PHYSICS DEPARTMENT IIT DELHI:
A PROFILE

for

INTERNAL REVIEW

February 2014

A. Preamble

The Physics Department of IIT Delhi is one of its largest departments, actively involved in research and teaching at the undergraduate and graduate level over a period of more than fifty years. A number of alumni of the department have made significant contributions to academics and research at reputed institutions and research laboratories world over, as well as in industries. Several faculty members of the department have earned distinguished national/ international awards and fellowships in recognition of their achievements in academics. The present faculty strength is 41 (19 Professors, 13 Associate Professors, 5 Assistant Professors, 3 Emeritus Professors and 1 Visiting Professor). Current major research activities of the Department are in the areas of *Material Science*, *Nanoscience and Technology*, *Optics and Photonics*, *Quantum Optics*, *Laser Spectroscopy*, *Plasma Physics*, and *Theoretical and Computational Physics*. There are on-going international collaborations in research with several groups. The involvement of faculty in carrying out advanced research in contemporary areas of Physics also helps in periodically updating the curriculum, and in offering new course modules in the teaching programs of the department. This also provides unique opportunity to undergraduate and postgraduate students to carry out projects and their dissertation work on some of these topics, and thus get exposure to the contemporary and emerging areas of research.

B. Strategic Vision:

- To carry out world-class competitive research in basic and applied areas of Physics, and to expand activities into important emerging areas.
- To provide undergraduate and postgraduate students with excellent education in Physics, with strong fundamentals and problem-solving skills, with a view to prepare them for the pursuit of higher education, as well as for employment in R&D organizations, educational institutions, and industries.

C. Research Areas:

Current research areas:

Materials and Condensed Matter Physics: Thin Films, Materials and Devices, Novel Functional Magnetic Materials, Nanomaterials, Lattice Dynamics, Semiconductors and Amorphous Materials, Electronic Ceramics, Microwave Absorbing Materials, Microwave Processing, Quantum Functional Materials, Spintronics, Superconductivity, Photovoltaics; Graphene, Topological Insulators.

Optics and Photonics: Holography, High-density Data storage, Liquid Crystals, Nonlinear Phase Conjugation, Optical Information Processing, Optical Data Security, Nonlinear Optics, Nonlinear guided Wave Optics, Solitons, Quantum Optics, Fiber Optics, Integrated Optics, Fiber Optic Sensors and Biosensors, Fiber Optic Components, Mid-IR Photonics, Laser Spectroscopy and Applications, Terahertz Spectroscopy and Applications, Ultrafast Dynamics, Laser Processing and Fabrication, Green and Biophotonics, Photonic Metamaterials, Bio-Medical Imaging, Inverse Problems in Imaging, Optoelectronics.

Plasma Physics: Particle Acceleration, Nonlinear Waves and Instabilities in Plasmas, Thermo Nuclear Fusion, Microwaves and Plasma Interaction, Solitons in Plasma, Space Plasmas, Terahertz (THz) Radiation Generation, Hall Thrusters, Interaction of Plasmas with Materials.

Theoretical Physics: Statistical Mechanics, Mathematical and Computational Physics, Theoretical studies in ultra-cold atoms, Nuclear and Particle Physics.

Proposed New areas:

- Theoretical physics:
  - Field theory
  - Ultracold atoms
  - Physics of Biological and complex systems
  - Computational material science
  - High energy physics
  - Cosmology/GTR/Gravitation
- Advanced materials
- Ultrafast optics
- Quantum photonics

In the following we give details of various teaching programs and research and developmental activities of the department.

1.Curriculum:

1.1 List of degree programs offered and enrolment:

The Department of Physics offers the following undergraduate and post graduate programs:

Program	**Students intake**
B.Tech. (Engineering Physics)	~ 65 per year
M.Sc.(Physics)	~55 per year
M.Tech. a) Solid State Materials b) Applied Optics c) Optoelectronics and Optical Communications*	 ~25 per year ~25 per year ~15 per year
Ph.D.	~ 25-30 per year

*Interdisciplinary program offered jointly with Electrical Engineering Department.

The *B. Tech (Engineering Physics) program* stresses the basic physics and the mathematical tools that underlie most developments in engineering which are important to all engineers and scientists.

The *M Sc program* is designed to impart strong foundations of Physics with a provision of exposure to applied areas through various elective courses and laboratory training.

The *M Tech programs* prepare graduates to take up challenges in research and development in solid state materials, applied optics and optoelectronics and optical communications.

In the *Ph D program* the students carry out research in a variety of fields, both in theoretical and experimental physics.

1.2 Consistency of curricula with academic vision of the department:

The primary vision of the department is to excel in teaching and research in basic and applied areas of physics and to train, motivate and enthuse undergraduate and postgraduate students in theoretical and experimental skills so as to prepare them for the pursuit of higher education, as well as for employment in R&D organizations, educational institutions, and industries. The curricula of various programs of the Department are specifically prepared with this vision in mind.

The B. Tech. Programme in Engineering Physics is currently under revision, and recent advances in various areas of Physics are being included in the new curriculum to expose the students to the most recent developments in Physics and also in interdisciplinary areas of Physics. Since many Physics-based elective courses should be of interest to students of other departments of the Institute the Department is also preparing such courses.

In the revised B Tech program it is proposed that each of the four (semester) Laboratory Courses during the II Year and III Year comprise of only one group of experiments, arranged under one theme e.g. *Optics*, *Solid State Physics*, *Electronics*, or *Condensed Matter Properties* and will be placed appropriately in the teaching program such that the laboratory courses follow the relevant theory course.

The post graduate programs of the Institute are also being revised. In order to develop a strong foundation of the M.Sc. students, core courses will be given adequate weightage in terms of course content and depth of coverage. It is proposed to provide a good number of '*Elective'* courses for catering to the varied interests of the students, in the third and fourth semesters so that students can develop *'specialization*' in the areas of their interest. To enhance exposure of the students to the new exciting developments in contemporary and advanced areas of Physics, several talks /seminars from outside experts commensurate to the M.Sc. curriculum is planned to be arranged. It is proposed to make this activity as an integral component of the curriculum.

The two M. Tech. Programs being offered exclusively by the department are also being reviewed and restructured to meet the aspirations of students, and the current requirement of trained manpower for relevant industries and R&D organizations. Advice from relevant industries and alumni will be taken by conducting one/two program-specific workshops before restructuring these M.Tech. programs; it is also planned to arrange several guest

lectures by industry leaders. These steps are also expected to result in better placement of the students. A revision of the Interdisciplinary M.Tech Programme (Optoelectronics & Optical Communication), in collaboration with the Electrical Engineering Department, is also being planned.

In order to meet the projected requirements of the country for large number of Ph.D. graduates, the department plans to increase the annual intake of Ph. D. students. To prepare our Ph. D. students for carrying out high quality research, it is planned to introduce at least half a dozen new/advanced-level Pre-Ph. D. courses. Department is also making efforts to enhance interactions among the Ph. D. students by organizing periodic seminars throughout the year by students and urging all research students to attend. Department will also introduce certain plans to motivate and enthuse bright M.Sc./M.Tech. students to consider joining the Ph. D. program

1.3 Quality of programs:

a) Periodicity of curriculum review UG and PG:

The overall curriculum of the undergraduate and postgraduate programs is usually reviewed every ten years at the Institute level. However, under courses titled "*Special Topics*" and "*Selected Topics*" with flexible course contents (as decided by the faculty teaching the courses) courses in new emerging areas are floated as and when required for the benefit of students. After running these courses a few times, the syllabi of these courses are then converted to regular courses which are then processed through appropriate academic bodies of the Institute for approval.

b) Mechanism of review at UG and PG level:

At the departmental level, committees of faculty members are formed to discuss and propose the changes required for both undergraduate and postgraduate programs. The committee seeks inputs from faculty and students of the department as well as alumni of the different programs for suggestions. Workshops are organized in which participants from industry and our alumni are invited to give their views regarding various aspects of the program. The recommendations are then discussed in the Faculty Board of the Department and suggestions are incorporated before finalization.

c) Course work for UG, PG and Phd Programmes core/elective

Details of course work under various teaching programs and Ph D are given below:

i) B.Tech. (Engineering Physics):

Current scheme:

Core	Elective
Basic Sciences (BS) Core	**Departmental Electives (DE)**
CYL110 Physical Chemistry: Concepts and Applications	EPD310 Mini Project (PH)
CYP100 Chemistry Laboratory**2**	EPL331 Vacuum Technology and Surface Physics
MAL110 Mathematics - I	EPL332 Nuclear Science and Engineering
MAL120 Mathematics – II	EPL333 Computational Physics
PHL120 Physics of Materials	EPL334 Lasers
PHP100 Physics Laboratory	EPL335 Low Dimensional Physics
CHL110 Transport Phenomena	EPL336 Semiconductor Optoelectronics
Engineering Arts and Sciences (EAS) Core	EPL337 Materials Science and Engineering
CSL101 Introduction to Computers and Programming OR	EPL338 Non-linear Phenomena in Physics and Engineering
CSL102 Introduction to Computer Science	EPL439 Microelectronic Devices
EEL101 Fundamentals of Electrical Engineering	EPL440 Quantum Electronics
MEL110 Graphic Science	EPL441 Applications of Lasers in Technology
MEL120 Manufacturing Practices	EPL442 Fiber and Integrated Optics
Humanities and Social Sciences (HC) Core	EPL443 Holography and Optical Information Processing
HUN100 Introduction to Humanities and Social Sciences	EPL444 Functional Nanostructures
Departmental Core (DC)	EPL445 Engineering Optics
EPC410 Colloquium (PH)	EPL446 Spintronics and Data Storage
EPD411 Major Project Part 1 (PH)	EPR310 Professional Practices (PH)
EPL101 Classical Mechanics and Relativity	EPS310 Independent Study (PH)
EPL103 Mathematical Physics	EPV430 Special Topics in Nano-Technology
EPL105 Optics	EPV431 Special Topics in Photonics and Optoelectronics
EPL107 Electromagnetics	EPV432 Special Topics in Emerging Processes
EPL202 Quantum Mechanics and its Applications	EPV433 Special Topics in Emerging Materials
EPL204 Thermal and Statistical Physics	EPV434 Special Topics in Emerging Devices
EPL206 Solid State Physics	EPV450 Selected Topics in Nano-Technology
EPL208 Principles of Electrodynamics and Plasmas	EPV451 Selected Topics in Photonics and Optoelectronics
EPL211 Principles of Material Synthesis	EPV452 Selected Topics in Emerging Processes
EPL213 Fundamentals of Semiconductors	EPV453 Selected Topics in Emerging Materials
EPN110 Introduction to Engineering Physics	EPV454 Selected Topics in Emerging Devices
EPP109 Physics Laboratory - I	EPD412 Major Project Part 2 (PH)
EPP110 Physical System Design	
EPP215 Physics Laboratory - II	
EPP216 Physics Laboratory - III	
EPP301 Design Laboratory	

Proposed Scheme for the Revised UG Curriculum of Physics Department (the proposal needs approval of the Academic bodies of the Institute)

B.Tech. (Engineering Physics)

The Curriculum Review Committee (CRC) of the Physics Department through a series of meetings and detailed discussions have come up with the following framework for the existing undergraduate program of the Department viz. *B.Tech. (Engineering Physics)*. This proposal, after discussion and approval in the DFB, has been submitted for consideration by the
UCIC.

Proposed Credit Structure:

The overall credit structure for a regular B.Tech. (Engineering Physics) is as follows:

Undergraduate Core (UC)	
Departmental Core:	**58**
Departmental Electives:	**12**
Basic Sciences:	**22**
Humanities and Social Sciences:	**15**
Engineering Arts and Sciences:	**18**
Open Category:	**10**
Program Linked Electives:	**14.5**

Total credits = 149.5 + *non-graded requirement of 15 credits* for the B.Tech Degree.

In the new UG Curriculum, a provision for students to opt for "*Departmental Specialization*", has been recommended; this refers to a group of courses in a specific area in which an interested student can specialize. Towards this, he/she would be required to earn 20 Credits from the basket of courses under a specific '*Departmental Specialization*'.

Those who opt for the '*Departmental Specialization'* (or '*Minor Area'*) need not do the 10 credits under
OC, and therefore, effectively, by earning additional 10 credits one can obtain a B.Tech. Degree with
Departmental Specialization (or Minor Area). Currently the Department is offering two specializations namely: "*Photonics Technology*" and "*Nanoscience and Technology*".

List of courses

Basic Science (BS) Core

	Credit Structure	Credits
1. PHL100 Electromagnetic Waves and Quantum Mechanics	3-0-0	3
2. CYL100 Introduction to Chemistry	3-0-0	3

3. MAL100 Calculus	3-1-0	4
4. MAL101 Linear Algebra & Differential Equations	3-1-0	4
5. SBL100 Introductory Biology for Engineers	3-0-2	4
6. PHP100 Physics Laboratory	0-0-4	2
7. CYP100 Chemistry Laboratory	0-0-4	2
Total BS Core	**15-2-10**	**22**

Engineering Arts and Science (EAS) Core

1. AML100 Engineering Mechanics	3-1-0	4
2. CSL100 Introduction to Computer Science	3-0-2	4
3. EEL100 Introduction to Electrical Engineering	3-0-2	4
4. MEP100 Introduction to Engineering Visualization	0.5-0-3	2
5. MEP101 Product Realization by Manufacturing	0-0-4	2
6. CEL140 Environmental Science	2-0-0	2
Total EAS Core	**11.5-1-11**	**18**

Program Linked (PL)

1. EEL201 Digital Electronics	3-0-3	4.5
2. EEL205 Signals & Systems	3-1-0	4
3. ESL350 Energy Conservation & Management	3-0-0	3
4. CYLxxx Chemical Synthesis of Functional Materials	3-0-0	3
Total PL Core		**14.5**

Departmental Core (DC)

1. EPL101 Electrodynamics	3-1-0	4
2. EPL102 Quantum Mechanics	3-1-0	4
3. EPL103 Mathematical Physics	3-1-0	4
4. EPL104 Solid State Physics	3-1-0	4
5. EPL105 Applied Optics	3-1-0	4
6. EPL106 Elements of Materials Processing	3-1-0	4
7. EPL201 Fundamentals of Dielectrics & Semiconductors	3-1-0	4
8. EPL202 Statistical Physics	3-1-0	4
9. EPL203 Classical Mechanics & Relativity	3-1-0	4
10. EPL204 Computational Physics	3-1-0	4
11. EPP211 Engineering Physics Laboratory-I	0-0-6	3
12. EPP212 Engineering Physics Laboratory-II	0-0-6	3
13. EPP221 Engineering Physics Laboratory-III	0-0-8	4
14. EPP222Engineering Physics Laboratory-IV	0-0-8	4
15. EPD401 Project-I	0-0-8	4

Department Electives (DE)

1. EPL301 Vacuum Technology & Surface Science	3-0-0	3
2. EPL302 Nuclear Science and Engineering	3-0-0	3
3. EPL303 Materials Science and Engineering	3-0-0	3
4. EPL304 Superconductivity and Applications	3-0-0	3

5. EPL305 Engineering Applications of Plasmas	3-0-0	3
6. EPL306 Microelectronic Devices	3-0-0	3
7. EPS300 Independent Study	0-3-0	3
8. EPD404 Project III	0-0-8	4
9. EPL311 Lasers	3-0-0	3
10. EPL312 Semiconductor Optoelectronics	3-0-0	3
11. EPL313 Fourier Optics and Holography	3-0-0	3
12. EPL321 Low Dimensional Physics	3-0-0	3
13. EPL322 Nanoscale Fabrication	3-0-0	3
14. EPL323 Nanoscale Microscopy	2-0-0	2
15. EPL324 Spectroscopy of Nanomaterials	2-0-0	2
16. EPL331 Applied Quantum Mechanics	3-0-0	3
17. EPL332 General Theory of Relativity & Cosmology	3-0-0	3
18. EPL411 Quantum Electronics	3-0-0	3
19. EPL412 Ultrafast Laser Systems and Applications	3-0-0	3
20. EPL413 Fiber and Integrated Optics	3-0-0	3
21. EPL414 Engineering Optics	3-0-0	3
22. EPV418 Selected Topics in Photonics	2-0-0	2
23. EPV419 Special Topics in Photonics	1-0-0	1
24. EPL421 Functional Nanostructures	3-0-0	3
25. EPL422 Spintronics	3-0-0	3
26. EPL423 Nanoscale Energy Materials & Devices	3-0-0	3
27. EPV428 Selected Topics in Nanotechnology	2-0-0	2
28. EPV429 Special Topics in Nanotechnology	1-0-0	1
29. EPL431 Relativistic Quantum Mechanics	2-0-0	2
30. EPL432 Quantum Electrodynamics	3-0-0	3
31. EPL433 Introduction to Gauge Field Theories	2-0-0	2
32. EPL434 Particle Accelerators	2-0-0	2
33. EPV438 Selected Topics in Theoretical Physics	2-0-0	2
34. EPV439 Special Topics in Theoretical Physics	1-0-0	1

ii) M.Sc. (Physics)

