Research Program of Department of Physics and Materials Science and Engineering

1. **Advanced Materials and Devices**

In recent years, discovery of new materials has improved human life through large number of useful technologies based on the functional properties of these materials. Be it industry or research organizations, development of new and better performing materials has taken centre stage of activity worldwide. With emergence of new tools and technologies, understanding of materials and capability of tailoring their properties to make them more functional and useful have tremendously increased. The capability of manipulation of materials and their properties is the key for making things with superior mechanical, electrical, magnetic and optical properties, more sustainable and cost-effective. This has made advanced materials and devices an attractive field to the industries related to automobile, information and communication technology, energy storage and energy conversion or any other industry concerning civil, defence or space applications. Research activities of the department are focused on Green energy materials and devices, Solar cells and LEDs, Ferroelectric and Multiferroic Materials, Piezoelectric materials for MEMS applications, Materials for Opto-chemical and fluorescence sensors, Molecular modeling and simulations of materials, Quantum dots, Metal-oxide nanostructures, and functional nanomaterials. Currently, *13 faculty members, and 18 research scholars* of the department are working in the area of Advanced Materials and Devices. *Five research projects worth Rs. 95.37179 Lac* received from various Govt. agencies have been completed/ ongoing. Two PhD thesis and 24 M. Tech thesis have already been completed *and 190 research papers* (87 in peer reviewed international journals, 75 in international conferences, and 28 in national conferences) have been published in this area.

2. Photonics, Plasma and Quantum Computing

The department is working on various aspects of applications in the field of photonics, plasma physics and quantum computing. The interaction of high power laser with plasma has emerged as a subject of world-wide subject due to its applications in laser fusion, particle accelerators, and radiation generation. Plasma can also be harnessed for waste disposal food processing and development of plasma medicine. Similarly, Photonics involves tremendous applications in communication, science and technology, medicine, image processing, defence, optical computing etc. Recently quantum computation and communication have evolved as very important fields of study as unconditional security achieved in quantum cryptography is un-achievable in classical world and as it can substantially speed-up computation if a scalable quantum computer is built. Research activities of the department are focused on photonic crystals and devices, optical fiber sensors, surface plasmon, higher order non-classical states, quantum cryptography, quantum gates and circuits, laser plasma interaction, and tera-hertz radiation generation. Currently, *7 faculty members, and 9 research scholars* of the department are working in the area of Photonics, Plasma and Quantum Computing. *Two research projects worth Rs. 14.91 Lac* received from various Govt. agencies have been completed/ ongoing. Two PhD thesis and one M. Tech thesis have already been completed *and 81 research papers* (40 in peer reviewed international journals, 4 in national journals, 30 in international conferences, and 7 in national conferences), one book chapter and a book entitled “Elements of Quantum Computation and Quantum Communication” authored by Anirban Pathak, CRC Press (Taylor and Francis) have been published.

Annexure PMSE-1

FUNDED RESEARCH PROJECTS – DEPTT. OF PMSE

S.N.	Name of PI	Duration	Amount Sanctioned *(Rs.)*	Subject/ Project Title	Funding Agency
1	**Dr. Anirban Pathak**	2006-09	216,000/-	Theoretical study of Single Photon Sources for Quantum computation **(Completed)**	Department of Science & Technology (DST)
2	**Dr. K. C. Mathur/ Dr. R. K. Dwivedi**	2008-11	700,000/-	Modernization of Physics and Materials Science and Engineering Lab **(Completed)**	All India Council of Technical Education (AICTE)
3	**Dr. Papia Chowdhury**	2010-14	936,000/-	Bistability due to intra-molecular and inter-molecular charge transfer in different environments	Department of Science & Technology (DST)
4	**Dr. Manoj Kumar**	2010-14	1,158,000/-	Synthesis and study of structural, dielectric, magnetic and magnetoelectric properties of multiferroic materials	Department of Science & Technology (DST)
5	**Dr. R. K. Dwivedi**	2010-12	1,612,800/-	Investigation on Multi Functional Properties in Substituted Multi ferroics **(Completed)**	Defence Res & Dev Organ (DRDO) , Min of Defence, GOI
6	**Dr. R. K. Dwivedi**	2011-14	5,131,179/-	Investigations on Multifunctional Properties of alkaline earth and rare earth doped BFe1-xTixO3 solid solutions	Department of Science & Technology (DST)
7	**Prof. Anirban Pathak**	2011-14	1,275,000/-	Theoretical study of higher order non-classicality and its applications	Department of Science & Technology (DST)
	Total amount (Rs.)		**11,028,979/-**		

