Hrs**
V	The transport and the Application Layers The transport layer: Transport layer design issues-Transport protocols-Simple transport protocol-Internet transport protocols UDP, TCP. The application layer: Domain name system-Electronic mail-World Wide Web.	**15 Hrs**

Text Books:

1. Edition, 2008.
2. Andrew S. Tanenbaum, " Computer networks", Prentice-Hall of India, New Delhi, 4th edition 2005.
3. Behrouz Forouzan, "Introduction to Data Communication and Networking", Tata McGraw-Hill, 2000.

Reference Books:

1. Douglas E. Comer, "Internet working with TCP/IP-Volume-I", Prentice-Hall of India, 4th Edition, 2001.
2. Paub and Schilling, "Principles of Communication System", MacGraw Hill, 1986.
3. James F. Kurose and Keith W. Ross, "Computer Networking-A top down Approach Featuring the Internet", Pearson Education, Asia, 3rd Edition-2006.

Web-Resources:

1. http://nptel.ac.in/courses/106105082/
2. http://www.networkworld.com/blogs

Course Outcome:

CO 1: Understand importance of data communication systems and fundamentals.
CO 2: Distinguish and relate various physical Medias, interfacing standards and adapters.
CO 3: Explain various flow control techniques.
CO 4: Analyze short range and long range wireless technologies
CO 5: Analyze various modulation technique in analog and digital careery system

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	M	S	S	S	S	S	S	S	M
CO3	S	S	S	S	M	S	S	S	S	S
CO4	S	M	S	S	M	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	M	S

S – Strongly Correlating
M – Moderately Correlating
W – Weakly Correlating
N – No Correlation

M.Sc., Physics
Entrepreneurship

Course & Title	**ELECTIVE COURSE II / NUMERICAL METHODS AND C++ PROGRAMMING**		
Class	**I MSc Physics**	**Semester**	**II**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To learn the necessarily of methods of least square for fitting a graph. • To learn the numerical methods of computing certain mathematical quantities, construction and evaluation of a function and solution of an ordinary differential equation. • To Write C++ computer programming necessary for numerical simulation of physical problems. • Know about the basis theory of errors, their analysis, estimation with examples of simple experiments in physics. Learn to write C++ Program for all the methods.	
UNIT	**CONTENT**	**NO OF HOURS**
I	**CURVE FITTING AND INTERPOLATION** **CURVE FITTING:** Method of least-squares - Straight-line fit -- Exponential and power-law fits. **INTERPOLATION:** Newton interpolation polynomial: Linear interpolation, Higher-order polynomials and first-order divided differences – Gregory--Newton interpolation polynomials – Lagrange interpolation.	**15 Hrs**
II	**SOLUTIONS OF LINEAR AND NONLINEAR EQUATIONS** **SIMULTANEOUS LINEAR EQUATIONS:** Upper triangular form and back substitution –Augmented matrix -- Gauss elimination method -- Jordan's	**15 Hrs**

	modification -- Inverse of a matrix by Gauss--Jordan method. **ROOTS OF NONLINEAR EQUATIONS:** Bi-section method and Newton--Raphson method.	
III	**NUMERICAL INTEGRATION AND DIFFERENTIATION** **NUMERICAL INTEGRATION:** Trapezoidal and Simpson's 1/3 rules -- Errors in the formulae -- Composite trapezoidal and Simpson's 1/3 rules -Simpson's 3/8 rules - Errors in the formulae.	**15 Hrs**
IV	**PROGRAMMING IN C++** Constants and variables -- I/O operators and statements -- Header files -- Main function – Conditional statements -- Switch statement -- Void function -- Function program -- For, while and do-while statements -- Break, continue and go to statements - Arrays.	**15 Hrs**
V	**PROGRAMMING IN** C++ 1. Least-squares curve fitting – Straight-line fit 2. Least-squares curve fitting – Exponential fit 3. Real roots of one-dimensional nonlinear equations -- Newton Raphson method 4. Complex roots of one-dimensional nonlinear equations -- Newton Raphson method 5. Interpolation – Lagrange method 6. Numerical integration – Composite trapezoidal rule 7. Numerical integration – Composite Simpson's 1/3 rule	**15 Hrs**

Text Books:

1. J. R. Hubbard, Programming with C++ (McGraw-Hill, New Delhi, 2006).
2. E. Balagurusamy, Objected Oriented Programming in C++ (McGraw Hill, New Delhi,

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation (New Age International, New Delhi, 1993).
2. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering (Prentice-Hall of India, New Delhi, 1998).