Core	**Elective**
PHD651 Project Part I	PHD658 Mini Project
PHD652 Project Part II	PHL653 Semiconductor Electronics
PHL551 Classical Mechanics	PHL654 Experimental Methods
PHL552 Electrodynamics	PHL655 Laser Physics
PHL553 Mathematical Physics	PHL656 Microwaves
PHL554 Concepts of Solids	PHL657 Plasma Physics
PHL555 Quantum Mechanics	PHL702 Science and Techn. of Thin Films
PHL556 Statistical Mechanics	PHL723 Vacuum Science and Cryogenics
PHL557 Electronics	PHL725 Physics of Amorphous Materials
PHL558 Applied Optics	PHL726 Nanostructured Materials
PHL565 Cooperative Phenomena in Solids	PHL741 Quantum Electrodynamics and
PHL567 Atomic & Molecular Spectroscopy	Particle Physics
PHL569 Nuclear Physics	PHL742 General Relativity and Introductory

PHP561 Laboratory I PHP562 Laboratory II PHP563 Advanced Laboratory	Astrophysics PHL743 Group Theory and its Applications PHL744 Adv. Topics in Quantum Mechanics PHL755 Statistical and Quantum Optics PHL758 Theory and Application of Holography PHL790 Integrated Optics PHL791 Fiber Optics PHL792 Optical Electronics

iii) M.Tech. (Solid State Materials):

Core	**Elective**
PHD801 Major Project Part 1 PHD802 Major Project Part 2 PHL701 Electronic Properties of Materials PHL702 Science and Technology of Thin Films PHL703 Materials Technology PHL704 Semiconductor Device Technology PHL705 Physics of Semiconductor Devices PHL707 Characterization of Materials PHP711 Solid State Materials Laboratory 1 PHP712 Solid State Materials Laboratory 2	PHL721 Electronic Ceramics PHL722 Analytical Techniques PHL723 Vacuum Science and Cryogenics PHL724 Magnetism and Superconductivity PHL725 Physics of Amorphous Materials PHL726 Nanostructured Materials PHL727 Quantum Heterostructures PHS731 Independent Study (PHM)

iv) M.Tech (Applied Optics)

Core	**Elective**
PHD851 Major Project Part 1 (PHA) PHD852 Major Project Part 2 (PHA) PHL751 Optical Sources, Detectors and Photometry PHL752 Laser Systems and Applications PHL753 Optical System Design PHL754 Optical Instruments and Metrology PHL756 Fourier Optics and Optical Information Processing PHL758 Theory and Applications of Holography PHP761 Optics Laboratory 1 PHP762 Optics Laboratory 2 PHP763 Optical Workshop	PHL755 Statistical and Quantum Optics PHL757 Optical Materials and Thin Films PHL759 Selected Topics in Applied Optics PHL791 Fiber Optics PHL792 Optical Electronics PHL795 Optics and Lasers PHL891 Guided Wave Optical Components and Devices PHP764 Mechanical Workshop and Engineering Drawing PHP853 Advanced Optical Workshop PHS855 Independent Study (PHA)

v) M.Tech. (Optoelectronics and Optical Communications)*:

Core	Elective
JOD801 Major Project Part 1 (JOP) JOD802 Major Project Part 2 (JOP) JOP791 Fiber Optics and Optical Communications Laboratory 1 JOP792 Fiber Optics and Optical Communications Laboratory 2 EEL712 Optical Communication Systems EEL769 Digital Communication and Information Systems EEL895 Broadband Communication and Information Systems PHL793 Semiconductor Optoelectronics PHL791 Fiber Optics PHL792 Optical Electronics	EEL789 Optoelectronic Instrumentation EEL813 Selected Topics 1 (JOP) EEL814 Selected Topics 2 (JOP) EEL890 Photonic Switching and Networking JOS800 Independent Study (JOP) PHL755 Statistical and Quantum Optics PHL790 Integrated Optics PHL795 Optics and Lasers PHL797 Selected Topics 1 (JOP) PHL798 Selected Topics 2 (JOP) PHL891 Guided Wave Optical Components and Devices

*Jointly with the Electrical Engineering Department.

d) Pre PhD course offered

Core	Elective
PHL707 Characterization of Materials PHL800 Numerical and Computational Methods in Research	All M.Tech. Courses

e) New advanced Masters/pre PhD courses included in last five years:

The courses "*Characterization of Materials*" and "*Numerical and Computational Methods in Research*" were originally optional courses for the Ph D students. These courses have now been made compulsory for all PhD students so that all graduate students get exposed to both experimental techniques as well as numerical methods for computation irrespective of whether they plan to conduct their research primarily in experimental or theoretical direction. This should be of great benefit to the students in terms of exposing them to both areas and making them aware of the broad nature of research.

f) Overlap between courses (c) and (d) and (e), including opening latter to UG

At present there are no UG courses that have significant overlap with other courses. The UG students can opt to take PG courses as their electives.

g) Seminar series held each semester:

The department organizes on an average about 10 seminars per semester. These seminars are given by faculty colleagues of the Department, Visitors to the Department from India and Abroad and also by Alumni of the Department.

The following is a partial list of seminars organized in the recent past:

S.No.	Speaker	Topic
1	Prof. Stephen C. Rand Director: Nonlinear & Ultrafast Laser Spectroscopy Laboratory, Division of Applied physics, Randall Laboratory, University of Michigan	New Science for Solar Energy
2	Prof. V. Ravishankar, Visiting Professor from IIT Kanpur	Relativity in the 21st Century
3	Dr. Mishkatul Bhattacharya Assistant Professor, Rochester Institute of Technology	Chiral Symmetries and Angular Momentum
4	Prof. G. Ramanath Materials Science & Engineering Department, Rensselaer Polytechnic Institute, Troy, NY, USA	Molecularly-tailored nanomaterials and interfaces with novel properties
5	Prof. Bishnu P. Pal IIT Delhi	Application-specific Specialty Optical Fibers: A Challenging, New Design Platform
6	Dr. Subhadeep De Scientist, National Physical Laboratory (Time and Frequency division)	The atomic Clocks - R and D Frequency Standard at NPL, India
7	Prof. Ratnamala Chatterjee IIT Delhi	NOVEL FUNCTIONAL MATERIALS: FROM 'SMARTNESS' TO 'SPINTRONICS
8	Prof. D. K. Pandya IIT Delhi	Electronics Rides on Spin
9	Rahul Pandit IISc, Bangalore	The Physics of Ventricular Arrhythmias: Insights from Computational Studies
10	Prof. P. Senthilkumaran IIT Delhi	Singular Optics
11	Prof. V. K. Tripathi IIT Delhi	Laser Driven Acceleration of Ions
12	Professor R. C. Budhani Director, NPL	Novel Electronic phases and phase transitions at oxide interface
13	Prof. Krishnendu Sengupta Indian Association for Cultivation of Science, Kolkata	Junction of Dirac materials

14	Prof. Ajit Kumar IIT Delhi	Quantum Gravity: Is it necessary? Is it possible?
15	Prof. Leonid Levitov MIT, USA	Dirac Fermions and atomic collapse in Graphene
16	Prof. Shivaji L. Sondhi Princeton University	Topological Phases of Condensed Matter Systems
17	Dr. Rejish Nath Gopinathan Rejani Max Planck Institute for the Physics of Complex Systems , Dresden, Germany	Rydberg Excitations: From Bose-Einstein Condensates to Spin Models
18	Chaitanya Joshi Heriot-Watt University, Edinburgh	Quantum Entanglement of Macroscopic object
19	Dr. Pinaki Sengupta Nanyang Technological University, Singapore	Bose Einstein condensation in quantum magnets
20	Dr. Takeshi Mizushima Physics Department, Okayama University, Okayama, Japan	What are Majorana Fermions?
21	Raghu Mahajan MIT, USA	Holographic View of Condensed Matter Physics: The AdS/CFT paradigm
22	V. Ravishankar IIT Kanpur	Quantum Oracle Algorithms
23	Prof Ravindra N Bhatt Princeton University	Importance of rare fluctuations in condensed matter physics
24	Vivek Venkatraman Cornell University	Ultralow power nonlinear optics in photonic bandgap fibers
25	Sonika Johri Princeton University	Singular Behaviour of Electronic Eigenstates in the Anderson Model of Localization
26	Dr. Mandar Deshmukh TIFR, Mumbai	Nanoscale electronics with graphene and nanowires
27	Prof. Chandan Dasgupta IISc, Bangalore	Physics of Glassy Systems
28	Prof. Ismail Mekkaoui Alaoui Semlalia Gadi Ayyad University, Marrakech, Morocco	Fingerprint detection and visualization techniques
29	Dr. G.V. Pavan Kumar Indian Institute of Science Education & Research (IISER), Pune	Plasmon-assisted light propagation and Raman scattering at subwavelength scales
30	Prof. Masahiro Yamacuchi Tohoku University, Japan	Soft Magnetic Thin Film Applications at Radio Frequencies
31	Awadhesh Narayan Physics Department, Trinity College, Dublin, Ireland	Probing Topological Insulators
32	Archana Kamal Physics Department, Yale University	Interference of photons and fluxons in superconducting quantum circuits
33	Dr. Sushan Konar NCRA - TIFR, Pune	Neutron Stars

34	Professor Deshdeep Sahdev IIT Kanpur	A case for Indigenous Technology
35	Dr. Kedar Khare IIT Delhi	How many msurements are needed to generate an N-pixel image?
36	Dr. Pranaba Kishor Muduli IIT Delhi	Spin torque nano-oscillators for communication applications
37	Dr. Amruta Mishra IIT Delhi	Matter under extreme conditions
38	Dr. Amartya Sengupta IIT Delhi	Optical Spectroscopy under extreme conditions: Putting the squeeze on materials
39	Prof. A. Rajagopal President, Inspire Institute Inc. Alexandria	Uncertainty Principles and its Avataras
40	Professor Konrad Banaszek Faculty of Physics, University of Warsaw, Poland	Generation of spatially pure photon pairs in a multimode nonlinear waveguide using intermodal dispersion

h) Placement details :

B.Tech., (Engineering Physics) : Since the B.Tech., (EP) course structure is inter-disciplinary in nature, students are absorbed in diverse nature of jobs including core industries, software and management. They also have an opportunity to pursue further education (Master's or Ph.D.) and many of our B.Tech students have joined reputed universities/Institutes in abroad as well as in India (such as IIMs and IITs) for their higher studies. About 30 % of students from our B Tech program go for higher studies both in India and abroad. Some of the reputed Universities/Institutes are: MIT, Cornell, Princeton, Stanford, University of Tennessee, University of Maryland, Iowa State University, UT Austin, University of Rochester, University of Wisconsin (USA), Poitecnico di Torino Italy, Institut polytechnique de Grenoble, France, EPFL Switzerland, University of Sheffield, University of Southampton (UK).

The sample list of Industries/ companies in which some of our previous batches of students have joined: Sumtotal Systems, ZS Associate, Sumtotal Systems, E-gain Communications, Fractal Analyst, Educational Initiatives, Sentieo, Ivy Comptech, Schlumberger, Estee Advisors, Citicorp Services India Ltd, Times Internet, Gulf Talent.com, Qualcomm, Paypal, Opera Solutions, Absolute data, Texas Instruments, GulfTalent, Nagarro, IBM, iRunway Consult, Itas, Thinklink, Parthenon.

M.Sc., (Physics): Most of the M Sc students opt to join Ph.D. degree in reputed institutions both in India (via CSIR/GATE examinations) as well as in abroad (such as Cornel, MIT etc.,). About 90% of students of the M Sc program go for higher studies.

M.Tech., (Applied optics, Solid State Materials, and Optoelectronics and Optical Communications) : Many of our M.Tech students prefer and excel in both research and teaching areas. Some of them opt for Ph.D. degree in reputed institutions both in India as well as abroad. Some of them prefer jobs in Industry/research laboratories, depending on the

discipline. Some of the organizations that our M Tech students have joined are DRDO, SSPL, CSIO, BARC, Moserbaer, Infinera; CISCO; Tejas Networks; C-DoT and BARC, Mumbai and other semiconductor optics based industries and companies. About 50% of the students of the various M Tech programs go for higher studies in India and abroad.

The following list is based on students placed directly through T& P.

	B.Tech.	**M.Tech.**	**M.Sc.**
2008-09	18	19	8
2009-10	16	6	3
2010-11	23	9	1
2011-12	25	3	3
2012-13	33	5	1

PhD students undertake post doctoral work in various institutions in India and abroad and some of them join industry or take faculty positions at various academic institutions within the country.

About 25% of Ph D students are part time/sponsored and carry out research in the Department while being employed in other organizations.

i) Relevance of UG and PG programmes to recruiters , potentials and on campus recruiters:

The UG program of the Department has been tailored to prepare the students for undertaking further research or for conducting research in National R & D organizations such as Defence, Space, Atomic Energy and industrial R & D centers. Many of our UG students also undergo summer internships at these institutions and get trained in industry oriented research. This increases their potential to get absorbed in such centers.

Some of our UG students have initiated startups dealing with education. Students passing out of M Tech (Applied Optics) program occupy very important positions in space, atomic energy and defence establishments as well as industries. Students passing out of M Tech (Optoelectronics and Optical Communication) program have been absorbed in many industries like Tejas Networks, Wipro, Infinera, Sterlite, etc. in India.

The Department constantly interacts with alumni of the Department to incorporate new developments and also contemporary areas of research of relevance to industries in their curricula so that the training of the students is very appropriate.

j) Benchmarking of curriculum:

The curriculum of the Department has been developed to be at par with any Engineering Physics program run by other Institutes in India and abroad. The courses offered are very

similar to the courses offered to other similar programs. In view of the specific specialization existing with the faculty of the department, there is extra emphasis on those areas in the curriculum. As part of their course work the students carry out a Major Project dissertation in which they get trained in carrying out research on contemporary areas of research.

Our M Sc programs prepare students for higher studies and to pursue Physics as a career. The M Tech programs prepare the students for possible jobs in various R & D organizations and industries.

Currently there is a conscious effort in the Department to induct new faculty in new areas as well as areas not currently represented in the Department. It is hoped that the Department will be able to attract excellent faculty in these disciplines.

2) Teaching environment:

2.1 Student-Teacher ratio for UG, PG and Ph.D. separately:

- UG: The Physics Department runs courses for all first year students (numbering about 850) of the Institute of all disciplines. Apart from this the faculty is also involved in teaching courses for Engineering Physics students.

  Excluding first year teaching, the student-teacher ratios are approximately as follows:

  - UG: ~ 12:1
  - PG: ~ 10:1
  - Ph. D.: ~ 4:1

2.2 Number of students graduated in each programme including PhD in the last 5 years:

Programme	Number Of students
B.Tech. (Engineering Physics)	191
M.Sc (Physics)	181
M.Tech. (Solid state materials and Applied Optics)	163
M.Tech.(Optoelectronics and Optical Communications)	73
Ph.D.	110

2.3 Student-T.A. ratio:

Approximately 12:1

2.4 Number of skilled technical staff:

There are 17 skilled technical/supporting staff in the Department.