Annexure PMSE-2

Publications in International Journals

2013

1. Priyanka, Prashant Chauhan, Gunjan Purohit "Relativistic ponderomotive effect on the propagation of rippled laser beam and the excitation of electron plasma wave in collisionless plasma" Optics Communications, Vol. 311, pp. 317-334, 2013 (Impact Factor:1.48)
2. Prakash Chandra Sati, Manisha Arora, Sunil Chauhan, Manoj Kumar and Sandeep Chhoker, "Rietveld analysis, magnetic, vibrational and impedance properties of $(Bi_{1-x}Pr_x)(Fe_{1-x}Zr_x)O_3$ ceramics" Journal of Materials Science: Materials in Electronics, vol. 24, pp. 5023-5034, 2013 [Indexed in SCOPUS, Impact factor: 1.48].
3. Sunil Chauhan, Manoj Kumar, Sandeep Chhoker and S.C. Katyal, "Structural, vibrational, optical and magnetic properties of sol-gel derived Nd doped ZnO Nanoparticles" Journal of Materials Science: Materials in Electronics, vol. 24, pp. 5102-5110, 2013 [Indexed in SCOPUS, Impact factor: 1.48]
4. Pal Vijayeta, Dwivedi R. K. and Thakur O. P., "Dielectric and Ferroelectric properties of lead free $[1-z\{(Bi_{1-x}La_x)_{0.50}(Na_{1-y}Li_y)_{0.50}TiO_3\}-zBaTiO_3]$, Advances in Materials Science and Engineering, Volume 2013, Article ID-125634, 7 pages (2013) [http://dx.doi.org/10.1155/2013/125634]. [IF = 0.50].
5. C. Shukla, A. Banerjee and A. Pathak, Bidirectional controlled teleportation by using 5-Qubit states: A generalized view, Int. J. Theor. Phys, 52 (2013) 3790-3796.
6. A. Pathak, J. Krepelka and J. Perina, Nonclassicality in Raman scattering: quantum entanglement, squeezing of vacuum fluctuations, sub-shot noise and joint photon-phonon number and integrated-intensity distribution, Phys. Lett. A 377 (2013) 2692-2701.
7. Srinet G, Kumar R, and Sajal V, ´ Structural, optical, vibrational, and magnetic properties of sol-gel derived Ni doped ZnO nanoparticles" Journal Of Applied Physics 114, 033912 (2013) [Impact factor: 2.16].
8. Sharma, Navneet K., Rani M., Sajal V., "Surface plasmon resonance based fiber optic sensor with double resonance dips", Sensors and Actuators B, vol. 188, pp. 326-333, 2013. [Impact factor: 3.535]
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11. Jha Priyanka A., Jha Pardeep K., Jha A.K. and Dwivedi R.K., "Dielectrical behavior of $(1-x)$ $[Ba\ Zr_{0.025}Ti_{0.975}O_3] - (x)$ $[BiFeO_3]$ $(x = 0.1\text{-}0.4)$ solid solutions", Materials Research bulletin, 48[1], 101-105, Jan 2013. [Impact Factor: 2.105].
12. Singh V., Subhash, Dwivedi R. K., Kumar M. and Kotnala R. K., "Multiferroic and optical properties of Pr substituted bismuth ferrite ceramics", Phys. Status Solidi A, vol. 210, No. 7, pp. 1442-1447, 2013. [Impact factor: 1.46]
13. Varshney P., Sajal V., Singh K. P., Kumar, R., Sharma Navneet K, "Strong terahetz radiation generation by beating of extra-ordinary mode lasers in a rippled density magnetized plasma", , Laser and Particle Beams , 31, 337–344, 2013. (Impact factor: 2.016).