Web-Resources:

1. Fundamental of Numerical Methods and Data Analysis-G.Collins.pdf

Course Outcome:

CO 1: To Equip them with sufficient Knowledge base of physics so that they do not find any difficulty pursuing higher Education

CO 2: Trained practical exposure which could equip to face the challenges in Physics.

CO 3: Understanding the Programming in C++ in constants and variables of the functions

CO 4: To Write C++ computer programming necessary for numerical integration to trapezoidal and simpson 's 1/3 rule

CO 5: Understand the various statements and Arrays.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	M	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	M	S	S	S	S	S	S	M	S

S – Strongly Correlating

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Course & Title	ELECTIVE COURSE II / COMPUTER ORGANIZATION		
Class	**I MSc Physics**	**Semester**	**II**
Internal Marks - 25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• Understand the organization of a computer with its various processing units, memory and peripherals. • Understand the modern computer with its various processing units. Also the Performance measurement of the computer system. • In addition to this the memory management system of the computer. • They can analyze the performance of a computer using the performance equation Understanding of different instruction types	
UNIT	**CONTENT**	**NO OF HOURS**
I	**Basic Structures of Computers** Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Basic Operational Concepts, Bus Structures.	**15 Hrs**
II	**Machine Instructions & Programmes** Memory Locations and Addresses , Byte Addressability, Big Endian and Little Endian Assignments, Word Alignment, Accessing numbers, characters and character strings, Memory Operations, Instruction and Instruction sequencing, Register Transfer notation, Assembly Language notation, Basic instruction types, Instruction execution and straight line sequencing, Branching, Condition codes, Addressing modes, Implementation of variables and constants, Indirection and pointers, Indexing and arrays, Relative addressing, Additional modes, Assembly Language, Assembler directives, Assembly and execution of programs, Basic Input- Output Operations.	**15 Hrs**

III	**Basic Processing Unit** Some Fundamental Concepts, Register transfers, Performing an Arithmetic or Logic operation, Fetching a word from memory, Storing a word in memory, Execution of a complete Instruction, Branch instructions, Multiple Bus Organization, Hardwired Control(basic block diagram only), A complete processor, Basic organization of Micro programmed Control Unit	**15 Hrs**
IV	**Input Output Organization** Accessing I/O Devices, Interrupts, Interrupt Hardware, Enabling and Disabling\ Interrupts, Handling Multiple Devices, Controlling Device requests, Exceptions, Direct Memory Access, Bus arbitration, Buses, Synchronous bus, Asynchronous bus, Interface Circuits, Parallel port and Serial port (Basic concept only), Standard I/O Interfaces (Basic concepts only), Peripheral Component Interconnect (PCI) Bus , SCSI Bus(Basic concepts only), Universal Serial Bus (USB) (Basic concepts only)	**15 Hrs**
V	**The Memory System** Some Basic Concepts, Semiconductor RAM Memories, Internal Organization of memory chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs, Structure of larger memories, Memory system consideration, Rambus memory, Read-Only Memories- ROM, PROM, EPROM, EEPROM, Flash Memory, Speed, Size and Cost, Cache Memories.	**15 Hrs**

Text Books:

1. Computer Organization, Carl Hamacher, zvonko Vranesic and Safwat Zaky, McGraw Hill, 5th edition
2. Advanced Computer Architecture (A practical approach), Rajiv Chopra, S. Chand, Revised edition, reprint 2014, ISBN8121930774

Reference Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. Computer architecture and organization , 4th edition , P Chakraborty , JAICO Publishers

Web-Resources:

1. http://www.srmuniv.ac.in/downloads/computer_architecture.pdf
2. http://www.dauniv.ac.in/downloads/CArch_PPTs/CompArchCh06L01PipeLine.pdf
3. http://elearning.vtu.ac.in/06CS46.html

4. . http://nptel.ac.in/courses/Webcourse-contents/IIT %20Guwahati/comp_org_arc/web/

Course Outcome:

CO 1: Recognize and explain the functional units of computers

CO 2: Describe assembly languages and machine instructions by analyzing how the data is stored and fetched from memory.