2.5 Gross laboratory space, break up for lab space for core UG/PG teaching:

a) Laboratory Space:

For UG	~ 6300 sq. Feet
For PG	~ 5678 sq. Feet

b) Break up:

B.Tech (I)	~ 2830 sq. Feet
B.Tech (II)	~ 1440 sq. Feet
B.Tech (III)	~ 2027 sq. Feet
M.Sc.	~ 2548 sq. Feet
M.Tech (3 labs)	~ 3130 sq. Feet

The common first year B Tech laboratory (which caters to first year students from all disciplines of engineering) will be shifting to the new Lecture Theater complex as soon as it is ready.

2.6 Laboratory modernization performed in last five years:

As a regular practice new experiments are introduced from time to time in various teaching laboratories of the Department. With the new curriculum that is being developed for the undergraduate program new experiments are being introduced for first year undergraduate students which will be housed in the laboratory space in the new Lecture Theater complex. The teaching laboratories for B. Tech. students of II and III year, are now being modified to be theme based and for this new sets of experiments are planned.

The modernization of research laboratories of the department are a continuous process and are regularly carried out by the respective faculty members. New projects are undertaken by the faculty and these help installation of new equipments and initiation of research in new directions.

New faculty recruited in the department also help in creating research laboratories in new contemporary areas of research.

Modernization in research laboratories in terms of new facility in the following areas has been initiated/carried out recently:

1. Ultrafast optics facility
2. Nano Research Facility - NRF (about 15 faculty members of the Physics Department are involved in the Nano research Facility of the Institute)
3. SQUID facility
4. Physical Property Measurement System (PPMS)

2.7 Course files for each course for last 5 years:

Each faculty member maintains a record of the course taught in terms of course contents, problem sheets, question papers and other important details. Faculty members interact with each other in case of requirement of course material and feedback in running the course.

2.8 Study Materials:

For each course, at the beginning of the semester, there is a prescribed set of books and other reference material that is announced by the faculty teaching the course. The books are made available in the Central Library of the Institute or in the Departmental Library. Other study materials like published papers or other material available in the net is informed to the students. In some courses the faculty also distributes detailed notes or power point slides which cover material that is not found in the reference books. Reference to web based courses such as NPTEL courses or courses offered by other Institutes in the world is also given to the students. The institute provides a course mailing list which has email addresses of all students registered in the course. The faculty uses these mailing lists for distributing Problem sheets, tutorial sheets and all other important information.

The teaching laboratories have laboratory manuals that have been prepared specifically for those laboratories that are made available to the students.

The following are some NPTEL courses given by the faculty of the Department that are available in the web:

- *Nuclear science* by Dr. Shantanu Ghosh
- *Quantum Electronics* by Professor K.Thyagrajan
- *Semiconductor Optoelectronics* by Professor M.R.Shenoy

- **Partial list of Books authored by the faculty of the Department (during the last five years):**

  - POLARIZATION OF LIGHT WITH APPLICATION TO OPTICAL FIBER, Arun Kumar and A.K.Ghatak, 2012
  - LASERS: FUNDAMENTALS AND APPLICATIONS, K Thyagarajan and Ajoy Ghatak, Springer, NY and Macmillan India, 2010
  - PROBLEMS IN OPTICS AND PHOTONICS, Ajoy Ghatak and K Thyagarajan, Tata McGraw Hill, 2011

2.9 Research and innovation in teaching learning process:

- The Department organizes visits to various research laboratories of the Department for the first year B. Tech. (Engineering Physics) students
- Other course students are taken to relevant research laboratories within the Department to clarify concepts taught in the class.
- Wherever feasible, demonstrations are shown in the class
- Emphasis on interaction with scholars/students at all levels
- Regular weekly quizzes are conducted in many courses
- Term paper assignment is allotted wherein the student needs to finalize a topic, carry out literature survey and prepare a document. In courses where the number of students is not very large, the students are asked to make brief presentations on these topics to the entire class.

2.10Number of students who have spent at least a semester at other universities/institute (overseas/ Indian)

- 2 to 3 students per year at the Master's level visit German Laboratories under DAAD scheme for carrying out their Major Project dissertations for a period ranging from 6 to 9 months.
- 2 to 3 UG students per year go to France and Switzerland under the exchange program for carrying out studies for one semester.
- On an average about 2 to 3 Ph D students go abroad every year for carrying out research work in other laboratories sponsored by UKIERI, UGC-DST, DAAD, and Erasmus-Mundus programs.
- Every year several undergraduate students also undergo summer internships in various Research Laboratories abroad. Some of them go back and continue their higher studies in these research laboratories.

2.11Number of students from overseas universities who have taken classes done project work or internship UG and PG separately in department

Approximately 15 students during the past 5 years.

2.12 Course Feedback:

At the end of every semester the students attending a course fill the course feedback forms online. These are available for viewing to the faculty who taught the course and helps them to improve or take appropriate action on various aspects of the course.

2.13 Industry expert who have delivered lectures, seminars, discussions as a part of a core/ elective course

None

2.14 Industry exposure to students:

The department organized a visit of B. Tech. (Engineering Physics) students to Moser Baer India Limited. Experts from different industries have given lectures to the students of various programmes.

The B Tech students also spend time at industries for their summer internship.

3.Research

3.1 No. of Masters and Ph.D. students supported by-

	Masters	**Ph.D**
Institute Assistantship	All M Tech students and about 20% of M Sc students are supported by Institute assistantships.	About 60 Ph D students receive Institute Assistantships while others get assistantships from organizations such as CSIR, UGC etc.
Sponsored projects/ consultancies	-	Some of our Ph D students carry out their work under support from various sponsored projects running in the Department.
Other sources	Some students receive DST Inspire fellowship	Some students receive DST Inspire fellowship
Sponsored by external organizations	In M Tech programs we have students sponsored by Defence organizations, DAE and some industries.	In the Ph. D. program we have many part time students sponsored by various R & D institutions within the country as well as some industries.

3.2 No. of the Ph.D.s enrolled, graduated per faculty for last 5 years:

S.No.	Faculty	Enrolled	Graduated
1.	Prof. K.Thyagarajan	8	3
2.	Prof. R. Chatterjee	18	10
3.	Prof. Sujeet Chaudhary	11	4
4.	Prof. B.D. Gupta	10	5
5.	Prof. H.C. Gupta	6	3
6.	Prof.Joby Joseph	9	5
7.	Prof. Neeraj Khare	7	2
8.	Prof. Ajit Kumar	3	2
9.	Prof. Arun Kumar	5	2
10.	Prof. B.R. Mehta	11	5
11.	Prof. D.S. Mehta	7	7
12.	Prof. G.B. Reddy	5	1
13.	Prof. P. Senthilkumaran	10	2
14.	Prof. Anurag Sharma	10	2
15.	Prof. M.R. Shenoy	7	3
16.	Prof. Ravi Kant Soni	6	3
17.	Prof. Pankaj Srivastava	4	4
18.	Prof D K Pandya	8	4
19.	Prof B P Pal	5	4
20.	Dr. Varsha Banerjee	4	2
21.	Dr. M.C. Bhatnagar	5	1
22.	Dr. Sankalpa Ghosh	5	2
23.	Dr. Santanu Ghosh	7	2
24.	Dr. H.K. Malik	9	10
25.	Dr. Amruta Mishra	3	1
26.	Dr. J.P. Singh	5	3
27.	Dr. Rajendra Singh	8	3
28.	Dr. Aloka Sinha	6	2
29.	Dr. A.K. Sukla	6	4
30.	Dr. R.D. Tarey	3	0
31.	Dr. R.K. Varshney	5	2
32.	Dr. G. Vijaya Prakash	8	4
33.	Dr. Pintu Das (New faculty)	NA	NA
34.	Dr. Kedar B Khare	2	0
35.	Dr. P.K. Muduli	3	Nil
36.	Dr. Amartya Sengupta	2	0
37.	Dr. Joyee Ghosh	-	-
	Emeritus Fellow		
38.	Prof. S.C. Kashyap	2	2
39.	Prof. V.D. Vankar	-	-
40.	Prof. Vikram Kumar	3	1

3.3 Areas of research (e.g. areas listed in prospectus, and others) by (i) Volume (quantifiable parameters), (ii) Breadth, and (iii) Years these have been research areas

(For volume of research contributions and the breadth of their research outputs can be judged from the number of publication from the faculty in last 5 years)

S. No.	Faculty	Area of research	Publications
1.	Prof. K. Thyagarajan	(1) Fiber optics (2) Quantum optics	40 5
2.	Prof. R. Chatterjee	(1) Shape Memory effect in Heusler Alloys & Oxides at MPB. (2) Multiferroics (solid solutions & Composites) (3) Stealth Technology – Microwave absorbing materials (4) MEMS technology (5) Magnetic Semiconductors like Nanotubes and nanoparticles of ZnO and HfO2 (6) Other Oxide/ Dielectric/ Ferroelectric materials	8 - 7 - 8 4
3.	Prof. Sujeet Chaudhary	(1) Exchange Bias (2) Magnetic Tunnel Junctions (3) Half metallic thin films (4) Giant Magnetoresistance (GMR) nano structure (5) Transparent Conductors (6) Thermoelectricity (7) Ferromagnetic Resonance (8) Multiferroic thin films and composites	5 5 5 4 5 2 2 2
4.	Prof. B.D. Gupta	(1) Fiber optic sensors	-
5.	Prof. H.C. Gupta	(1) Condensed matter theory	25
6.	Prof. Joby Joseph	(1) Photonics metamaterials (2) Digital Holography (3) Optical Biosensor (4) Holographic storage	10 5 1 2
7.	Prof. Neeraj Khare	(1) Nanostructure functional oxides	5
8.	Prof. Ajit Kumar	(1) Non linear Optics (2) General Theory of Relativity and Cosmology	5 2
9.	Prof. Arun Kumar	(1) Fiber and integrated optic devices (2) Plasmonic waveguides and devices	25 1
10.	Prof. B.R. Mehta	(1) Thin film and nanostructured materials (2) Photovoltaic and photoelectrochemical energy conversion (3) Thermoelectric and memory devices (4) Pd and Pd alloy nanoparticle for hydrogen	38 12 12

		applications	15
11.	Prof. D.S. Mehta	(1) Biophotonics: Optical Coherence Tomography and Quantitative Phase Microscopy, Optical tweezers and applications. (2) Optical Metrology: 3D-surface profilometry/3D-shape measurement techniques. (3) Green Photonics: Optics of LEDs and OLEDs & Sun light harvesting.	61
12.	Prof. G.B. Reddy	(1) Development materials for Electrochromic smart windows (2) Synthesis nanostructured transition metal oxide thin films using novel deposition techniques (3) Development of thermoelectric materials with improved figure of merit (in collaboration with NPL) (4) Synthesis and characterization graphene films	7 5 3 3
13.	Prof. P. Senthilkumaran	(1) Focussing of singular beams (2) Generation of singular beams (3) Vortices in singular beams	5 8 5
14.	Prof. Anurag Sharma	(1) Optical Waveguide Theory and Numerical Modelling (2) CGH Based Optical Information Processing (3) Digital Zone Plate Coded Imaging	12 2 1
15.	Prof. M.R. Shenoy	(1) Guided Wave Optical Components (2) Fiber Lasers (3) Nonlinear Optical Frequency Conversion	10 4 3
16.	Prof. Ravi Kant Soni	(1) Pulsed laser ablation on nanomaterials (2) Plasmonics	5 3
17.	Prof. Pankaj Srivastava	(1) Materials and condensed matter physics.	30
18.	Prof D K Pandya	1. Transparent conducting oxides 2. Semiconducting/Oxide Nanowires 3. Magnetic Nanowires 4. Half-metallic films 5. Magnetic Tunnel Junctions & Exchange bias 6. Spin dynamics & FMR 7. Granular nano- magnetic systems 8. Ferromagnetic Semiconductors 9. GMR multilayers	7 11 6 5 9 2 3 4 1
19.	Prof B P Pal	1. Photonic bandgap guided Bragg fibers & Bragg reflection waveguides, and index guided microstructured optical fibers 2. All-fiber components, devices, and sensors: 3. Mid-IR Photonic components 4. Transverse localization of light in disordered	15 10 5 5

		optical waveguides	
20.	Dr. Varsha Banerjee	Non equilibrium statistical physics	31
21.	Dr. M.C. Bhatnagar	(1) Metal oxide gas sensors (2) Ferroelectric materials and ceramics (3) Nanostructure oxide materials	15 5 5
22.	Dr. Sankalpa Ghosh	(1) Quantum simulation with ultra cold atom (2) Electron transport in graphene (3) Theoretical studies in topological insulator	13 7 3
23.	Dr. Santanu Ghosh	(1) Thin film and nanomaterials (2) Nanomagnetism (3) Ion-material interaction (4) Field emission	-
24.	Dr. H.K. Malik	(1) Tetrahertz radiation generation (2) Hall thrusters (3) Particle acceleration/Laser Plasma interaction (4) Microwave-Plasma interaction (5) Plasma material interaction (6) Solitary waves and Solitons	4 4 14 14 3 10
25.	Dr. Amruta Mishra		
26.	Dr. J.P. Singh	1. Metal Oxide Synthesis 2. Glancing angle deposition 3. Scanning probe microscopy 4. SERS based biosensors	8 12 17 2
27.	Dr. Rajendra Singh	1. Semiconductor devices 2. Ion implantation/irradiation 3. Semiconductor nanowires	-
28.	Dr. Aloka Sinha	1. Liquid Crystals 2. Biometrics	3 10
29.	Dr. A.K. Shukla	1. Laser Raman Spectroscopy 2. Photoluminiscene 3. Non linear optical fringes 4. Semiconductors 5. Nanoscience	-
30.	Dr. R.D. Tarey	1. Experimental Plasma Physics 2. Plasma sources	12 12
31.	Dr. R.K. Varshney	1. Fiber Optics	30
32.	Dr. G. Vijaya	1. Inorganic/Organic hybrid multiple Quantum wells	51

	Prakash	2. Photonic structures for template self assembly 3. Nanofunctional Photonic composites and self organized nano/mesa structures 4. Silicon Photonics 5. Photonic glass waveguides and phosphors	
33.	Dr. Pintu Das	1. Magnetism of nano-/micro-structures 2. Charge carrier dynamics of correlated electron systems 3.Electronic behaviour of correlated electron systems at atomic/nanometer scale	3 2 3
34.	Dr. Kedar B Khare	1. Optics/Photonics,Computational 2. Imaging	12
35.	Dr. P.K. Muduli	-	-
36.	Dr. Amartya Sengupta	(1) High pressure Condensed Matter Physics (2) Ultrafast Optics	5 8
37.	Dr. Joyee Ghosh	(1) Quantum and Nonlinear Optics, Quantum Information Science; (2) Atomic, Molecular and Optical Physics	3 5
	Emeritus Fellow		
38.	Prof. S.C. Kashyap	1. Spintronics 2. Microwave Processing 3. Semiconductor Alloys 4. Ferrites	5 5 5 5
39.	Prof. V.D. Vankar	-	-
40.	Prof. Vikram Kumar	1. Semiconductor physics, Device Technology 2. Nanotechnology	-

3.4 Publication per faculty (for last five years) in academic journals.

Average publication per faculty per year during the last five years is about 5.