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21. Singla N., Bhadram V. S., Narayana C., and Chowdhury P., "White Light Generation by Carbonyl Based Indole Derivatives Due to Proton Transfer: An Efficient Fluorescence Sensor", J. Phys. Chem., vol. 117, pp. 2738-2752, March 2013. (impact factor-2.77)
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Book Publications

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Annexure PMSE-3

Ph.D. Thesis

Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Enrol. No. & Name of the Student	Status
Group 1: Advanced Materials and Devices			
Magnetism and magneto-transport in half and over doped manganites: Impact of substrate induced strain and polycrystalline disorder	R.K. Dwivedi H.K. Singh	064010062 Pawan Kumar	Completed
Preparation, Characterization and Battery Applications of Proton Conducting Polymer Electrolytes	Prof. D. K. Rai	08410061 Kuldeep Mishra	Completed
Some studies on collisions of electrons and photons with atoms and nano structures	Dr. S.P. Purohit and Prof. K.C. Mathur	09410063 Anchala	Ongoing
Ion Transport Studies of Some Ionic Liquid Based Solid Electrolysis	Prof. D. K. Rai	9410062 S. S. Pundir	Ongoing
Studies on Multifunctional Properties of Doped Multiferroics	R.K. Dwivedi and Manoj Kumar	09410061 Vikash Singh	Ongoing
Some Studies of Electronic and Optical Properties in Atomic Systems and Nanostructures	Dr. S.P. Purohit and Prof. K.C. Mathur	10411068 Deepti Maikhuri	Ongoing
Study of aliovalent ions substitution effect on $BiFeO_3$ multiferroic ceramics	Dr. Manoj Kumar and Dr. Vivek Sajal	10411061 Prakash Chandra Sati	Ongoing
Preparation and characterization of ferroelectric bulk and thin film materials	R.K. Dwivedi	10411062 Subhash	Ongoing
Synthesis and characterization of multiferroic nanomaterials	Dr. Manoj Kumar	10411063 Manisha Arora	Ongoing
Synthesis and Characterization of doped ZnO	Dr. Ravindra Kumar	10411066 Gunjan Srinet	Ongoing
Synthesis and characterization of lead free piezoelectric ceramics	R.K. Dwivedi	10411065 Vijayeta Pal	Ongoing
Exploring the proton transfer dynamics of some hydrogen bonded heterocyclic molecules in different environments	Dr. Papia Chowdhury	010411064 Nidhi Singla	Ongoing
Synthesis and characterization of multifunctional nanomaterials	Prof. S. C. Katyal and Dr. Manoj Kumar	11411606 Sunil	Ongoing
Synthesis and Characterization of Metal Oxide Nanostructures	Dr. Navendu Goswami	11411604 Anshuman Sahai	Ongoing
Piezoelectric actuators and energy harvesters	Dr. Geetika	11411607 Vineet Tiwari	Ongoing