CO 3: Explain the execution of complete instruction and bus organizations.

CO 4: Identify various interrupt handling mechanism and buses.

CO 5: Differentiate between different types of memories.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	M	S	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	S
CO4	S	S	S	M	S	S	S	M	S	S
CO5	S	S	M	M	S	S	S	M	S	S

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W – Weakly Correlating

N – No Correlation

Core Course & Title	ELECTIVE COURSE-V ADVANCED EXPERIMENTAL TECHNIQUES		
Class	**II MSc Physics**	**Semester**	**IV**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To make the students understand the principles. • To involve in measuring devices, error measurements, the standards of measurements. • To understand performance characteristics of an instrumentation system, transducers, and vibration sensing devices. • To apply the techniques.	
UNIT	**CONTENT**	**NO OF HOURS**
I	**X ray diffraction methods** Sterographic projection - wulff net – measurement of angle between poles- determination of Miller indices of an unknown pole. X- ray diffraction under non ideal conditions – Scherrer formula for estimation ofparticlesize. Laue method, rotating crystal method – powder method-Scherrer camera.	**15 Hrs**
II	**Spectroscopic techniques** Mass spectroscopy and Xray emission spectroscopy (principle and limitations), Quadrupole mass spectrometer- X ray photo electron spectroscopy (XPS), Auger electron spectroscopy (AES) – laser Raman spectroscopy – Fourier transform infrared spectroscopy.	**15 Hrs**
III	**Electron beam techniques** Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Ruther ford back scattering spectrometry (RBS), Ion beam techniques, Field ion microscopy (IM)	**15 Hrs**

IV	**Optical techniques** Use of polarized light in the study of transparent materials – polarized light microscopy – coloscopy –compensator techniques– Babinet– Soleil compensator - Berek compensator.	**15 Hrs**
V	**Thermal analytical techniques** Differential thermal analysis – Instrumentation – differential scanning calorimetry – thermo gravimetric analysis – Instrumentation.	**15 Hrs**

Text Books:

1. Cullity BD, Elements of X ray diffraction Addison Wesley PublishingCo, 1967,$_3$rd Edition.
2. Dieter K Schroder, *Semiconductor material and Characterization* John Wiley and sons inc, 1990, 2nd edition).
3. PruttonM ,Surface Physics,ClarendonPress,1975,2nd edition.
4. M.Woolfson,An IntroductiontoXrayCrystallography,CambridgeCambridge,1970,2nd edition.

Reference Books:

1. Cullity BD, Elements of X ray diffraction Addison Wesley PublishingCo, 1967,$_3$rd Edition.
2. Dieter K Schroder, *Semiconductor material and Characterization* John Wiley and sons inc, 1990, 2nd edition).
3. PruttonM ,Surface Physics,ClarendonPress,1975,2nd edition.
4. M.Woolfson,An IntroductiontoXrayCrystallography,CambridgeCambridge,1970,2nd edition.

Web-Resources:

1. https://www.amazon.in/Advanced-Experimental-Techniques-Physics-Prakashan/dp/B07YCM821T
2. https://eng.ua.edu/tag/advanced-experimental-techniques/

Course Outcome:

CO 1: The students are expected to learn the art and science of carrying out experimental research.

CO 2: At the end of the course a student should be able to design and carry out an experiment on his/her own.

CO 3: This is an important skill which anybody wanting to do experimental research is expected to possess.

CO 4: To learn the art and science of carrying out experimental research

CO 5: Techniques of curve fitting and parameter estimation

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	M	S	M	S	S	S	S	S

S – Strongly Correlating
M – Moderately Correlating
W – Weakly Correlating
N – No Correlation