S.No.	Faculty	No of publication
1.	Prof. K.Thyagarajan	24
2.	Prof. R. Chatterjee	64
3.	Prof. Sujeet Chaudhary	45
4.	Prof. B.D. Gupta	34
5.	Prof. H.C. Gupta	25
6.	Prof. Joby Joseph	30
7.	Prof. Neeraj Khare	25
8.	Prof. Ajit Kumar	-
9.	Prof. Arun Kumar	15
10.	Prof. B.R. Mehta	78

11.	Prof. D.S. Mehta	61; 3 patents filed
12.	Prof. G.B. Reddy	10
13.	Prof. P. Senthilkumaran	32
14.	Prof. Anurag Sharma	35
15.	Prof. M.R. Shenoy	16
16.	Prof. Ravi Kant Soni	26
17.	Prof. Pankaj Srivastava	30
18.	Prof D K Pandya	48
19.	Prof. B P Pal	35
20.	Dr. Varsha Banerjee	12
21.	Dr. M.C. Bhatnagar	12
22.	Dr. Sankalpa Ghosh	14
23.	Dr. Santanu Ghosh	-
24.	Dr. H.K. Malik	32
25.	Dr. Amruta Mishra	-
26.	Dr. J.P. Singh	25
27.	Dr. Rajendra Singh	40
28.	Dr. Aloka Sinha	14
29.	Dr. A.K. Sukla	15
30.	Dr. R.D. Tarey	5
31.	Dr. R.K. Varshney	17
32.	Dr. G. Vijaya Prakash	50
33.	Dr. Pintu Das	9
34.	Dr. Kedar B Khare	1.5(journal papers/year), 2 patents
35.	Dr. P.K. Muduli	Not given
36.	Dr. Amartya Sengupta	9
37.	Dr. Joyee Ghosh	-
	Emeritus Fellow	
37.	Prof. S.C. Kashyap	30
38.	Prof. V.D. Vankar	Not available
39.	Prof. Vikram Kumar	21

3.5 Publications (journal and conference) total and per (a) Ph.D. student, (b) Masters students, (c) UG student.

S.No.	Faculty	No. of publication		
1.	Prof. K.Thyagarajan	**S. No.**	**Student**	**Total number of publication**
		1.	Ph.D.	50
		2.	Master	5 (conference)
		3.	UG	1
				56
2.	Prof. R. Chatterjee	**S.**	**Student**	**No. of publication**

		No.		
		1.	Ph.D.	64
		2.	Master	1
		3.	UG	1
				66
3.	Prof. Sujeet Chaudhary	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	95
		2.	Master	8
		3.	UG	1
			Total	104
4.	Prof. B.D. Gupta	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	34
		2.	Master	
		3.	UG	
			Total	34
5.	Prof. H.C. Gupta	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	25
		2.	Master	
		3.	UG	
			Total	25
6.	Prof. Joby Joseph	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	40
		2.	Master	2
		3.	UG	
			Total	42
7.	Prof. Neeraj Khare	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	25
		2.	Master	
		3.	UG	
			Total	25
8.	Prof. Ajit Kumar	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	-
		2.	Master	
		3.	UG	
			Total	
9.	Prof. Arun Kumar	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	35

		2.	Master	1
		3.	UG	-
			Total	36
10.	Prof. B.R. Mehta	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	77
		2.	Master	1
		3.	UG	
			Total	78
11.	Prof. D.S. Mehta	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	194
		2.	Master	-
		3.	UG	-
			Total	194
12.	Prof. G.B. Reddy	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	10
		2.	Master	
		3.	UG	
			Total	10
13.	Prof. P. Senthilkumaran	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	43
		2.	Master	1
		3.	UG	
			Total	44
14.	Prof. Anurag Sharma	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	34
		2.	Master	1
		3.	UG	
			Total	35
15.	Prof. M.R. Shenoy	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	38
		2.	Master	5 (conf.)
		3.	UG	
			Total	43
16.	Prof. Ravi Kant Soni	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	24
		2.	Master	2
		3.	UG	

			Total	26
17.	Prof. Pankaj Srivastava	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	30
		2.	Master	
		3.	UG	
			Total	30
18.	Prof B P Pal	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	68
		2.	Master	2
		3.	UG	0
			Total	68
19.	Prof. D K Pandya	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	72
		2.	Master	3
		3.	UG	-
			Total	75
20.	Dr. Varsha Banerjee	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	12
		2.	Master	2
		3.	UG	-
			Total	14
21.	Dr. M.C. Bhatnagar	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	12
		2.	Master	
		3.	UG	
			Total	12
22.	Dr. Sankalpa Ghosh	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	8
		2.	Master	2
		3.	UG	2
			Total	12
23.	Dr. Santanu Ghosh	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	8
		2.	Master	-
		3.	UG	-
			Total	8
24.	Dr. H.K. Malik	**S.**	**Student**	**No. of publication**

		No.		
		1.	Ph.D.	
		2.	Master	
		3.	UG	
			Total	116
25.	Dr. Amruta Mishra	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	
		2.	Master	
		3.	UG	
			Total	
26.	Dr. J.P. Singh	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	25
		2.	Master	2
		3.	UG	Nil
			Total	27
27.	Dr. Rajendra Singh	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	39
		2.	Master	1
		3.	UG	0
			Total	41
28.	Dr. Aloka Sinha	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	14
		2.	Master	1
		3.	UG	
			Total	15
29.	Dr. A.K. Sukla	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	45
		2.	Master	
		3.	UG	
			Total	55
30.	Dr. R.D. Tarey	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	3
		2.	Master	
		3.	UG	
			Total	3
31.	Dr. R.K. Varshney	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	3

		2.	Master	
		3.	UG	
			Total	3
32.	Dr. G. Vijaya Prakash	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	62
		2.	Master	18
		3.	UG	
			Total	80
33.	Dr. Pintu Das	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	
		2.	Master	
		3.	UG	
			Total	
34.	Dr. Kedar B Khare	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	2
		2.	Master	
		3.	UG	
			Total	2
35.	Dr. P.K. Muduli	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	
		2.	Master	
		3.	UG	
			Total	
36.	Dr. Amartya Sengupta	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	
		2.	Master	
		3.	UG	
			Total	
37.	Dr. Joyee Ghosh	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	-
		2.	Master	-
		3.	UG	-
			Total	-
	Emeritus Fellow			
38.	Prof. S.C. Kashyap	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	37
		2.	Master	3

		3.	UG	
			Total	40
39.	Prof. V.D. Vankar	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	-
		2.	Master	-
		3.	UG	-
			Total	-
40.	Prof. Vikram Kumar	**S. No.**	**Student**	**No. of publication**
		1.	Ph.D.	-
		2.	Master	-
		3.	UG	-
			Total	-

3.6 Best papers in last 5 years: (i) individual best 3, (ii) department best 10; and brief justifications.

(i) Individual best 3

S.No.	Faculty	Individual best 3	Brief justification
1.	Prof. K.Thyagarajan	(1) Electro-optically switchable spatial-mode entangled photon pairs using a modified Mach–Zehnder interferometer, Jasleen Lugani, Sankalpa Ghosh, and Krishna Thyagarajan, Optics Letts., Vol. 37, (2012) 3729	Novel techniques for generation and switching of entangled states of photon pairs through spontaneous parametric down conversion.
		(2) Generation of polarization-entangled photons using type-II doubly periodically poled lithium niobate waveguides, K. Thyagarajan, J. Lugani, S. Ghosh, K.Sinha, A.Martin, O. Alibart, D.B. Ostrowsky, S. Tanzilli, Phys. Rev. A, Vol 80, 052321 (2009)	
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8.	Prof. Ajit Kumar	Ajit Kumar, Theo. Math. Phys., 160(1), 969-976, 2009. Ajit kumar and Vimlesh Mishra, Phys. Rev. A, 79, 063807, 2009. Akhilesh Kumar Mishra and Ajit Kumar, J. Mod. Opt., 59, No. 18, 15991606, 2012.	**Brief justification**: In the ***first paper*** a new nonlinear evolution equation for single- and sub-cycle laser pulses has been proposed and derived rigorously from the Maxwell's equations. The model equation has been derived without using the commonly employed slowly varying envelope approximation which is invalid for ultra-short pulses. In the ***second paper*** it was, for the first time, shown that, in the single-cycle regime, Self-steepening Effect and Stimulated Raman Effect counteract each other. The usual unwanted asymmetry in pulse shape introduced by self-steepening effect is removed by stimulated Raman Effect and the symmetry of the pulse is restored. The ***third paper*** is based on non-SVEA approach to the study of nonlinear optical effects in meta-materials. Our study predicts new regimes of very high gain modulational instability in cubic left-handed materials. The effect is experimentally observable and

			provided new regimes of Soliton and other localized structure formation in cubic left-handed materials.
9.	Prof. Arun Kumar	(1) Strain and temperature sensing characteristics of single mode-multimode-single mode structures, S M Tripathi, Arun Kumar, R K Varshney, Y B P Kumar, E. Marin and J P Meunier, IEEE J. Lightwave Tech. 27 (2009) pp. 2348-2356 (2) Critical wavelength in the transmission spectrum of SMS fiber structure employing GeO2 doped multimode fiber, S M Tripathi, Arun Kumar, E. Marin and J P Meunier, Photon. Tech Letts. 22 (2010) pp. 799-801 (3) Temperature insensitive fiber optic devices using multimode interference effect, S M Tripathi, Arun Kumar, Manoj Kumar and W J Bock, Optics Letters, 37 (2012) pp. 4570-4572	(1) In this paper we have shown for the first time that the transmission spectrum of single-multi-single fiber optic structures using GeO2 doped multimode fibers exhibit a critical wavelength around whichi the temperature/strain sensitivity is maximum and of opposite nature. The observarion is extremely useful in optimizing the sensitivity of multimode interference based fiber optic temperature and strain sensors. (2) In this paper we could show experimentally that the theoretical prediction made in the above mentioned paper is correct. (3) In this paper a design of temperature insensitive SMS-fiber optic structure is proposed for the first time. It should be extremely useful in realizing temperature insensitive fiber optic devices based on multimode interference.
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14.	Prof. Anurag Sharma	(1) Three dimensional finite difference split step non-paraxial beam propagation method: New method for splitting of operators, Debjani Bhattacharya and Anurag Sharma, Applied Optics (USA) 48, 1878 – 1885 (2009)	Each of these papers has made significant fundamental contribution. The first one gives a unique method for dealing with the problem of three dimensional wave propagation. The next one gives an analytical model for the modal field of a micro structured fibers and explains several experimentally observed characteristics of these fibers. The third paper develops an efficient semi analytical method for nanophotonics waveguides with high contrast.
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		(3) O.P. Naraniya, M. R. Shenoy, K. Thyagarajan, MULTIPLE-WAVELENGTH QUASI-PHASE-MATCHING FOR EFFICIENT IDLER GENERATION IN MGO:$LINBO_3$ BASED NANOSECOND OPO, *Appl.*	

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16.	Prof. Ravi Kant Soni	(1) Sub-micron periodic surface structures in InP induced by nanosecond UV laser pulses, Brijesh Kumar and R.K. Soni, J. Appl. Phys. D: Applied Physics, 41, 155303 (2008) (2) Effect of liquid medium on size and shape of nanoparticles prepared by pulsed laser ablation of tin, Geetika Bajaj and R.K. Soni, Applied Physics A97, 481 (2009) (3) Synthesis of composite gold/tin-oxide nanoparticles by nano-soldering, Geetika Bajaj and R.K. Soni, J. Nanopart. Res. (2009) DOI 10.1007/s11051-009-9836-2	All papers listed above use a novel approach to prepare nanostructures or nanoparticles using pulsed laser. The laser based technique provides excellent control on the shape and size of nanoscale structures.
17.	Prof. Pankaj Srivastava	(1) Tailoring the Nature of Magnetic Coupling of Fe-Porphyrin Molecules to Ferromagnetic Substrates, Phys. Rev. Lett. 102, 047202 (2009) (2) Growth kinetics and compositional analysis of silicon rich a-SiNx:Hfilm: A soft X-ray reflectivity study;Appl. Phys. Lett. 97 (2010)151906. (3) Probing origin of room temperature ferromagnetism in Ni ion implanted ZnO films with X-ray absorption spectroscopy;J. Appl. Phys. 111 (2012)013715.	All the above addressed contemporary problems/ uses of condensed matter physics and were well received by the scientific community.
18.	Prof D K Pandya	(1) Structural, electronic and magnetic behavior of two-dimensional epitaxial Fe_3O_4/TiN/Si(100) system, Ankit Kumar, **D. K. Pandya** and Sujeet Chaudhary, **Appl. Phys. Lett. 102 (April 2013) 152406** **(2)** Hydrogen incorporation induced metal-semiconductor transition in ZnO:H thin films sputtered at room temperature, Anil Singh, Sujeet Chaudhary and **D. K. Pandya**, **Appl. Phys. Lett. 102 (April 2013) 172106** (3) Manifestations in the magnetization of the *hcp*-Co nanowires due to	(1) Growth of anti phase boundary free 2-D epitaxial layers (5-50 nm) with very high saturation magnetization (461 emu/cc) and very low saturation field (250 mT) for spin injection and spin filter spintronic devices. (2) Transparent conducting semi-metallic films with metal-semiconductor transition achieved without conventional doping (thus gaining in charge carrier mobility at high carrier concentration), and all this via room temperature sputter

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20.	Dr. Varsha Banerjee	-	

21.	Dr. M.C. Bhatnagar	(1) P-type gas sensing behavior of undoped SnO2thin films irradiated with a high energy ion beam, Rani S, Bhatnagar MC, Roy SC, et.al., Sens & Acts B Chemical 135 (1) 35-39 Dec 2008. (2) Potentiometric Determination of Low Content of Water in Different Organic Solvents Using NASICON Based Probe, P Yadav, MC Bhatnagar - Sensors & Transducer 146 (2012) 182-190. (3) "Synthesis, Characterization and Ethanol Sensing Properties of Tin Oxide Nanostructures" Anima Johari, Vikas Rana and M.C. Bhatnagar, Nanomaterials and Nanotechnology Journal, Vol1 (2) 2011 p 49-54	
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		society of Chemistry) 2012, **22**, p. 6356-6366. 2. Kumar H., **Ghosh S.**, Avasthi D K., Kabiraj D., Muecklich A., Zhou S., Schmidt H., Stouquert J. P. (2011): Ion beam induced shaping of Ni nanoparticles embedded in a silica matrix: from spherical to prolate shape. (Nanoscale Research Letters (NANO EXPRESS) Springer), 2011, **6:155** p. 1-9 3. Pandey B., **Ghosh S.**, Srivastava P., Kumar P., Kanjilal D.(2009): Influence of microstructure on room temperature ferromagnetism in Ni implanted nanodimensional ZnO films (J. Appl. Phys. 105, AIP) 2009, **105**, 033909, p.1-5	Cited in 26 articles. We believe that this will be considered as one of the potential materials for future spintronic devices. Based on the research works of RTFM of ZnO as magnetic semiconductor, we have been invited to author a book chapter for CRC press book on Advanced magnetic materials .]
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25.	Dr. Amruta Mishra	-	
26.	Dr. J.P. Singh	-	
27.	Dr. Rajendra Singh	(1) N.Singh and A.Sinha,"Optical image encryption using Fractional Fourier transform and chaos" *On the mechanism of blistering phenomenon in high*	

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29.	Dr. A.K. Shukla	-	
30.	Dr. R.D. Tarey	-	
31.	Dr. R.K.	1. S.Ghosh,N.D.Psaila,R.R.Thomson,	New techniques/ results

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		2. A Barh, S Ghosh,G P Agrawal,R K Varshney,I D Aggarwal and B P Pal ,"Design of an efficient mid-IR light source using chalcogenide holey fibers: a numerical study",J.Opt., Vol.15,035205,2013.This paper has been selected for inclusion in the exclusive 'Highlights of 2013' collection.	
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	Emeritus Fellow		
38.	Prof. S.C. Kashyap	(1) Biaxial anisotropy driven asymmetric kinked magnetization reversal in exchange-biased IrMn/NiFe bilayers, Himanshu Fulara, Sujeet Chaudhary, and Subhash C. KashyapAppl. Phys. Lett. *103(5)*, (30 July 2013) 052405. (2) Room temperature Ferromagnetism in Mn doped TiO_2 thin films: Electronic structure and Raman investigations Sudesh Sharma, Sujeet Chaudhary, Subhash C Kashyap, Shiv K Sharma J. Appl.Phys., *109 (8), (Apr 18, 2011) 083905.* (3) Charu Lata Dube, Subhash C.	1.The observed phenomenon has been explained by a two step process; and the magnetoresistance and mirror loop(M-H)measurements lead to the critical role of the symmetry of AF anisotropy on the reversal symmetry and Training effect in IrMn/NiFe bilayers. 2.The formation of single phase in pure and doped TiO2 films formed by spray pyrolysis established by Raman and X Ray.The

		Kashyap, D. C. Dube and D. K. Agarwal, "Growth of Si0.75Ge0.25 alloy nanowires in a separated H-field by Microwave Processing", Appl. Phys. Lett. 38 , 213107 (2009).	observed room temperature ferromagnetism in Mn-TiO2 films is due to bound magnetic polarons.(cited 17 times) 3.A rapid and novel technique of growing Si-Ge alloy nanowires (at 900 degrees in <10 min).The growth is explained on the basis of e.m.field assisted morphological transformation.
39.	Prof. V.D. Vankar	-	
40.	Prof. Vikram Kumar	-	