Synthesis and studies on multifunctional properties of substituted ferroic materials	Dr. R. K. Dwivedi	11411608 Pradeep Jha	Ongoing
Synthesis and characterization of functional nanomaterials	Dr. Geetika and Dr. Manoj Kumar	12411603 Seema Joshi	Ongoing
Compound Semiconductors and Devices	Dr. B. C. Joshi	12411604 Vanita Devi	Ongoing
Material development for energy efficient devices	Dr. A.P.S. Chauahn	12410605 Komal Chawla	Ongoing
Carbon Nanotube based solar cell oxide functional oxide nanomaterial for device applications	Dr. Sandeep Chhoker and Prof. S. C. Katyal	13411603 Kushal Singh	Ongoing
Group 2: Photonics, Plasma and Quantum Computing			
Theoretical Study of Higher Order Nonclassicality in Intermediate States	Dr. Anirban Pathak	064010063 Amit Verma	Completed
Synthesis, Optimization and Testing of Reversible and Quantum Circuits	Dr. Anirban Pathak	064010064 Anindita Banerjee	Completed
Investigation of Electromagnetic wave Propagation in Photonic crystals	Dr Suneet Kumar Awasthi	11411601 Maitreyi Upadhyay	Ongoing
Studies on surface plasma resonance based fiber optic sensors	Dr Navneet Kr Sharma	11411603 Mahima Rani	Ongoing
To design new protocol, analyze and improve the security and efficiency of existing protocol of secure quantum communication	Prof. Anirban Pathak and Dr. Amit Verma	11411602 Chitra Shukla	Ongoing
Parametric instabilities and electron acceleration in a plasma	Dr. Vivek Sajal and Dr. Ravindra Kumar	11411605 Prateek Varshney	Ongoing
Parametric instabilities in a magnetized plasma	Dr. Vivek Sajal	12410606 Kanika Verma	Ongoing
Plasmonics: Interaction of Electromagnetic waves with surface plasmons	Dr Prashant Kr Chauhan and Dr. Anshu D Varshney	12411601 Deepika	Ongoing
Studies on SPR based fiber optic sensors with different materials	Dr Navneet Kr Sharma	13411601 Sarika Shukla	Ongoing
Design and Analysis of Nanophotonic Waveguides and Devices	Dr. Swati Rawal	13411602 Brahm Raj Singh	Ongoing
Quantum Optics and Quantum Information	Dr. Amit Verma	13411605 Sumit Bhushan	Ongoing

Annexure PMSE-4

M. Tech. Dissertation

Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Enrol. No. & Name of the Student	Status
Group 1: Advanced Materials and Devices			
Synthesis and Characterization of Metal-Polymer Nanocomposites	Dr. Navendu Goswami	06311203 Anurag Prasad	Completed
Synthesis and Characterization of Zinc Oxide Nanostructures	Dr. Navendu Goswami	06311204 Dhirendra Kumar Sharma	Completed
Quantum analysis of spectroscopic behaviour of pyrrole derivative and its experimental verification	Dr. Papia Chowdhury	06311202 Neeraj Kumar	Completed
Studies on synthesis and magneto-electrical properties of manganites	Dr. R.K. Dwivedi	06311201 Anubha Gupta	Completed
Photophysical and photochemical study of organic and inorganic material	Dr. Papia Chowdhury	07311205 Rakesh Kumar	Completed
Synthesis and Study of Electro-Optical Properties of Metal Doped Oxides and Doped Polymers	Dr. Anirban Pathak	07311207 Saurabh Singh Pundir	Completed
Studies on proton conduction gels	Prof. D. K. Rai	07311203 Somya Hasan Ahmad Ben	Completed
Studies on proton conduction composite soild electrolyte	Prof. D. K. Rai	07311202 Kapil Malik	Completed
Studies on Magneto-electrical properties of manganites	Dr. R.K. Dwivedi	07311208 Vikash Singh	Completed
Studies on dielectric behavior doped perovskite oxide materials	Dr. R.K. Dwivedi	07311209 Arvind Kumar	Completed
Host guest inclusion complex with cyclodextrin	Dr. Papia Chowdhury	07311210 Salahuddin Mohammad	Completed
Synthesis and Characterization of a proton conducting gel	Prof. D. K. Rai	08311955 Sanjay Singh Yadav	Completed
Optical and magnetic properties of Mn doped ZnO diluted magnetic semiconductor	Dr. Ravindra Kumar and Dr Vivek Sajal	08311951 Gunjan Srinet	Completed
Synthesis and characterization of lead free piezoelectric ceramics	Dr. R.K. Dwivedi	08311953 Vijayeta Pal	Completed
Fabrication and characterization of optical thin films	Dr Navneet Kr Sharma	08311952 Subhash	Completed
Synthesis & characterization of Nano-based composites in micellar system	Dr. Papia Chowdhury	08311956 Prakash Sati	Completed
Synthesis and characterization of ZnO Nanomaterial	Dr. Navendu Goswami	08311954 Vinod Kumar Sharma	Completed
Synthesis of nanomaterials and their characterization for structural, optical, electronic	Dr. Navendu Goswami	09311954 Anshuman Sahai	Completed