Core Course & Title	ELECTIVE COURSE-V BASICS OF COMPUTATIONAL NANOELECTRONICS		
Class	**II Msc physics**	**Semester**	**IV**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• The purpose of this course is to introduce the physical concepts underlying the phenomena in the mesoscopic systems. • The aim of the course is, how to model and solve nanojunctions. • In this course, students will learn some new advanced topics such as: quantization of electrical conductance, Coulomb Blockade, quantum capacitance and etc.	
UNIT	**CONTENT**	**NO OF HOURS**
I	Two Key Concepts, Why Electrons Flow, Conductance Formula, Ballistic Conductance, Diffusive Conductance, Connecting Ballistic to Diffusive, Drude Formula, Characteristic Length Scale, Transport Regime.	**15 Hrs**
II	Density of States, Number of Modes, Electron Density, Conductivity vs. Electron Density, Quantum Capacitance, Nanotransistors, What and Where is the Voltage, Spin Voltage, Current from QuasiFermi Levels, Electrostatic Potential	**15 Hrs**
III	What a Probe Measures, Boltzmann Equation, Semiclassical Model, Quantum Model, Landauer Formulas, NEGF Equations, Self-Energy, Surface Green's Function, Current Operator, Scattering Theory, Transmission, Rate Equations.	**15 Hrs**
IV	Spin Transport, Vectors and Spinors, Spin-Orbit Coupling, Spin Hamiltonian, Spin Density/Current, Seebeck Coefficient, heat Current, Second Law, Entropy, Fuel Value of Information	**15 Hrs**
V	Application of Nanomaterials Molecular Electronics and	**15 Hrs**

	Nanoelectronics – Nanobots- Biological Applications – Quantum Devices – Nanomechanics - Carbon Nanotube – Photonics- Nano structures as single electron transistor –principle and design.	

Text Books:

1. Lessons from Nanoelectronics: A New Perspective on Transport: Volume 1 & 2 by Supriyo Datta (World Scientific) G:
2. Theory of Quantum Transport at Nanoscale: An Introduction by Dmitry A Ryndyk (Springer) H:
3. Quantum Transport: Introduction to Nanoscience by Yuli V. Nazarov and Yaroslav M. Blanter (CAMBRIDGE)

Reference Books:

1. S.P. Gaponenko, Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1980.
2. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 2002. \

Web-Resources:

1. https://www.ecc.itu.edu.tr/index.php/ELE_523E
2. https://www.nature.com/subjects/computational-nanotechnology

Course Outcome:

CO 1: Discuss the types of nanotechnology, molecular technology and the preparation of nano materials.

CO 2: Explains the fundamental of the devices such as logic devices, field effect devices, and spintronics.

CO 3: Describe the concepts of silicon MOSFET and Quantum Transport Devices.

CO 4: Summarize the types, synthesis, interconnects and applications of carbon nano tubes.

CO 5: Explain the concepts, functions, fabrications and applications of molecular electronics

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	M	S	S
CO2	S	S	M	M	S	S	S	S	S	S
CO3	S	S	M	M	S	S	S	M	S	S
CO4	S	S	M	M	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

M.Sc., Physics
Skill development

Core Course & Title	**CORE COURSE IV / METHOD OF SPECTROSCOPY**		
Class	**I MSc Physics**	**Semester**	**I**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To applications in the determinations of atomic structure, chemical composition and Physical properties of materials. • To explain the absorption and emission spectra. • To justify the difference in intensity between stokes and antistokes line. • Explain NMR Spectroscopy knows how nuclear spins are affected by a magnetic field. • To study Frank Condon principle.	
UNIT	**CONTENT**	**NO OF HOURS**
Unit I	**ATOMIC SPECTROSCOPY** Hyperfine structure – Zeeman and Paschen—Back effect of one and two electron systems – Selection rules – Stark effect. **MICROWAVE AND INFRARED ABSORPTION SPECTROSCOPIES** **MICROWAVE SPECTROSCOPY:** Rotation of diatomic molecules – Rotational spectra of polyatomic molecules – Spectrum of non rigid rotator – Experimental technique – Polyatomic molecules – Linear, symmetric top and asymmetric top molecules.	**18 Hrs**
II	**INFRARED ABSORPTION SPECTROSCOPY:** Vibrating diatomic molecule –Anharmonic oscillator – Diatomic vibrating rotator – Vibration-rotation spectrum of carbon monoxide – Influence of rotation on the spectrum of polyatomic molecules – Linear and symmetric top molecules.	**18 Hrs**
III	**RAMAN SPECTROSCOPY**	**18 Hrs**