3.7 Citations of publications:

S.No.	Faculty	Average citation
1.	Prof. K. Thyagarajan	150
2.	Prof. R. Chatterjee	151/year(total citations since 2009 is 756)
3.	Prof. Sujeet Chaudhary	80 per year
4.	Prof. B.D. Gupta	290 per year
5.	Prof. H.C. Gupta	-
6.	Prof.Joby Joseph	80 per year
7.	Prof. Neeraj Khare	-
8.	Prof. Ajit Kumar	-
9.	Prof. Arun Kumar	80 per year
10.	Prof. B.R. Mehta	6
11.	Prof. D.S. Mehta	110 per year
12.	Prof. G.B. Reddy	-
13.	Prof. P. Senthilkumaran	83 per year
14.	Prof. Anurag Sharma	10 per paper
15.	Prof. M.R. Shenoy	23 per year
16.	Prof. Ravi Kant Soni	-
17.	Prof. Pankaj Srivastava	72 per paper
18.	Prof. D K Pandya	200

19	Prof B P Pal	
20.	Dr. Varsha Banerjee	-
21.	Dr. M.C. Bhatnagar	16 per paper
22.	Dr. Sankalpa Ghosh	30 per year
23.	Dr. Santanu Ghosh	33 per year
24.	Dr. H.K. Malik	120 per year
25.	Dr. Amruta Mishra	-
26.	Dr. J.P. Singh	-
27.	Dr. Rajendra Singh	-
28.	Dr. Aloka Sinha	50
29.	Dr. A.K. Sukla	543(Total)
30.	Dr. R.D. Tarey	-
31.	Dr. R.K. Varshney	87 per year
32.	Dr. G. Vijaya Prakash	-
33.	Dr. Pintu Das	-
34.	Dr. Kedar B Khare	20 per year
35.	Dr. P.K. Muduli	-
36.	Dr. Amartya Sengupta	32 per year
37.	Dr. Joyee Ghosh	-
	Emeritus Fellow	
38.	Prof. S.C. Kashyap	7.55 of 101 published papers
39.	Prof. V.D. Vankar	-
40.	Prof. Vikram Kumar	-

3.8 Changes, modification, etc. done to improve the quality of (i) M.Tech., and (ii) Ph.D. graduates by the faculties of Physics department:

(i) M.Tech.:

1. Giving Term paper and assignments
2. Getting the students to make oral presentations in the class for improving communication skills
3. Asking students to do self study of certain portions of the course for understanding in a better way
4. Introduction of new topics for project work.
5. Laboratory visits during the lecture course so as to provide hands on exposure to the concepts learned in the lecture classes

(ii) Ph.D.:

1. Organizing regular colloquiums and Departmental seminars at regular intervals in the department
2. Maintaining good teacher student interaction
3. Inviting experts from outside to give seminars and to interact with students
4. Scheduling regular meetings with students and requesting them to present their work.
5. Motivating them to work hard and aim for fundamental understanding.

6. Creation of a number of measurement specific research facilities.
7. Emphasizing the need to clear the 'comprehensive' examination well to make sure that they are fully aware of the basics of physics before working on the actual research problem.
8. Giving basic training in work presentation and communication skills.
9. Initiating interdisciplinary research and motivating students to carry out research in these areas.
10. Meeting of Head and Ph D coordinator with the research scholars at least once every semester to motivate them

3.9 Sponsored projects (last 5 years)-

S.No.	Faculty	Individual	With another faculty of the group/section of the department	With another faculty of the department but from another group/section of the department	With another faculty of the another dept/center
1.	Prof. K.Thyagarajan	-	5	-	2
2.	Prof. R. Chatterjee	13	--	-	1
3.	Prof. Sujeet Chaudhary	-	2	2	-
4.	Prof. B.D. Gupta	6	2	-	-
5.	Prof. H.C. Gupta	-	1	-	-
6.	Prof. Joby Joseph	3	2	1	1
7.	Prof. Neeraj Khare	5	-	1	1
8.	Prof. Ajit Kumar	-	-	-	-
9.	Prof. Arun Kumar	-	-	-	-
10.	Prof. B.R. Mehta	14	-	2	2
11.	Prof. D.S. Mehta	1	6	1	-
12.	Prof. G.B. Reddy	-	-	-	2
13.	Prof. P. Senthilkumaran	4	1	-	1
14.	Prof. Anurag Sharma	1	1	4	-
15.	Prof. M.R. Shenoy	-	6	-	-
16.	Prof. Ravi Kant Soni	2	-	2	-
17.	Prof. Pankaj Srivastava	1	4	2	1
18.	Prof D K Pandya	1	2	1	0
19.	Prof B P Pal	-	5	-	-
20.	Dr. Varsha Banerjee	5	1	-	-
21.	Dr. M.C. Bhatnagar	-	-	1	-
22.	Dr. Sankalpa Ghosh	-	-	-	1
23.	Dr. Santanu Ghosh	2	6	-	-
24.	Dr. H.K. Malik	5	1		1
25.	Dr. Amruta Mishra	3			
26.	Dr. J.P. Singh	3	-	2	-
27.	Dr. Rajendra Singh	4	2	-	1

28.	Dr. Aloka Sinha	2	-	-	-
29.	Dr. A.K. Sukla	3	5	-	-
30.	Dr. R.D. Tarey	-	-	-	-
31.	Dr. R.K. Varshney	-	5	-	-
32.	Dr. G. Vijaya Prakash	4	2	1	-
33.	Dr. Pintu Das	-	-	-	-
34.	Dr. Kedar B Khare	-	2	-	-
35.	Dr. P.K. Muduli	-	-	-	-
36.	Dr. Amartya Sengupta	1	-	-	1
37.	Dr. Joyee Ghosh	-	-	-	-
	Emeritus Fellow				
38.	Prof. S.C. Kashyap	-	-	1	-
39.	Prof. V.D. Vankar	-	-	-	-
40.	Prof. Vikram Kumar	--	-	-	-

3.10 Industry consultancies (associated with faculties of the department)

1. Tejas Networks, Bangalore
2. Optiwave Photonics, Hyderabad
3. Eagle Photonics, Bangalore
4. ERDA, Vadodara
5. EVR Engineering, Faridabad Funding agency: Bharat Heavy Electricals Limited, Bangalore
6. Ultrasolar Technology,Inc., USA
7. Lockheed Martin Corporation USA
8. TBRL (DRDO) Chandigarh
9. Sterlite Pvt. Ltd., Aurangabad
10. GE Research, Bangalore

3.11 New areas of research which are different from the faculty's Ph D thesis area:

S.No.	Faculty	New areas of research
1.	Prof. K.Thyagarajan	1. Nonlinear optics 2. Quantum optics 3. Optical amplifiers 4. Periodic waveguides
2.	Prof. R. Chatterjee	1. Multiferrois, 2. Shape Memory Alloys and Oxides 3. Topological Insulators 4. Microwave absorbing materials 5. Electronic Excitation in Quasicrystals
3.	Prof. Sujeet Chaudhary	1. Started the activities in the emerging area of SPINTRONICS and Experimental Investigations on First Order Phase transitions in magnetic and dielectric systems.

4.	Prof. B.D. Gupta	1. Fiber optic sensor 2. Plasmonic sensor
5.	Prof. H.C. Gupta	-
6.	Prof.Joby Joseph	1. Photonic metamaterials, 2. Biosensors
7.	Prof. Neeraj Khare	1. Nano structures functional oxides
8.	Prof. Ajit Kumar	-
9.	Prof. Arun Kumar	1. Plasmonic waveguides and devices
10.	Prof. B.R. Mehta	1. Synthesis of metal, alloy, core shell nanoparticle-nanorod structure by an integrated synthesis method 2. Nanoparticle and thin film for photovoltaic-thermoelectric-photo electrochemical energy applications.
11.	Prof. D.S. Mehta	1. Bio-photonics: Optical Coherence Tomography and Quantitative Phase Microscopy, Optical tweezers and applications. 2. Optical Metrology: 3D-surface profilometry/3D-shape measurement techniques. 3. Green Photonics: Optics of LEDs and OLEDs & Sun light harvesting.
12.	Prof. G.B. Reddys	1. All research currently pursuing are totally different the Ph.D thesis area.
13.	Prof. P. Senthilkumaran	1. Singular optics – optical vortex metrology. 2. Signal processing with optical vortices. 3. Fractal diffraction optics. 4. Berry's phase in optical fiber.
14.	Prof. Anurag Sharma	1. Computer Generated Hologram (CGH) based Wavefront Information Processing 2. Digital Zone Plate Coded Imaging 3. Gradient-Index Optical Imaging
15.	Prof. M.R. Shenoy	1. Nonlinear optical parametric processes
16.	Prof. Ravi Kant Soni	1. Plasmonics and nanosensors. 2. FDTD simulations
17.	Prof. Pankaj Srivastava	1. Surface-interface characterization and electronic structure studies of technologically relevant systems viz. semiconductor-insulator surfaces and interfaces. 2. Electronic structure of nano composites.
18.	Prof D K Pandya	1. Spin current generation and detection and Spin torque effect in nano-magnetic systems 2. Novel absorber systems for new generation hybrid solar cells 3. Search for high efficiency thermoelectric thin film materials 4. Perpendicular Magnetic Anisotropy in ultrathin FM films

		5. A new research activity of "Spintronics" initiated and a group of faculty and research students formed in the Department
19.	Prof B P Pal	My Ph.D. topic was semiconductor plasma. My areas of research post-Ph.D. have been all along in Photonics/Guided Wave Optics
20.	Dr. Varsha Banerjee	
21.	Dr. M.C. Bhatnagar	1. Chemical sensors, 2. Nano structure metal oxide sensors, 3. Multiferroic materials
22.	Dr. Sankalpa Ghosh	1. Ultra cold atom 2. Graphene 3. Topological Insulator.
23.	Dr. Santanu Ghosh	
24.	Dr. H.K. Malik	1. Terahertz Radiation generation 2. Particle acceleration 3. Microwave Plasma interaction 4. Plasma Material interaction 5. Hall Thrusters
25.	Dr. Amruta Mishra	
26.	Dr. J.P. Singh	1. SERS detection of bacteria and virus using AsNR based SERS active substrate, Nanomechanics. 2. Role of H in passivation of Oxygen vaccines in Metal Oxide Nanotubes
27.	Dr. Rajendra Singh	1. Semiconductor nanowires 2. GaN materials
28.	Dr. Aloka Sinha	1. Biometrics 2. Liquid crystal based nanocolloids 3. Optical data security 4. Optical information processing
29.	Dr. A.K. Shukla	1. Nanoscience
30.	Dr. R.D. Tarey	The current area in which I work are completely different from my Ph.D. thesis work
31.	Dr. R.K. Varshney	1. Speciality Fibre designs 2. Transverse localization of light in disordered structure 3. MID-IR light source
32.	Dr. G. Vijaya Prakash	1. Nanophotonic materials 2. Hybrid materials 3. Optoelectronic devices
33.	Dr. Pintu Das	1. Nanoscale magnetism 2. Low-frequency dynamics of charge carriers in correlated electron systems
34.	Dr. Kedar B Khare	1. Bio- imaging
35.	Dr. P.K. Muduli	Most of my present research (Spin dynamics, spin torque oscillators, Spin Hall effect and spin pumping) are different

		from my PhD thesis.
36.	Dr. Amartya Sengupta	1. High pressure Condensed Matter Physics
37.	Dr. Joyee Ghosh	-
	Emeritus Fellow	
38.	Prof. S.C. Kashyap	1.Spintronics 2.Microwave processing 3.Semiconductor alloys 4.Ferrites
39.	Prof. V.D. Vankar	-
40.	Prof. Vikram Kumar	-

3.12 Methodology for (i) identifying obsolescence in research areas, and (ii) identification of the new area for future research.

(i) Identifying obsolescence in research areas:

1. When ideas get transferred to industry and technology gets developed one needs to move on and pursue research in other areas
2. Through Literature Survey which points to the current trend in research and shows emerging areas of research.
3. Through interaction with scientists and engineers working in other institutions and also during international conferences.
4. By identifying Product based on the research already in the market.
5. To discontinue research in areas that is not environmental friendly.

(ii) Identification of the new area for future research:

1. Being aware of research being carried out across the world through constant literature survey
2. Interacting with visiting scientists and also scientists while attending international conferences.
3. Identification of challenging problems
4. Anticipating growth of new areas
5. Importance of the field, Interest and self expertise
6. Absence of such work in the institute (starting a new field),
7. Possibility of further developing the existing expertise in the institute,
8. Possibility for internal collaboration within the department or with faculty from other departments/centers.
9. National focus areas such as Energy and Environment (Green Technology)

3.13 Number of large interdisciplinary projects

The faculty of the Department has been involved in about 9 large interdisciplinary projects.

4. Innovation, Design and Development

4.1 No of Students funded for innovating (TePP, PRISM, etc.): NIL

4.2 Technologies developed

S.No.	Faculty Name	
1.	Prof. Joby Joseph	1.Digital Holographic Microscope -patented through intellectual ventures/ FITT -prototype being developed for 3D phase visualization and biological specimen
2.	Dr. Kedar B. Khare	A technology for high resolution quantitative phase imaging is being developed. First targeted application is live cellular imaging with diagnostic/ basic Biosciences emphasis. The single shot high resolution imaging capability of this technique is better than any other group worldwide.
3.	Prof. D.S. Mehta	a) Miniaturised Michelson Interferometer with three control variables. b) Coated mirror integrated Miniaturised Michelson Interferometer with two level control variables. c) Public information display system with GSM and GPS connectivity d) Design and development of high efficiency solar powered LED based tube light.
4.	K. Thyagarajan and M R Shenoy	a) Fiber optic Educational Kit: A kit for conducting various experiments in fiber optics especially useful for teaching purposes. b) Mid stage access Erbium doped fiber amplifier: It is an optical amplifier which finds wide applications in optical communication industry.

4.3 Technologies transferred

S.No.	Faculty Name	
1.	Prof. D.S. Mehta	(i) Miniaturised Michelson Interferometer with three control variables. (ii) Coated mirror integrated Miniaturised Michelson Interferometer with two level control variables. Name of the Industry: NVIS Technologies Pvt. Ltd., 141-B, Electronic

		Complex, Pardesipura, Indore-452 010, India.
2.	Prof. B.R.Mehta	(i) Nanoparticle hydrogen interaction (ii) Hybrid resistive switching devices (iii) Nanoparticles solar cells (iv) Photo electrochemical energy conversion
3.	K. Thyagarajan and M R Shenoy	a) Fiber optic Educational Kit: The kit is manufactured by Eagle Photonics, Bangalore b) Mid stage access Erbium doped fiber amplifier: The amplifier is manufactured by Optiwave Photonics, Hyderabad

4.4 No of patents filed/ granted - 18

4.5 Innovation of products, processes, designs etc.*

S.No.	Faculty Name	
1.	Dr. Kedar B. Khare	High resolution phase microscope is currently being developed for 3D imaging of live Biological cells

4.6 Availability and access to students' workshops, "tinkering laboratories" so that they may pursue their own ideas:

Some of the research laboratory facilities become available to undergraduate or postgraduate students to carry out experiments on their own ideas. This happens primarily when the students are already associated with the laboratory for their project dissertation work.