and electrical properties			
Synthesis and studies on dielectric behavior of functional Perovskite oxides	Dr. R.K. Dwivedi	09311952 Mahesh Pal Singh	Completed
Synthesis and Characterization of Multiferroic Nanoparticles	Dr. Manoj Kumar	09311951 Sunil	Completed
Optical and magnetic properties of Co doped ZnO diluted magnetic semiconductor	Dr. Ravindra Kumar and Dr Vivek Sajal	09311951 Prateek Varshney	Completed
Optimization of design parameters of Piezoelectric properties for uni-morph cantilever	Dr. R.K. Dwivedi And Dr. Geetika Srivastava	10311205 Rashiya Sharma	Completed
Study of functional nanomaterials	Dr. Navendu Goswami	10311206 Renu Kumari	Completed
Investigation of application oriented properties of low dimensional materials	Dr. Navendu Goswami	10311203 Amit Badola	Completed
Synthesis and characterization of $Ba_{1-x}Bi_xTiO_3$ ceramics	Dr. R.K. Dwivedi and Dr. Ravindra Kumar	11310203 R. S. Chauhan	Completed
InGaN/GaN Multi Quantum wells light emitting diodes	Dr B.C. Joshi	12311204 Jaya Singh	Ongoing
Preparation and characterization of ion conducting polymer electrolyte	Prof. D. K. Rai	12311201 Supriya Srivastava	Ongoing
Polymer baser optical sensors	Dr. Papia Chowdhury	12311203 Ashish Tripathi	Ongoing
Group 2: Photonics, Plasma and Quantum Computing			
Studies on prism based surface plasmon resonance sensors	Dr Navneet Kr Sharma	12311202 Swati Yadav	Ongoing

Annexure PMSE-5

B. Tech. Projects

S.N.	Enrol. No. & Name of the Student	Title of Thesis/ Dissertation/ Project	Names of Joint Supervisors	Level(Phd/M Tech/B.Tech.)	Status (Completed/ Ongoing)
1.	Ankit Dalmia	Enhancing the Role of Captcha in Data Security	Dr. Anirban Pathak	B. Tech.	Completed (May, 2006)
2.	Rishabh Jain	Real Time Multi-Site Photo-Stimulation of A Neural Tissue Using A Digital Micro-Mirror Device	Dr. Anirban Pathak	B. Tech.	Completed (August, 2005)
3.	Prakash Gupta	Physical Model of A River	Dr. Anirban Pathak	B. Tech.	Completed (May, 2005)
4.	V. Naveen Kumar	Optical Mems for Switching Applications	Dr. Pushkar Singh	B. Tech.	Completed (May, 2005)
5.	Pratap Narayan Pandey	Quantum Cryptography with Single Photon Source	Dr. Anirban Pathak	B. Tech.	Completed (May, 2005)
6.	Manu Gupta	Distributed Quantum Computing Using Non-Local Quantum Gates and Related Studies	Dr. Anirban Pathak	B. Tech.	Completed (May, 2005)
7.	Abhishek Santosh Gupta	Quantum Algorithms for Some Simple Problems	Dr. Anirban Pathak	B. Tech.	Completed (May, 2005)
8.	Suresh	Protein folding	Dr. Papia Chowdhury	B. Tech.	Completed

Courses offered

Outline syllabus

10B1NPH732 Introduction to Quantum Information Theory (Credit: 3)
Introduction to Physical aspects of Information and Classical Information Theory, Quantum computations and communications, Quantum mechanics and Algebraic techniques required for Quantum information. Quantum algorithms – Grover's algorithm, Shor's algorithm, Quantum Circuits, Protocols of Quantum Key Distribution and Other Aspects of Quantum Communication, Quantum Error Correction Schemes.