	Quantum theory of Raman effect –Pure rotational Raman spectra – Linear molecules – Symmetric top molecules – Vibration Raman spectra – Rotational fine structure – Structural determination – Raman spectra – Instrumentation – Raman effect and molecular structure – Raman activity of molecular vibrations.	
IV	**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY** Basic principles –Quantum theory of NMR- Bloch equations and solutions – Shielding and deshielding effects – Chemical shift – Spin lattice and spin-spin relaxation– Coupling constants – Experimental technique – Double coil method – Structural diagnosis and hydrogen bonding.	**18 Hrs**
V	**ELECTRONIC AND ESR SPECTROSCOPY** **ELECTRONIC SPECTROSCOPY OF MOLECULES:** Electronic spectra of diatomic molecules -- The Franck-Condon principle – Dissociation energy and dissociation products – Rotational fine structure of electronic vibration transitions. **ESR:** Theory of ESR – Resonance conditions – Experimental study – ESR spectrometer – Crystalline solids and free radicals in solution – Determination of g factor.	**18 Hrs**
VI	• Infrared (IR) Spectroscopy. ... • Ultraviolet-Visible (UV/Vis) Spectroscopy. ... • Nuclear Magnetic Resonance (NMR) Spectroscopy. ... • Raman Spectroscopy. ... • X-Ray Spectroscopy.	**Project**

Text Books:

1. Gupta kumar Sharma - Elements of Spectroscopy -10th Edition
2. C.N. Banwell, Fundamentals of Molecular Spectroscopy (McGraw Hill, New York, 1981).

Reference Books:

1. J. Michael Hollas, Modern Spectroscopy (Wiley India, New Delhi, 2004).
2. B.P. Straughan and S. Walker, Spectroscopy Volumes I--III (Chapman and Hall, New York, 1976).

Web-Resources:

1. https://guides.lib.unc.edu/spectroscopy/general.
2. https://guides.lib.unc.edu/spectroscopy/general.
3. ElectronMicroscopy-PrinciplesandFundamentals-S.Amenlinckx,etal.,(Wiley-VCH,1997) WW.pdf

Course Outcome:

CO 1: Explain what it means to use Spectroscopic methods for qualitative and quantitative analysis.

CO 2: Compare and contrast of atomic and molecular spectra.

CO 3: Explain the difference between stokes and anti-stokes line in a Raman spectrum.

CO 4: Understanding of Quantum theory and NMR spectroscopy.

CO 5: The probability of transition between vibration levels of two electronic states determined by Frank-Condon principle.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	M	S	S	S
CO2	S	S	S	S	S	S	M	M	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	M	S

S – Strongly Correlating

M – Moderately Correlating

W – Weakly Correlating

N – No Correlation

Course & Title	ELECTIVE COURSE-III Nano Materials and Applications		
Class	**II MSc Physics**	**Semester**	**III**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To understand the theoretical concepts involved in crystal growth and thin film sciences and to learn the basic characterizing techniques of materials. • To foundational knowledge of the Nanoscience and related fields. • To make the students acquire an understanding the Nanoscience and Applications • To help them understand in broad outline of Nanoscience and Nanotechnology. • For Nanomaterials understood the principles and Characterization Techniques. Understand and improved the application of Nanotechnology.	
UNIT	**CONTENT**	**NO OF HOURS**
I	**Back ground of Nano technology** Scientific revolution-Emergence of Nano technology, Challenges in Nano technology –Periodic Table, Atomic structures, Molecules and Phases-Energy, Atomic size, surfaces and dimensional space	**15 Hrs**
II	**Preparation of Nano Materials** Nano Material-Preparation-Top down-ball milling,Nano lithography-Bottom up, Self Assembly -Sol gel -Hydro thermal method-Polyol Process	**15 Hrs**
III	**carbon nano structures** Carbon molecules and carbon bond -- C60: Discovery and structure of C60 and its crystal -- Superconductivity in C60 -- Carbon nanotubes: Fabrication – Structure – Electrical properties – Vibrational properties –	**15 Hrs**

	Mechanical properties -- Applications (fuel cells, chemical sensors, catalysts).	
IV	**Characterization of Nanomaterials** Principles, experimental set-up, procedure and utility of scanning electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling microscope (STM) and scanning probe microscopy (SPM).	**15 Hrs**
V	**Applications** Molecular electronics and nanoelectronics – Nanorobots -- Biological applications of nanoparticles - Catalysis by gold nanoparticles – Band-gap engineered quantum devices -- Nanomechanics -- CNT emitters – Photoelectrochemical cells -- Photonic crystals – Plasmon waveguides.	**15 Hrs**

Text Books:

1. Manasi Karkare, Nano Technology Fundamentals and App1ications.
2. K. International Publishing House Limited.
3. Charles P. Poole JR and Frank Owens."Introduction to Nanotechnology" Wiley, 2003.
4. B.B. Laud, Non Linear Optics,2nd Edn. New Age International (P) Limited. Delhi,1991.