4.7 No. of students/ teams who have competed in national/ international competitions, and outcome*

1. Best Poster Award "Role of Bimodal Distribution in Tailoring Inter-particle Interactions in $Cu_{79}Co_{21}$ Nano-granular Films", Dinesh Kumar, Sujeet Chaudhary and Dinesh K Pandya, 58th DAE Solid State Physics Symposium, Patiala, India, 17-21 December 2013
2. BOSS Award 2010 for hardware/application oriented best B.Tech. Project: "*Fabrication of GMR based Motion Sensor" by Awadhesh Narayan 2006PH10654 and Abhishek Sharma 2006PH10595*.
3. Somnath Ghosh: Best student paper award for high quality research papers presented by students in the oral session for the paper "Localization of light in a disordered waveguide lattice with longitudinally modulated refractive index", Oral presentation, Optical Society of India (OSI) annual symposium: Frontiers in Optics and Photonics, 3-5 December, 2011, IIT Delhi, India. (Supervisor: Dr. B.P. Pal and Dr. R.K.Varshney)
4. Somnath Ghosh: Best student paper award by OSA Optical Society (USA) at the International conference Photonics – 2010 for the paper "Role of photonic bandgap and

transverse localization of light in a coupled optical waveguide lattice", Dec. 13-15, 2010, IIT Guwahati, India. (Supervisor: Dr. B.P. Pal and Dr. R.K.Varshney)

5. Somnath Ghosh: Best student paper award by OSA Optical Society (USA) at the International conference Photonics – 2008 at India Habitat Center, New Delhi for the paper "Design of high negative dispersion all-solid Bragg-like fiber for dispersion compensation through chirped claddings", Dec. 15-17, 2008, New Delhi, India. (Supervisor: Dr. B.P. Pal and Dr. R.K.Varshney)
6. Ajanta Barh: Best Oral Award by CODEC 2012 International Associates at the 5th IEEE International Conference for Computers and Devices for Communication for the paper "Design of a compact SOI Polarization Rotator for mid-IR application", CODEC 2012, December 17-19, 2012, Inst of Radio Physics, Kolkata, India.
4. Ajanta Barh: The paper "Design of an efficient mid-IR light source using chalcogenide holey fibers: a numerical study" has been selected by the editors of *Journal of Optics* (IOP) as a Highlight of 2013.
5. I. Aruna, *Alexander von Humboldt Fellowship, Institute for nanostructures and technology (NST), University of Duisburg-Essen, Germany. 2007-09*(Supervisor: Prof B R Mehta)
6. Nupur Mathur, *Jagat Chopra best thesis award "Synthesis and characterization of gadolinium nanoparticles layers", IIT Delhi, 2009*(Supervisor: Prof B R Mehta)
7. Praveen Kumar, *Marie Curie International Fellowship, Institute of optoelectronic systems and microtechnology, University of Madrid, Spain, 2011*(Supervisor: Prof B R Mehta)
8. Saatviki Gupta, *Bhaskara Advanced Solar Energy (BASE) Fellowship Program, University of Texas, Austin, USA, 2014*(Supervisor: Prof B R Mehta)
9. Rakesh Sheron, Bhaskara *Advanced Solar Energy (BASE) Fellowship Program, Lawrence Berkeley, National Laboratory, Berkeley, California, USA, 2014*(Supervisor: Prof B R Mehta)
10. Adhip Agarwala, received "Jagat Ram Chopra Award" (By IIT Delhi) for 'the best M.Sc. Project, demonstrating a process/equipment/device/sotware in Physics/ Chemistry/ Mathematics put together (Supervisor Dr. Sankalpa Ghosh)

5. R & D Environment

5.1. No of post-doctoral scholars hired in the department/centers and their durations, from

(i) Abroad: 1

(ii) On project: -

(iii) Others, and outcome: -

List of Research Associate Post Doctoral Fellow between 2009 & 2014:

Name	Designation
DEBJANI BHATTACHARYA	Research Associate
DR. SANJAY KUMAR	Research Associate
SANJAY GUPTA	Research Associate

NAMRATA SHUKLA	Research Associate
PAWAN KUMAR	Research Associate
ASHOK KUMAR SHARMA	Research Associate
AADESH P SINGH	Post Doctorate Fellow
DR. ATHULYA ARAVIND	Post Doctorate Fellow
BABITA INGALE	Research Associate
ORUGANTI ANJANEYULU	Research Associate
MAGESH KUMAR K K	Research Associate

5.2 Number of foreign students enrolled in

(i) Masters: Nil

(ii) In PhD programmes : Nil

5.3 No. of Indian and foreign faculty/ researchers who have spent a sabbatical in the department

Many visitors from abroad have spent from a week to a few months as part of their Sabbatical year. During this period they have interacted with the doctoral students, the faculty and also given a course of lectures in the Department.

5.4 Sabbatical taken by faculty (time) and where spent (last 5 years):

Name	Where spent	Duration
K Thyagarajan	Visited University of Nice Sophia Antipolis, Nice, France; University of Waterloo, Canada; City University of Hong Kong, Hong Kong; Tokyo Institute of Technology, Tokyo, Japan	May 2009 to July 2010
B.R. Mehta	1. Technical Advisor, Ultra Solar Inc, USA, 2013-2014	2013-2014
D.K Pandya	North Carolina State University, USA	May-June 2003 2 months
B.D. Gupta	University of Birmingham	One month,June 2010
Arun Kumar	1. San Jose State University, California USA 2. University of Quebec at Ottawa CANADA 3. Ecole Polytechnique, Canada	1-6-2010 to 31-5-2011
J.P. Singh	University of Georgia USA	1 June 2011 to 30 June 2012
Ratnamala Chatterjee	1.MIT,Cambridge,USA-4months 2.U.o.P.Rico,USA-4months 3.TIFR,Mumbai-2 months	July 2012 to July 2013

5.5 No. of seminars (education and research separately) given by the faculty

(i) In the department ---------- ~ **26**

(ii) In other departments ---------- ~ **13**

(iii) At other institutions ---------- ~ **291**

5.6 Faculty/researchers/scholars invited by the department for giving:

(i) Seminars---------- ~**50**

(ii) Spending at least a week in the department--- ~ **3**

5.7 No. of faculty/researchers who visited the department on their initiative for giving:

(i) Seminars---------- ~**80**

(ii) Spending at least a week in the department---- ~ **3**

5.8 Adequacy of research infrastructure

The research areas covered by the Department are all globally accepted state-of-the art research fields. One of the major constraints to improve further is timely availability of infrastructure primarily space. Larger space allocation to the Department of Physics and provision of uninterrupted regulated power supply would greatly benefit in terms of the future vision of the Department to enhance the research activities and to initiate research in new areas.

5.9 Adequacy of technical staff-existing number and competence areas: competence areas in which there is shortage:

The technical staff in the Department is involved in running the undergraduate and postgraduate teaching laboratories, research laboratories, computer units and the common Departmental facilities. The technical staff is trained in specific instruments and help in running and maintaining the instruments. New staff appointed is also trained in different laboratories.

The Department feels shortage in well trained technical staff in running and maintaining some of the sophisticated instruments in research laboratories and departmental facilities. Special training sessions need to be organized to train these staff so that they can function efficiently.

5.10 Work space available for

(i) Masters students ----------

The Master's students use the Departmental library, computation laboratory for their study during their stay in the Department. Students carrying out Major project dissertations use the research laboratory space for carrying out their work.

(ii) Ph.D. Students ----------

The Ph D students have space allocated to them in individual research groups of the department.

(iii)Project staff----------

Most project staff use the laboratory for their work and no specific space is allocated for them due to shortage of space in the Department

5.11 No. of national conferences/workshops/seminars attended by PhD students (Total and per student for 5 years) ---------- Total 261/ Avg 4 per student

5.12 No. of International overseas conferences/workshops/seminars attended by PhD students (Total and per student for 5 years) ---------- Total 157/ Avg 1 per student

5.13 Number of students who have continued to Ph. D. (i) is same department ii) in other departments of IITD (iii) in India (iv) abroad (during the past five years)

(i) In the same department ---------- ~ 24

(ii) Other departments of IITD---------- ~ 5

(iii) In India ---------- ~ 75

(iv) Abroad ---------- ~ 40

5.14 No. of projects with co-guide from industry------- ~ 11

5.15. No. of students who have spent time in industry as part of thesis/project work (Give number and duration):

(i) Number---------- ~ 9

(ii) Duration---------- Spent approximately 3 to 6 months each depending on the project.

5.16 Self assessment reports of the Department/centers/schools if any: None

5.17 Placement of M.Tech. And Ph.D. students in technological career

About 50% of M Tech and 10% of Ph Ds continue in technical career.

5.18 Inter Disciplinary work:

(i) Joint thesis guidance by faculty across groups within the department or across the department/centers……..~**53**

(ii) Proposal submitted and funded PI, CO-PI and their group/department affiliations

---------- **PI: ~ 46, CO-PI: ~ 9**

6. Outreach / External stakeholder engagement -:

6.1 Educational

(a) Workshops/Short term courses-topical research for disseminating research of IITD --- **68**

(b) Workshops/Short term courses- educational methods (teaching, earning resources, pedagogy) ---------- **8**

(c) Learning, research material on the website ---------- **10**

(d) Science &Technology for public information – on web site ---------- **17**

(e) Courses taught to students of other IITs/NITs/ Other Institutions ---------- **43**

(f) Courses taught via NKN ---------- **NIL**

(g) Courses developed for NPTEL ---------- **5**

(h) Books, monographs, study material made available outside IITD ---------- **13**

(i) Experiment developed and made available for other institutions ---------- **26**

(j) Seminars live/via NKN, web to other institutions in India/abroad ---------- **47**

(k) Reach out to schools, NCERT, KVs, etc. (e.g. K-12 programs) ---------- **41**

(l) Mentoring of others institutions, e.g. new IITs, NITs, universities, etc. including faculty mentoring, curriculum development, laboratory development, etc ---------- **27**

6.2 Industry collaborations

(a) No. of student (Ph.D./Masters) directly linked to industry funded projects ---------- **11**

(b) No. of industry staff/engineers who have taken a regular course(s) for entire semester- **19**

(c) Technology transfer to companies, entrepreneurs, local and other governments/ government agencies, NGOs (separately) ---------- **7**

(d) Continuing education / courses for industry: The department runs continuing education programs from time to time for industry personnel.

(e) Faculty secondment to industry: None

(f) Research projects undertaken with industry as partner ---------- **11**

(g) Laboratories, equipment, etc. provided by industry for use in UG/PG teaching laboratories and student projects ---------- **2**

(h) Seminars/workshops held with industry by the department ---------- **2**

6.3 Professionals

(a) Service as board, senate, and selection committee member at other IITs, NITs, and Universities.

There are approximately 15 senior faculty members who served/in service as board, senate, and selection committee member at other IITs, NITs, and Universities. (Involved in more than 50 institutes, labs etc.)

(b) Service as PhD thesis examiner at other institutions.

About 20 faculty members serve as PhD thesis examiners of about 80 theses from other institutions

(c) Service as technical expert on committees – MHRD, DST, CSIR, DRDO, DeiTY, INSA, Pan-IIT initiatives, other ministries, state and local governments

About 15 Faculty members served as technical expert on committees – MHRD, DST, CSIR, DRDO, DeiTY, INSA, Pan-IIT initiatives, other ministries, state and local governments

(d) Technical expert on policy, regularity, laws and standard committees----- Several faculty members of the department are in the standard review committees for various international journals.

(e) Member of Board/Advisory Board of public and private sector corporation.

6 faculty members serve as Member of Board/Advisory Board of public and Private Sector Corporation.

(f) Positions held by faculty on lien

Professor H.C. Gupta: Vice Chancellor of CCS University Meerut and Deputy Director of IIT Delhi.

6.4 Contribution to national developments goals

(a) Projects undertaken and their outcome:

There are several faculty members who have undertaken project from government, semi government, industries, institutes, and different funding agencies from national/international. Few of them are listed here CARS, CSIR, DBT, DST, DRDO, DeITY, IIT Delhi High Impact Projects, IAEA, SSPL, UKIERI, EU etc. There are many postgraduate and Ph. D. students who were involved in the project, got trained and submitted their thesis to the institute. There are large numbers of research papers published in various journals. Specialized R & D facilities have also been developed in the Department.

6.5 Alumni engagement

(a) Regular interactions / engagement with alumni and outcomes.

The department invites Alumni to interact with the students and also give seminars to motivate the students. These are highly effective to expose the students to the effort they need to put, the breadth of learning required of them, the communication skills that they need to develop etc.

(b) Contributions from alumni. Discussions, lectures, collaborative research, merit awards.

6.6 Recognitions and awards

(a) Awards to faculty ---------- **20**

(b) Fellow of academics ---------- **10**

7. Governance

7.1 a) The Organization Structure of the Department

The Department has the following administrative committees:

1. Faculty Board.
2. Professorial Committee.
3. Departmental Research Committee.
4. Standing Review Committee.
5. Faculty Search Committee
6. Space Planning & Utilization committee
7. Curriculum Review & Development committee

8. Committee for write off of obsolete/ unserviceable stores

9. Employees Welfare & Grievance cell

10. Budget committee

The membership, mode of selection for membership, tenure and functions of each of these Boards/committees is as given below:–

Faculty Board

a) Department has a Faculty Board comprising of all full-time faculty members. Usually the Emeritus Professors and Visiting Professors are invitees to the Faculty Board meeting.
b) The Faculty Board meets at least once every month.
c) The Head of Department is the ex-officio Chairman of the Board.
d) One of members of the Faculty Board of the Department nominated by the Board acts as Member Secretary. His tenure is at the discretion of the concerned Board.
e) The duties & responsibilities of the Board are Overall Policy Formulation, Coordination and Review of all activities of the Department in addition to the matters which are referred to it by the Head of the Department /Deputy Director(s)/Dean(s)/Director.

Professorial Committee

a) Department has a Professorial Committee comprising of all Professors and Scientific/Design staff of the equivalent rank.
b) The Head of the Department (Ex-officio) is the Chairman of the Professorial Committee.
f) One of members of the Professorial Committee acts as Member Secretary.
g) The Professorial Committee meets at least once every month
h) Apart from matters which are referred to it by the Director, Deputy Directors, Deans and Head of Department/Centre concerned, the Professorial Committee assists the Head of Department in execution of the policies/programmes formulated by the authorities of the Institute and Faculty Board of the Department such as recommending the areas and levels for faculty advertisement, short listing of application for faculty positions, secondment of faculty to any outside Organization, grant of leave (long & medium) to faculty, visiting faculty appointments.

Department Research Committees (DRC)

a) The Departmental Research Committee consists of about twelve to fifteen members including the Chairperson
b) The Chairperson of the Committee is nominated by the Department Faculty Board. Normally he/she is a Professor.
c) All Post Graduate Programme Co-ordinators are also ex-officio Members of the Committee.
d) The Faculty Board of the Department nominates the other Committee members. While nominating the members, the Board ensures that all prominent research areas of the Department are represented in the committee.

e) The tenure of the Chairperson as well as members of the Committee is for a period of two years.
f) The DRC discusses all issues pertaining to outside funded projects, theses submissions, matters concerning post graduate programs, fixing of selection committees for admission to different post graduate programs.

Standing Review Committee (SRC)

a) The Standing Review Committee is constituted by the Director to make a review of the academic activities (Teaching, Research & Development etc.) of the Department and to advice on its future academic activities.
b) SRC comprises of Head of the Department/Centre/Coordinator of the Programme and experts from outside, including those from Industry /educational/research institutions and user organisations.
c) The membership of the Standing Review Committee (SRC) is chosen to cover as many areas of the Department as possible.
d) The Committee reviews the activities (Teaching, Research and Development) of the Department every alternate year.

Apart from these, there are various standing committees to help in the efficient running of the Department, whose details are given below:

1. Space Planning & Utilization committee : To plan for efficient utilization of existing laboratory space keeping in view the requirement of space for new research and teaching laboratories, to plan for appropriate office space to the existing and new faculty members and to frame the policy for utilization of laboratory space of faculty who are retiring.
2. Curriculum Review & Development committee : To periodically review the Syllabi of existing courses and to examine the proposals for floating new courses/programmes

3. Committee for write off of obsolete/ unserviceable stores : To examine requests received from various faculty members for write off and make recommendations for an appropriate action

4. Employees Welfare & Grievance cell: To examine and attend to various Departmental issues raised by Group. B, C and D employees of the Department.

5. Budget committee: To prepare annual budget for the Department and to approve expenditure from various Institute budget bodies for amount exceeding Rs.1,00,000/.

There are also separate faculty in-charges to carry out specific work related to the management of the Department. Department has faculty in-charges for monitoring Departmental library, Computing facility, Departmental stores and preparation of Departmental reports and brochure, TA ship coordinator , Social functions and Physics society and organization of guest lectures and seminars.

7.1 (b) Planning documents developed by Department- space, faculty, staff related:

Vision documents and space allocation document are available in the department.