10B1NPH831 Photonics and Applications (Credit: 3)
Basic processes of laser, Einstein's coefficients, Semiconductor lasers, Modes of laser cavity, Numerical aperture of optical fiber, Step index and graded index fibers, TE and TM modes of step index planar waveguide, Losses in optical fiber, Basic principle of optoelectronic detection, p-n and p-i-n photodiodes, Basic understanding of optical electronics and nonlinear optics, Principle of holography, Applications of photons in memory devices.

10B1NPH834 Plasma Physics (Credit: 3)
Introduction to Plasmas, Debye Shielding, Plasma Parameters, Dielectric Constant of Plasma and Collisions, Production of Plasmas in Laboratory, Drifts of Charged Particles under Effect of Different Combinations of Electric and Magnetic Fields, Mirror Machine, Plasma Oscillations, Space Charge Waves of Warm Plasma, Ion-Acoustic Waves and Electromagnetic Waves in Magnetized Plasma, Decay of Plasma by Diffusion, Diffusion across a Magnetic Field, Single Fluid MHD Equations, Diffusion in fully Ionized Plasmas, Plasma Instabilities, Non Linear Landau Damping, Magnetic and Inertial Confinement Schemes, ITER and TOKAMAK.

11B1NPH833 Biophysics (Credit: 3)
Physical Processes in Living Organisms; DNA Computing, Hamiltonian Path Problem, Satisfiability Problem, DNA Logic Gates, Quantum Dots, Self Assembly as Computing Devices, Basic Nuclear Processes, Energy Transfer Processes, Radiation Effects, Radio Tracer Techniques, Radiation Damage to DNA, Radiation Detection and Protection, Radiation shielding, Bio-Devices Organic Semiconductor, Organic Solar Cell, OLED, AMOLED, Hydrogen Fuel Cell; Biosensors - Working, Design and Applications.

13M11PM111 Structures and Characterization of Materials (Credit: 3)
Cohesion and Bonding in Solids, Crystal Structure, Point and Space Group Symmetry, Stereographic Projections, Structure Factor, Defects and Dislocations, Relation of Physical Properties of Crystals with Crystallography and Symmetry, Electrical, Magnetic and Thermal Characterization Techniques, UV Absorption, Infrared and Raman Spectroscopy, X-ray and Neutron Diffraction, Transmission and Scanning Electron Microscopy, EPMA, Optical Metallography, Image analysis, Quantitative phase estimation, Scanning probe microscopy.

13M11PM113 Properties of Engineering Materials (Credit: 3)
Electrical Conductivity of Metals and Semiconductors, Thermoelectric Effect and Thermal Conductivity, Superconductors, Meissner Effect, BCS theory, Josephson Effect, Magnetic Flux Quantization, Applications of High T_C Superconductors, SQUID, Dielectric Polarization Mechanism, Frequency Dependent Polarization, Dielectric Loss, Piezoelectric Materials and Devices, Magnetic Properties of Materials, Ferrites, Garnets, Hard and Soft Magnetic Materials, Magnetic Storage and Retrieval, Optical Properties of Materials.

13M11PM114 Processing of Engineering Materials (Credit: 3)
Processing of Metals, Powder Processing, Crystal Growth, Precipitation Hardening, Microstructure and Property Control, Polymers, Classification and Processing Techniques, Fiber-Reinforced Polymer Processing, Fiber Spinning, Processing of Ceramic and Glasses, Glass Transition Temperature, Shaping and Sintering of Ceramics, Defects, Packing Density, Porosity, Phase Analysis, Composites and Processing of Composites.