Reference Books:

e Books:

1. RobertW.Boyd, Non Linear Optics, 2ndEdn.AcademicPress,Newyork,2003.
2. K.Ravichandran, K.Swaminathan,B.SakthivelC.Pavidoss Introduction to Characterization of Nano Material and Thin Films(Publication JAZYM Publication)

Course Outcome:

CO 1: Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

CO 2: Apply their learned knowledge to develop Nanomaterial's.

CO 3: Choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.

CO 4: Appreciate enhanced sensitivity of nanomaterial based materials and their novel applications in industry.

CO 5: Understand the synthesis of nanomaterial and their application and the impact of nanomaterial on environment

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	M	M	S	S	S	S	S
CO3	S	S	M	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating
M – Moderately Correlating
W – Weakly Correlating
N – No Correlation

Course & Title	ELECTIVE COURSE-III / CRYSTAL PHYSICS		
Class	**II M.Sc Physics**	**Semester**	**III**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• To provide a qualitative idea on the fundamentals of growing crystals and characterizing the grown samples. • This paper will serve as an eye opener for students keen in research activities particularly in experimental physics. • To know the principles in the method involved in the growth of crystal. know the principles the advantage and the disadvantages different thin film deposition method. • To understanding the theories involve in crystal growth nucleation process and solution, melt and vapour growth techniques. To learn the importance of different thin films and coatings for a variety industrial applications.	
UNIT	**CONTENT**	**NO OF HOURS**
I	**NUCLEATION** Introduction-kinds of nucleation-equilibrium stability and Meta stable state-classical theory of nucleation-effect of soluble impurities on nucleation-determination of solubility-methods of induction period measurements-desupersaturation-steady state nucleation rate-nucleation parameters.	**15 Hrs**
II	**SOLUTION AND GEL GROWTH TECHNIQUES** Low temperature solution growth-slow cooling methods-temperature gradient method-criteria for optimizing solution growth parameters-basic apparatus for solution growth. Gel growth-structure of silica gel and gelling mechanism-nucleation control-merits of gel method-experimental methods- chemical reaction method-chemical reduction method-complex de complex method-solubility reduction method-sol	**15 Hrs**

	gel method.	
III	**HIGH TEMPERATURE AND OTHER TECHNIQUES OF GROWTH** Growth from melt-Bridgman, Czochralski, zone melting, Verneuil techniques-physical vapor deposition-flux growth-chemical vapor deposition chemical vapor transport-hydrothermal growth- epitaxial growth.	**15 Hrs**
IV	**OPTICAL STUDIES** Atomic absorption spectroscopy-UV-Visible-NIR spectroscopy-Experimental set ups for Fourier Transform Infrared analysis, FT-Raman vibrational spectroscopy and NMR Illustrations with selected crystals-Nonlinear optical phenomenon (qualitative)-Kurtz powder SHG method-photoconductivity and schematic set up for measurements-negative photoconductivity.	**15 Hrs**
V	**CRYSTAL CHARACTERIZATION** Thermal analysis-methods of thermal analysis-thermogravimetric analysis (TGA)-Differential thermal analysis (DTA)-Differential Scanning Calorimetry (DSC)-Mechanical studies-methods of hardness testing (qualitative)-Vickers hardness testing-correlation of microhardness with other properties-estimation of hardness number and work hardening coefficient (n)-dielectric studies-dielectric constant and dielectric loss measurements.	**15 Hrs**

Text Books:

1. Brice J. C. (1986), 'Crystal Growth Process', John Wiley and Sons, New York.
2. Brice J.C. (1973), 'The growth of crystals from liquids', North Holland publishing company, Amsterdam.
3. Buckley H.E. (1951), 'Crystal Growth', John Wiley and Sons, New York.
4. Pamplin B.R. (1980), 'Crystal Growth', Pergman Press, London.
5. Henisch H.K. (1988), 'Crystals in gels and Liesegang rings', Cambridge Univ. Press. USA

Reference Books:

1. R.T. Sane and Jagdish K Ghadge 'Thermal Analysis Theory and applications' Quest Publications 1997
2. V G Dmitriev, G.G. Gurzadyan, D.N. Nikigosyan; 'Handbook of Nonlinear optical crystals' Springer- Verlag 1991
3. Joshi V.N. (1990), 'Photoconductivity', Marcel Dekker, New York.

4. Santhanaraghavan P. and Ramasamy P. Crystal growth Process and Methods, (2000) KRU Publications, Kumbakonam.

Course Outcome:

CO 1: Students will learn about the fundamentals of

CO 2: Nucleation mechanism and different kinds of nucleation.

CO 3: To learn about important crystal growth technique like Bridgeman, czochralski (pulling method), solution growth and hydrothermal methods, physical and chemical vapor transport.

CO 4: To understand with various techniques involved in crystal growth.

CO 5: To determine various theoretical parameters.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	M	M	M	S	S	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	M	S	S	S

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N – No Correlation

Course & Title	ELECTIVE COURSE-IV / COMMUNICATION PHYSICS		
Class	**II M.Sc Physics**	**Semester**	**III**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• Students will demonstrate an understanding of multiple theoretical perspectives and diverse intellectual traditions in communication. • Students will demonstrate an understanding of importance of free expression. • Students will competency in human relational interaction. • To understanding of professional and ethical responsibility. An ability to communicate effectively	
UNIT	**CONTENT**	**NO OF HOURS**
I	**WAVE PROPAGATION** Fundamental of EM Waves - Free Space propagation –surface wave propagation –sky wave propagation space wave propagation-Troposphere scatter propagation-structure of Atmosphere-Virtual height-MUF-Lowest Usable Frequency-skip distance –Optimum length-duct propagation.	**15 Hrs**
II	**AMPLITUDE MODULATION** Introduction - Principle - AM - DSBSC, SSB, VSB Techniques-Generation of Amplitude modulation Signals-Generation of AM, DSBSC, SSB,VSB-Introduction to PAM, PCM, PPM, PWM	**15 Hrs**
III	**ANGLE MODULATION TECHNIQUES** Introduction of communication system- Elements of Communication System- Information-Transmitter, Channel, Receiver –Need for modulation-Theory of angle modulation techniques (FM, PM) - Comparison of Phase modulation and Frequency modulation-Characteristics of PM and FM –Practical issues in FM (Noise and	**15 Hrs**

	Frequency Modulation)	
IV	**ANTENNAS** Electromagnetic Radiation- Elementary doublet-Current and Voltage Distribution-Resonant Antennas, Radiation Pattern and length contraction- Antenna Resonance- Band width, Beam width and Polarization – Grounded and ungrounded Antennas-Effect of Height-Feed Point-impedance Matching.	**15 Hrs**
V	**ANTENNAS** Electromagnetic Radiation- Elementary doublet-Current and Voltage Distribution-Resonant Antennas, Radiation Pattern and length contraction- Antenna Resonance- Band width, Beam width and Polarization – Grounded and ungrounded Antennas-Effect of Height-Feed Point-impedance Matching.	**15 Hrs**

Text Books:

1. Kennedy and Davis, Electronic Communication System, Tata McGraw Hill,8th edition

Web-Resources:

1. www.math.ox.ac.uk
2. www.math.upenn.edu**.**
3. Mathematical Physics-A Modern Intro to its Foundations-S.Hassani(Springer,1999)WW.pdf

Course Outcome:

CO 1: Demonstrate critical and innovative thinking
CO 2: Display competence in oral, written and visual communication.
CO 3: Show an understanding of opportunities in the field of communication.
CO 4: Students will demonstrate an understanding of the impact of physics and science on society
CO 5: Identify the applications in communications.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	M	S	S	S	S	S
CO2	S	S	M	S	S	S	S	S	S	S
CO3	S	M	M	S	S	S	S	S	S	S
CO4	S	S	S	M	M	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	S