7.1 (c) Records of discussion within the department-internal documents (meeting minute, position papers, discussion papers, concept papers etc.)

Minutes of all the above referenced discussion are circulated to the concerned faculty and a copy is kept in the Department for reference.

7.1 (d) <u>Physical Resources</u>

The Department has well-equipped teaching laboratories for B.Tech, M.Sc. and M.Tech students. The research infrastructure is excellent in terms of faculty expertise, high-quality and sophisticated instruments, several of which are installed in the Department as central facilities and many are being continuously upgraded.

Department is planning for a thematic re-organization of B.Tech. Laboratory courses , so that only one group of experiments are arranged under one theme. Proposed themes are optics, solid state physics, electronics etc. This would involve grouping of existing experiments appropriately and introduction of new experiments.

In order to improve the quality of research output, all characterization facilities of the Department are proposed to be centrally placed and controlled by a group of faculty. This centralization will ensure clean uninterrupted power (backed by UPS and DG set) and proper water circulation system. Besides, it is expected that these facilities would be functional 24x7x365. The Department is also planning to ensure that all faculty members have appropriate space (~600 ± 200) sq feet for maintaining their respective research labs.

7.1 (e) Financial Resources

In the last 5 years, the Department has been awarded more than Rs.520 million worth of sponsored research projects by various government and international agencies. Several members of faculty are deeply involved in international network of collaborative research and in recent years have attracted substantial funding from government and reputed research organizations including corporate world from the western countries.

a) Major funding for carrying out research and setting up laboratory comes from MHRD.
b) The Department has also recently attracted FIST funds from Department of Science and Technology for the installation of the sophisticated equipment XPS. In 2013 another DST FIST project has been sanctioned to the Department of Physics to setup a facility for *Ultrafast Optics*. This should be of great use to the department as well as to other faculty colleagues working in other departments of the Institute.

Some of the governmental funding organizations being –

1. Department of Science and Technology (DST)
2. Council of Scientific & Industrial Research (CSIR)
3. DST Young Scientist Grant

4. University Grants commission (UGC)
5. Defence Research and Development organization(DRDO)
6. Ministry of Communications and Information Technology (MCIT)
7. All India Council for Technical Education (AICTE)
8. Solid State Physics Laboratory (SSPL)
9. Indian Nano electronics Users Program (INUP), IIT Bombay
10. Board of Research in nuclear sciences(BRNS), BARC
11. Department of Atomic Energy (DAE), Government of India
12. Department of Electronics and Information Technology(DeitY), government of India

Faculty members have also obtained funds from international organizations, for example:

1. The UK India Education and Research Initiative (UKIERI)
2. The Massachusetts Institute of Technology (MIT), USA
3. Department of Air force, USA
4. Office of Naval Research, Department of Navy, USA
5. Deutscher Akademischer Austauschdienst(DAAD), Germany
6. Indo-French Centre for the Promotion of Advanced Research(CEFIPRA)
7. Russian Foundation for Basic Research (RFBR),Russia
8. National Agricultural Innovation Project (NAIP), World Bank
9. International Atomic Energy Agency(IAEA),
10. EU
11. India brazil south Africa research fund

Various companies have also funded projects, some of them being:

1. Moserbaer, India
2. Corning Incorporated, India
3. Lockheed Martin Corporation, USA
4. Eagle Photonics, Bangalore
5. ERDA, Vadodara
6. BHEL, Hyderabad
7. Ultra solar technologies USA
8. St Gobain Research India.

IRD Unit of IIT Delhi provides a one-time grant of up to rupees 10 Lac to every new faculty member who joins the Institute. This assistance is given to the new faculty so that they can initiate new projects, which may subsequently be submitted to various funding agencies.

7.2 Departmental management and operations

a) Organization structure-mandates, flexibility etc.
The Department has many administrative committees including the Departmental Faculty Board, Professorial Committee, Departmental Research Committee etc. Details of various committees are given in Sec. 7.1 (a).

b) Processes for curriculum planning:
The curricula of all programs are prepared and discussed in the Departmental Faculty Board before finalization. Inputs from current students, alumni and industries are sought and incorporated wherever feasible.

c) Processes and methods for teaching resources management:
Teaching resources in terms of reference books are procured regularly and made available to all students in the Central Library as well as the Departmental Library.

d) Guest faculty, affiliation for teaching core, elective UG & PG courses:
In some courses the Department requests Guest Faculty to teach some courses in the Department. These Guest Faculties in many cases are our own faculty colleagues who have retired in the recent past.
When we have visiting scientists from India or abroad visiting the Department for extended periods, the Department requests the visitors to give a short course of lectures to the students. These are primarily elective courses and are in areas that are in the developmental stage throughout the world. This gives an opportunity to the students of various programs to get exposed to current research activities.

e) Faculty short listing criteria:
The Faculty short listing criteria are decided by the Professorial Committee of the Department. Thrust areas where new faculty is required is discussed in the Departmental Faculty Board before finalization.

f) How collectiveness of the faculty has enhanced academic output and enhanced quality etc.
The Departmental colloquia that the Department organizes regularly has helped in stronger interaction among the faculty working in different areas. It is expected that this will increase further in coming times and enhance the quality of research and also bring in greater interaction among faculty and students working for example in condensed matter and optics, theoretical and experimental research etc.

g) Nature, quantum and quality of support from secretarial staff, stores and inventory management, purchases, ambiance etc.
The Secretarial Staff of the Department contributes greatly to an efficient running of the Department. The staff handles notes and memos that are received by the Department or being sent out of the Department. They also help in collating data from faculty, in maintaining the Departmental website, and other important activities of the Department. There is a specific staff to manage Stores and Purchase of the Department who helps in regular procurement of equipments, maintaining inventory of the Department.

The Department has a very good ambiance in terms of inter relationships among the faculty and staff brought about by positive outlook among them and a feeling of understanding.

7.3 Faculty

a) Faculty profile and a critique of the same

The Physics Department of IIT Delhi is one of the largest Departments; its present faculty strength is 41 out of which 19 are Professors, 13 Associate Professors, 5 Assistant Professors, 3 Emeritus Professors and 1 Visiting Professor.

b) Diversity in faculty profile by i) gender (ii) category, (iii) region, (iv) PhD institution (v) post doctoral institutions worked in (v) organization/industry worked in (v) employment prior to joining the department

If we consider the age distribution of the faculty members, there are about 12 faculty members in the age group 30-44, 17 faculty members in the age group 45-59 and 12 faculty members (of which 5 are above superannuation age) who are above 60. The Department has recruited two more young faculty members as Assistant Professors who should be joining the Department in the next couple of months. Hence the Department has a good mixture of dynamic young faculty members and highly experienced ones.

The Department is trying to recruit more female faculty members so as to bridge the gender difference. Currently out of 41 faculty members, the Department has five female faculty members.

The Faculty members in the Department represent a mini India as they come from almost all states, like Andhra Pradesh, Himachal Pradesh, Karnataka, Punjab, Orissa, Tamilnadu, Kerala and Gujarat. However, the highest numbers of faculty members are from the states of Uttar Pradesh, West Bengal and Rajasthan.

A Large number of Faculty members have done their Ph.D. in India. Many have completed Ph.D. in IIT Delhi; some have studied at IIT Kanpur and IIT Madras. Four faculty members have obtained Ph.D. degree from JNU and one, one each from BHU and University of Rajasthan.

Apart from these, some faculty members have done Ph.D. from abroad namely from Humboldt University, Germany, Rutgers-the state university of New Jersey, Moscow University, etc.

Almost all faculty members have done Post doctoral studies from abroad. On an average, they have served in two universities as Post doctoral fellow. Some universities in which our faculty has spent time are given below:

a) United states of America: Florida state university, University of Puerto-Rico, North-Carolina state University, MIT, Washington State University, Syracuse University, Rensselear Polytechnic Institute

b) United Kingdom: University of Leeds, Glasgow University
c) France: CNRS, University de Nice, Ecole Normale Superieure, Paris; University of Jean Honnet, ISMRA Caen
d) Germany: Institute fur Experimental Physic Freies Universitat, IPM Freiburg, Alexander Van Humbolt, and Technical University
e) Canada: University of Quebeck Ottawa, Ecole Polytechnique Montreal, University of British Columbia, University of Toronto, University of Guelph
f) Japan: Osaka University, Kobe University
g) Sweden: Royal Institute of Technology, University of Gothenburg

Apart from these there are also universities in Netherlands, Norway, and Switzerland etc where the faculty members have worked.

Many of the Faculty members have worked in reputed organizations or colleges as scientists or lecturers before joining in the Department. Some members have worked as scientific officers. They have been associated with very reputed institutions.

Several faculty members of the department have earned distinguished national/international awards and fellowships in recognition of their achievements in academics such as SS Bhatnagar Award of CSIR (India), International Commission of Optic's Galileo Galilei Awards, MRSI medal, Fellowships of Societies such as Optical Society of America, Institution of Engineers and many others.

Faculty also regularly receives honours as conference chair/co-chair, technical session chair at major international conferences plenary and invited speakers at national/international conferences, members of editorial boards of international journals, chairs/members of major committees/initiatives of the Government of India on thrust areas from time to time.

h) Procedure for faculty searches

The Institute has rolling advertisement for the post of Assistant Professor in its various academic Departments/Centres. Prospective candidates can apply any time throughout the year. Based on the need of the Physics Department, faculty is recruited.

Faculty also proactively contacts others while attending conferences to attract potential good candidates.

All the applications are processed through the Eaculty Search Committee which carried out the shorlisting of applications based on the criteria decided in the Professorial Committee of the Department. These candidates are then invited to spend a day interacting with the faculty of the Department and also to give a Seminar to the faculty. These inputs help the Department in assessing the potential of the candidate for teaching as well as research. On the basis of the interaction and seminar recommendation for personal interview is made by the Professorial Committee to the Dean (Faculty) for conduct of personal interviews.

Advertisements for the position of Associate Professor and Professor are made from time to time by the Institute and short listing of candidates is carried out by the Professorial Committee of the Department.

i) Result of faculty searches (area wise)

The Department receives applications from candidates in different areas of Physics. During the last year about 47% of applications were from Condensed Matter Physics, 12% in the area of Optics and Photonics, 20% in the area of Theoretical Physics, about 6% in Plasma Physics, about 5% in Nuclear Physics, about 5% in Electronics and 5% in miscellaneous areas. With dissemination of information that our department is eager to recruit faculty in new areas, the number of applications in other areas such as theoretical physics, ultrafast optics etc. is increasing.

j) Success in recruitment

In the last 5 years, 10 new faculty members have been recruited.

k) Faculty lost to other institutions post selection

The Department has also lost 2 faculty members post selection. One of these was for personal reasons and the other due to his interest in a position with a greater focus on research rather than on teaching

l) Faculty time utilization in class, in meetings, project management, PhD guidance, Masters project guidance, UG project guidance:

S.No.	Time utilization in various activities	Percentage time spent
1	In Class	40
2	In Meetings	20
3	Project Management	15
4	Ph.D. Guidance	10
5	Masters Project Guidance	5
6	UG Project Guidance	5
7	Extension tasks	5

m) Level of harmony amongst departmental faculty

Level of harmony amongst the faculty members is very good. They work in collaboration on different projects and lab facilities can be shared easily too.

Recruiting Guest Faculty

1. Part-time Visiting Faculty:

For various reasons including shortage of faculty in a given area, Department needs the services of Delhi based professionals to teach a specific course or part of a course to the UG or PG students. Such appointments are made subject to the approval of the Director on the recommendation of the Head of Department in consultation with the Professorial Committee and are for a specified period of time for carrying out a specific teaching assignment. Part-time Visiting faculty are paid an honorarium for the assignment in accordance with rules framed by the Board of Governors and are not deemed as regular employees of the Institute.

2. Whole-time Visiting Faculty

(i). Distinguished research workers and teachers permanently attached to other institutions may be invited to serve the Department as whole time Visiting Faculty/ Professors.

2. During their tenure at the Department, their duties and privileges are the same as that of permanent teaching faculty.

3. Request for appointment of Visiting Faculty is submitted by the Head of Department on the standard application form for faculty positions along with a minimum of two letters of reference and recommendation of the Professorial Committee of the Department

4. All such requests are considered by a Standing Committee, consisting of the Director (Chairman), Deputy Director (Faculty), Head of Department and one expert nominee of the Senate/Board of Governors.

5. Appointment is made up to a maximum tenure of 2 years on a level to level basis with the approval of the Chairman, Board of Governors on the recommendations of the Standing Committee.

3. Honorary Visiting Professor

Eminent and distinguished Scientists/Engineering working in industry and research institutions may be invited to academically interact with the Institute in the capacity of Honorary Visiting Professor on a part-time basis. Such appointments are made for tenure of 2 years, extendable for further periods of 2 years at a time.

Honorary Visiting Professors are expected to take at least 15 lectures per academic session for which they are given an honorarium.

The criteria for appointment of an Honorary Visiting Professor are:

(a) He should have good academic qualifications;

(b) He should have held the position of a Professor or above in a University or a responsible position in a R&D Organization not less than in charge of a R&D section or an eminent position in industry with active participation in R&D work

(c) He should be actively engaged in the profession indicative of academic interest.

7.4 Students

A. Criteria for shortlisting and selecting students for admission to Master's and Ph D programs of past 5 years.

1) Master of Physics (M.Sc. Physics)

Only candidates who qualify in JAM (Joint Admission Test) i.e., those whose names appear in the JAM merit list, are eligible to apply for admission. In addition, they need to fulfill the following minimum eligibility criteria:

i. Bachelor's degree with Physics as a subject for at least two years/ four semesters and Mathematics for at least one year/two semesters.
ii. At least 55% aggregate marks (taking into account all subjects, including languages and subsidiaries, all years combined) for General category candidates and at least 50% aggregate marks (taking into account all subjects, including languages and subsidiaries, all years combined) for SC/ST and PD category candidates in the qualifying degree.