13M11PM211 Nanoscience and Engineering (Credit: 3)
Review of Nanoscience and Engineering, Quantum dots, Wires and Wells, Fullerene, Fabrication of Nanoparticles and Nanotubes, Physical and chemical synthesis of Nanostructures, Quantum Confinement, Oscillator Strength, Density of States (DOS) and Surface States of Low Dimensional Structures, Optical, Electrical, Magnetic and Mechanical Properties, Characterization and Applications of Nanomaterials, Single Electron Transistor, Spintronics, Optoelectronic Devices for Display, Storage and Sensing, NEMS.

13M11PM212 Modeling and Simulation of Materials (Credit: 3)
Introduction to Modeling and Simulation of Physical Systems, Basics of Quantum Mechanics, Introduction to Mathematica, Solutions of Eigen Value Problems Using Matlab and Mathematica, Basic Ideas of Approximation Techniques, Variational Method, Perturbation Method and JWKB Method, Numerical Integration of Schrodinger Equation, Central Field Approximation, Introduction to Gaussian 03 and Gaussview, Harttree-Fock Self-Consistent Field Method, Semi-Empirical, AM1 Hamiltonian, Density Functional Theory, Simulation using Gaussian, Monte-Carlo Simulation, Multi-Scale Modeling.

13M11PM232 Thin Film Technology and Applications (Credit: 3)
Vacuum Science and Technology, Physical Vapor Deposition Techniques, Chemical Vapor Deposition Techniques, Chemical Methods, Nucleation and Growth of Thin Films

13M11PM233 Advanced Materials and Applications (Credit: 3)
Introduction to Advance Materials, Ferro Electricity, Domain Concept in Bulk and Thin Films, Ferroelectric Materials for FERAM Devices, Barrier Layer and Multilayer Dielectrics for Capacitor Technology, Compositional Tuning of Transition Temperature and its Applications, High–K Dielectrics for Electronics, Piezoelectricity, Electro-Mechanical Coupling Coefficients and Piezoelectric Devices, Sensors and Actuators, Electro-optic Ceramics (PLZT), Processing and Fabrication and Aging.

13M11PM234 Optoelectronic Materials and Devices (Credit: 3)
Review of Different Types of Lasers, Q-switching and Mode Locking in Lasers, Fiber Numerical Aperture, Attenuation and Dispersion, Mode Cutoff and Mode Field Diameter, EDFA, OTDR and Optical Fiber Sensors, Wave Propagation in Anisotropic Media, Electro-Optic Effect, Acousto-Optic Effect and Magneto-Optic Effect, SHG, Sum and Difference Frequency Generation, Parametric Amplification, Nonlinear Effects in Optical Fibers, SPM, XPM and FWM, Solitons, Electro-Optical, Acousto-Optical and Magneto-Optical Devices, Holography and its Applications.

13M11PM331 Photovoltaic Techniques and Processes (Credit: 3)
Solar Energy and Photovoltaics, Review of Semiconductors and p-n Junction Properties, Introduction to Solar Cells, Ideal Solar Cell, Solar Cell Characteristics, Photovoltaic Materials, Crystalline Solar Cells, Thin Film Solar Cells, Multi-Junction Solar Cells, Organic Solar Cells, Fabrication and Characterization of Solar Cells, PV Systems, Balance of System, Photovoltaic Cells, Estimating PV System Size and Cost, Photovoltaic Safety.

13M11PM332 Nanotechnology (Credit: 3)
Principles, Design and Working of Various Scanning Probe Microscopes, Applications of Scanning Probe Microscopy for Materials Testing, Utility of SPM, Synthesis of Nanostructures by Nanoindentation and Nanomaniplulation for Futuristic Applications, Status of Scientific and

Technological Development of Carbon Nanotubes (CNT), Organic Semiconductors and Electronics, Plasmonics, Computational Nanotechnology.