S – Strongly Correlating
M – Moderately Correlating

W – Weakly Correlating
N – No Correlation

Core Course & Title	**ELECTIVE COURSE-IV / LASER AND FIBER OPTICS**		
Class	**II MSc Physics**	**Semester**	**IV**
Internal Marks -25	External Marks-75	Total Marks: 100	

Cognitive Level	**K-1** Acquire/Remember **K-2** Understand **K-3** Apply **K-4** Analyze **K-5** Evaluate **K-6** Create	
Course Objectives	• Learn the underlying physics of Lasers and laser systems by combining the knowledge of gain media together with the aspects of design, configuration and operation of lasers. • Fundamental principles of stimulated emission and how to convert it into coherent light emission. • The manipulation of light i. e. mode selection, continuous and pulsed generation, spectral narrowing etc. • Applications of various lasers in various fields including scientific research to common use.	
UNIT	**CONTENT**	**NO OF HOURS**
I	**LASER AND FIBER OPTICS** **Lasers:** Basic concepts of stimulated emission-Population inversion and metastable state-Ruby laser and He –Ne laser production –applications. F**iber optics** : Introduction –Optical fiber – total –Critical angle - Principle of propagation of light through optical fibers – Type of optical fibers - Fiber optics communication system –Fiber optics sensors.	**15 Hrs**

II	**Laser Resonance and cavity modes:** ABCD law for Gaussian Beams; Gaussian beams in stable resonators; ABCD law applied to cavities; Mode volume, Resonance; Q- factor & finesse; Photon lifetime; Resonance of Hermite – Gaussian modes. 8 hrs 5. Laser oscillation: Threshold condition; Oscillation frequency, Oscillation and amplification in a homogeneously broadened transition; Gain saturation; Oscillations in an inhomogeneous system; Hole burning & Lamb dip.	**15 Hrs**
III	**FIBER OPTICAL SOURCES AND COUPLERS LED** LED materials – fiber LED coupling – LASER – spatial emission pattern of LASER – modulation response of LASER – single frequency LASER – light emitting transistor. Optical Couplers: Types of optical couplers – star couplers – T couplers – source to fiber coupling efficiency – opto-couplers and applications.	**15 Hrs**
IV	**ANALOG AND DIGITAL TRANSMISSION SYSTEM** Overview of analog links – multichannel transmission techniques – multichannel amplitude modulation – multichannel frequency modulation – digital transmission - line coding – NRZ codes RZ codes – Block codes	**15 Hrs**
V	**COHERENT OPTICAL FIBER COMMUNICATION SYSTEM** Fundamental concepts – homodyne detection – heterodyne detection – modulation techniques – direct detection OOK – OOK homodyne detection – PSK homodyne detection – heterodyne detection schemes – polarization control requirements.	**15 Hrs**

Text Books:

1. Optical Fiber Communication – Gerd Keiser – McGraw-Hill – 2nd Edition
2. Optical Communication System – John Gowar – Prentice Hall of India –
3. 2nd Edition
4. Optical fiber and fiber optic communication system – Subirkumarsarkar-
5. S.Chand – 4th Edition (2010).

Reference Books:

1. Svelto O.: Principles of Lasers, (V Edition), Springer 2010.
2. William Silfvast, Laser Fundamentals, Cambridge press, 2004.
3. Verdeyen,J.T.: Laser Electronics, (III Edition) Prentice Hall, 1995.
4. Govind P. Agarwal - Fiber Optic Communication System John Wiley & Sons (2002)

Web-Resources:

1. https://www.ikbooks.com/home/samplechapter?filename=190_Sample-Chapter.pdf
2. https://www.ikbooks.com/home/samplechapter?filename=190_Sample-Chapter.pdf

Course Outcome:

CO 1: Understand the principle and structure of optical fibers.

CO 2: Understand the working principle of fiber optical sources and couplers and apply it in the optical communication systems.

CO 3: Apply the fundamental principles of optics and light wave to design optical fiber communication systems.

CO 4: Understand different analog and digital transmission systems.

CO 5: Understand and apply the concepts of coherent optical modulation and detection techniques.

Mapping of COs with POs & PSOs:

CO/PO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

S – Strongly Correlating
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