2) M.Tech. Programme (Applied Optics)

M.Sc. Physics/Electronics, B.Sc /B.E./B.Tech Engineering Physics with at least 60.0% (for general and non creamy OBC) and 55.0% (for SC/ST/PH) aggregate marks or equivalent CGPA (i.e. 6.75 for GE/non - creamy OBC and 6.25 for SC/ST/PH categories, on a 10 point scale) **PLUS** a valid GATE (PH) Score ≥ **330** (300 for non - creamy OBC and 220 for SC/ST/PH)

OR

B.Tech /B.E. (Electrical/Electronics) with at least 60.0% (for general and non - creamy OBC) and 55.0% (for SC/ST/PH) aggregate marks or equivalent CGPA **PLUS** a valid GATE Score ≥ **700** (630 for non - creamy OBC and 450 for SC/ST/PH)

3) M.Tech. Programme (Solid State Physics)

M.Sc. Physics/Electronics, B.Sc. /B.E./B.Tech Engineering Physics with at least 60.0% (for general and non creamy OBC) and 55.0% (for SC/ST/PH) aggregate marks or equivalent CGPA (i.e. 6.75 for GE/non creamy OBC and 6.25 for SC/ST/PH categories, on a 10 point scale) **PLUS** a valid GATE (PH) Score ≥ **330** (300 for non - creamy OBC and 220 for SC/ST/PH)

OR

B.Tech/B.E. (Electrical/Electronics) with at least 60.0% (for general and non - creamy OBC) and 55.0% (for SC/ST/PH) aggregate marks or equivalent CGPA **PLUS** a valid GATE Score ≥ **700** (630 for non - creamy OBC and 450 for SC/ST/PH)

4) M.Tech. Programme (Optoelectronics and Optical Communications)

M.Sc. Physics/Electronics, B.Sc. /B.E./B.Tech Engineering Physics with at least 60.0% (for general and non creamy OBC) and 55.0% (for SC/ST/PH) aggregate marks or equivalent CGPA (i.e. 6.75 for GE/non creamy OBC and 6.25 for SC/ST/PH categories, on a 10 point scale) **PLUS** a valid GATE (PH) Score ≥ **330** (300 for non - creamy OBC and 220 for SC/ST/PH)

4) Ph.D. Programme

Minimum Qualifications and Eligibility criteria for short-listing for Interview/Test for **Full-Time (Regular)** Ph.D. Programme

*Applicant has to meet **any one** set of requirements out of the rows A, B, C and D (Discipline wise)*

			GEN	OBC	SC	ST	PH
A.	M.Tech./Integ. M Tech./Dual Degree	%Aggregate ≥	73	73	60	60	60
	AND	CGPA(10PT)≥	8.0	8.0	6.75	6.75	6.75
	M.Sc.(Phys.) **or** B.Tech. / B.E. in (Electrical/Electronics) *[for applicants having M.Tech. degree]*	%Aggregate ≥	60	60	55	55	55
		CGPA(10PT)≥	6.75	6.75	6.25	6.25	6.25
B.	M.Sc. (Phys) / B.Tech. (Engg. Phys.)	%Aggregate ≥	60	60	55	55	55
	AND	CGPA(10PT)≥	6.75	6.75	6.25	6.25	6.25
	B.Sc. *[for applicants having M.Sc. degree]*	%Aggregate ≥	60	60	55	55	55
	AND	CGPA(10PT)≥	6.75	6.75	6.25	6.25	6.25
	Valid GATE (PHYS) score **or** CSIR/UGC/DST-INSPIRE - JRF	Score (Phys) ≥	500	450	330	330	330
C.	B.Tech./B.E. (Electrical/Electronics)	%Aggregate ≥	75	75	60	60	60
	AND	CGPA(10PT)≥	8.5	8.5	6.75	6.75	6.75
	Valid GATE (Electrical/Electronics) score	Score (Phys) ≥	660	600	440	440	440
D.	M.Sc. (Phys.) **or** B.Tech.(Engg. Phys./Electrical/Electronics) **[from IITs]**	CGPA(10PT)≥	8.0	8.0	8.0	8.0	8.0

Part - time and Sponsored (full - time) Ph.D. program

The following eligibility conditions apply:

i. Only employees of Public Sector Undertakings or Government Departments or Research and Development Organizations or Private Industries (approved by IITDs) are eligible for admission to Ph.D. program.
ii. All candidates should have minimum experience of two years.

iii. Minimum qualification for these candidates is the same as for full time candidates except that the requirements of qualifying in a national examination (CSIR/UGC NET/GATE/DST INSPIRE, etc.) are waived off.

iv. For Part Time candidates from outside NCR (or at a radial distance of more than 50 km from IIT Delhi), there is a minimum residency requirement of 6 months.

v. Sponsored (Full time) candidates seeking admission to a Ph.D. programme on the basis of study leave, must submit a "Sponsorship Certificate" on a proper letterhead from the appropriate authority in the organization clearly stating the following:

a) For the period of his/her studies in the programme, the candidate would be treated as on duty with usual salary and allowances
b) That he/she will be fully relieved and granted study leave for a minimum period of 3 years (2years for M Tech. and equivalent degree holders).

vi. Part Time (PT) candidates are required to submit the "No Objection Certificate" on a proper letterhead from the appropriate authority in the organization clearly stating the following:

a) The candidate is permitted to pursue studies on a PT basis.
b) That his/her official duties permit him/her to devote sufficient time for research
c) The facilities for research in the candidate's field of research are available at the candidate's place of work, and
d) He/ She will be fully relieved from duty and permitted to reside at the Institute for the period required for residency (This is not a requirement for candidates who are working in NCR or in organizations located within a distance of 50KMs from IIT Delhi).

B. Facilities Provided To Students:

Facilities to carry out research exist in a variety of fields both in Experimental and Theoretical Physics. The Department has well-equipped laboratories for both teaching and research programmes. Some of the major research laboratories are:

1. Solid State Physics Laboratory,
2. Thin Film Science and Technology Laboratory,
3. Magnetics & Advance Ceramics Laboratory,
4. Nano-tech. Laboratory,
5. Plasma Physics Laboratory,
6. Beam Plasma Laboratory,
7. Fibre and Integrated Optics Laboratory,
8. Laser Spectroscopy Laboratory,
9. Optical Image Processing Laboratory,
10. Quantum Electronics Laboratory.

A large number of facilities are available in these and other laboratories and these include:

1. Electron Microscopes (HRTEM, TEM, SEM),
2. Atomic Force Microscope (AFM),
3. Scanning Tunnelling Microscope (STM),
4. MOKE Microscope,

5. Scanning Auger Microprobe (SAM),
6. Electron Spectroscopy for Chemical Analysis (ESCA).
7. Secondary Ion Mass Spectroscopy (SIMS),
8. Powder and Thin Film X-ray Diffractometers,
9. XRR,
10. FTIR Spectrophotometer,
11. Laser Raman Spectroscopy System,
12. SQUID Magnetometer,
13. Dielectric and Ferroelectric set-up,
14. Arc melting,
15. Auto Lab General Purpose Electrochemical System,
16. Optical Multichannel Analyser,
17. Closed-cycle Helium Cryotip System,
18. High Power Argon-ion/ Neodymium/YAG/ Excimer/ Dye/ Ti:Sapphire Lasers,
19. Optical Photon-correlator,
20. Plasma Diagnostics System,
21. VSM Facility,
22. Microwave Processing of Materials in a single (E- or H- field) or multiple mode.
23. Ultrahigh Vacuum Units,
24. Vacuum Coating Units,
25. DC and RF Sputtering Units,
26. Concave Reflection Grating,
27. Spatial Light Modulators,
28. Optical Transfer Function Bench,
29. Holographic Recording Set-up,
30. Coherent Filtering Set-up,
31. Facility for Optical Phase Conjugation with Photorefractives,
32. Facility for Fabrication of Tunnel Diodes, Solar Cells, Thin Film Devices and Integrated Circuits,
33. Optical Fibre Splicing and Characterisation Set-up,
34. In-line Optical Fibre Components Fabrication and Testing,
35. Fabrication and Characterization of Planar Optical Waveguides,
36. Erbium doped fibre amplifiers,
37. Optical Spectrum Analyser,
38. Wavelength Meters,
39. High resolution Microscope,
40. DWDM wave length tuned Laser Diode light sources,
41. Long Period Fibre Grating fabrication,
42. variety of optical fibre sensors,
43. Facility for Making High Temperature Superconductors,
44. Plasma and Photo CVD Units, DLTS,
45. PL Facility,
46. Optical CD Fabrication Facility.
47. Indigenously developed HV compatible field emission measurement setup.

Besides this, the Department also has a Departmental computational laboratory with a large number of computers and a Departmental library consisting of essential text books for use by students.

Department conducts regular colloquium by faculty members of the Department. These colloquia are meant to introduce the students to the emerging areas of research and to generate interest among the student community for a healthier overall growth with the students getting exposed to other important contemporary areas of Physics. This has also increased the interaction and collaboration among the faculty members of the Department.

The Department also conducts regular workshops and seminars in different specialized areas. Faculty members from the Department and also experts from outside are invited to deliver lectures, presentations and tutorial talks.

8. Benchmarking

8.1 Departments/Centers within IITD as peers

Significant amount of research work in the Department of Physics is interdisciplinary in nature and in these areas the department has been working in collaboration with many other departments and centers within IIT Delhi. Some departments/centres within IITD as peers are:

1. Electrical Engineering
2. Centre for Applied Research in Electronics (CARE)
3. Department of Chemistry
4. Centre for Energy Studies
5. Department of Biochemical Engineering and Biotechnology
6. Department of Mechanical Engineering
7. Instrument Design Development Center

8.2 Other universities / IITs/NITs as peers:

1. IISc, Bangalore
2. National Physical Laboratory, New Delhi
3. Jawaharlal Nehru University (JNU)
4. Tata Institute of Fundamental Research (TIFR)
5. Inter-University Accelerator Centre, New Delhi
6. IIT Bombay'
7. IIT Kanpur
8. IIT Chennai
9. Solid State Physics Laboratory(SSPL),New Delhi
10. IIT Roorkee
11. UGC-DAE-CSR, Indore
12. IOP, Bhubaneswar
13. RRCAT, Indore
14. IIT Hyderabad

15. IIT Kharagpur
16. IIT Guwahati
17. MNIT, Jaipur
18. Jamia Milia Islamia, Delhi
19. Delhi University
20. Institute for Plasma Physics, Gujarat
21. IIT BHU

8.3 Institutions in other countries as peers:

1. Moscow University, Russia
2. Ecole des Mines, France
3. MIT, USA
4. University of Puerto Rico, USA
5. Caltech, California
6. Imperial College, London
7. Stanford University, California
8. EPFL, Switzerland
9. Nancy University, France
10. Utsunomiya University, Japan
11. POSTECH, South Korea
12. Russian Academy of Science, Russia
13. Hachinohe institute of Technology, Japan
14. Max Planck Institute, Germany
15. Walter Schutty Institute, Germany
16. University of Malaya, Kuala Lumpur
17. NTU, Singapore
18. University of Strathholyde, United Kingdom
19. University of Southampton, United Kingdom
20. University of Duisburg- Essen, Germany
21. European Synchrotron Radiation Facility, France
22. ELETTRA Synchrotron Facility, Italy
23. ICTP Trieste, Italy
24. University of Birmingham, United Kingdom
25. New York University, USA
26. Toyohashi University , Japan
27. University of Kiel, Germany
28. HZDR, Dresden, Germany
29. Synchrotron centre, Petra, Germany
30. University of Gothenburg, Sweden
31. Nottingham University, United Kingdom
32. RPI, New York, USA
33. University of Duisburg, Germany
34. RTWH, Aachen, Germany
35. University of Rochester, USA
36. City University of London, United Kingdom

37. Teknion, Israel
38. Okayama University, Japan
39. Max Planck Institute of complex systems, Germany
40. Princeton University, USA
41. University of Leeds, United Kingdom
42. National Physical Laboratory, United Kingdom
43. University of Nice, France

Various Governmental and Private sector Industries as peers:

1. Moser Baer India Ltd (Noida)
2. Optiwave Photonics Pvt Ltd.(Hyderabad)
3. Tejas Networks Pvt Ltd (Bangalore)
4. All India Institute of medical Sciences (AIIMS)
5. British Telecom Research centre (United Kingdom)
6. Lockheed Martin Corporation (USA)
7. Renka Corporation (USA)
8. Naval research Laboratory, USA

8.4 Parameters for benchmarking

The parameters that may be considered for benchmarking are

i. Publications in international journals of repute
ii. Patents filed by the faculty and students of the department
iii. Invitation to faculty for spending extended periods of time in other universities in India and abroad
iv. Request by scientists and faculty of other institutions who wish to visit the Department for interaction
v. Request for running courses for institutions, industries and other organizations
vi. Sponsored projects that have attracted funding by other agencies
vii. Awards and recognitions received by the faculty of the department
viii. Chairmanship, membership and other honors of faculty
ix. Invitations to chair sessions in International Conferences
x. Invitation to deliver invited talks at International Conferences

9. Feedback system and results

9.1 System for feedback for UG students and results

- Every semester the Department organizes Class committee meetings of the teacher and the students of the class after the first Minor examination. In large classes the class is represented by group representatives. The meeting is chaired by the Head of the Department. In these meetings the students raise various issues, if any, in the course and the concerned faculty then takes corrective action.

- At the end of the semester the students fill online a Course Evaluation Form that is available to the teacher of the course and to the Head of the Department. The feedback helps the teacher to improve and to correct any issues in terms of coverage of the course, speed of teaching, availability of learning material etc.

9.2 System for feedback for PG, Master's and Ph.D., students and their outcome

- Every semester the Department organizes Class committee meetings of the teacher and the students of the class after the first Minor examination. In large classes the class is represented by group representatives. The meeting is chaired by the Head of the Department. In these meetings the students raise various issues, if any, in the course and the concerned faculty then takes corrective action
- At the end of the semester the students fill online a Course Evaluation Form that is available to the teacher of the course and to the Head of the Department. The feedback helps the teacher to improve and to correct any issues in terms of coverage of the course, speed of teaching, availability of learning material etc.
- The Head of the Department and the Coordinator of the Ph D program meet the Ph D students once every semester. This helps the students raise any issues that they may be facing in their research work. The comments are then taken into account and corrective action initiated.

9.3 System of feedback from recruiters (i) on-campus, and (ii) off campus separately for UG and PG graduates; and results.

Many of our students have joined various industries within the country. We try to get feedback from them which is helpful during course reorganization, setting up of new experiments etc.

9.4 Mechanism for obtaining industry feedback and findings.

Many of our alumni working in various industries visit the Department and during the interaction the Department takes feedback from them in respect of courses, research and development etc. At other times when we have scientists and technologists visiting the Department in different areas, the faculty interacts with these professionals to get inputs.

9.5 Alumni feedback mechanism and its outcome.

Some of the Alumni are invited to visit the Department and interact with the students and faculty. Their inputs are taken through discussions and action initiated for incorporation of various suggestions.

9.6 Placement Records-Ph.D., M.Tech. and B.Tech. (as provided by T & P Unit of IIT Delhi)

Year	B.Tech.	M.Tech.	M.Sc.
2009-10	16	6	3

2010-11	23	9	1
2011-12	25	3	3
2012-13	33	5	1

10. Vision for next 5-10 Years

10.1 Goals

- To continue to carry out world-class competitive research in basic and applied areas of contemporary Physics and to expand activities into important emerging areas.
- To provide undergraduate and postgraduate students with excellent education in Physics with strong fundamentals with a view to prepare them for higher education as well as for employment in R&D organizations, educational institutions, and industries.

10.2 Innovations proposed:

- Hold regular thematic workshops in different areas of Physics wherein faculty from within the Department and experts from outside can deliver lectures interact with each other; give tutorial talks to excite students etc. This will help generate interest, collaboration and awareness of the upcoming fields.
- Consciously improve our strength in the area of theoretical physics by attracting faculty candidates in different areas of theoretical physics. This has already been initiated and we have received a number of applications from very good candidates.
- Follow developments taking place worldwide in Physics and incorporate these in both teaching and research being carried out in the Department.
- Look into possibility of setting up excellent facilities in the Department through funding from outside agencies.
- Starting an active "Journal Club" for the Ph.D. students and those involved in research for improving the general and specific awareness required to do good research and also form a habit of regular journal reading.

10.3 Areas Identified for improvement in (i) curriculum (ii) teaching and learning process

(a) <u>M.Tech. Program:</u>

All the M. Tech. Programs will be reviewed and restructured to meet the current requirement of industries and R&D organizations, as well as keeping in view the aspirations of applicants

seeking admission to these programs. Input from industry will be taken from the very beginning in restructuring the M.Tech. Programs so that better placement of the students can be achieved.

Suggested changes in the emphasis and names of the existing programs:

- M.Tech. (SSM) may be restructured as M.Tech. in Advanced Materials/ Physics of Advanced Materials.
- M.Tech. (Applied Optics) may be restructured as M.Tech. (Applied Optics and Photonics) or M. Tech. (Optics and Photonics Engineering)

(b) M. Sc. (Physics):

- In order to develop a strong foundation of the M. Sc. students, core courses will be given adequate weightage in terms of course content and depth of coverage. It is proposed to provide a good number of '*Elective*' courses for catering to the varied interests of the students, in the third and fourth semesters so that students can develop specialization in areas of their interest.
- To enhance exposure of the students to the developments in contemporary and advanced topics of Physics, more talks /seminars from experts will be arranged keeping in view the M. Sc. curriculum. It is proposed to make this as a part of the curriculum. It is proposed that the Department should allocate some funds to invite external experts for giving such talks/seminars and for interaction with the students of the department.

(c) B. Tech. (Engineering Physics):

- The B. Tech. Programs is getting revised and recent advances in various areas of Physics will be included in the revision to expose the students to the most recent developments. Physics based courses that should be of interest to other departments of the Institute will also be introduced in the programs.
- It is recommended that each of the four semester Laboratory Courses during the II Year and III Years comprise of only one group of experiments, arranged under one theme e.g. Optics, Solid State Physics or Electronics, or Condensed Matter Properties, etc. and its placing in the program should be tuned with the theory courses. The lab courses will be placed appropriately in the teaching plan such that it comes after the relevant theory course. In the reorganization process, some of the existing experiments will be grouped and some new experiments will also be introduced.

(d) **Ph. D. Programs:**

- In order to meet the future requirements of the country for more graduates with a Ph. D. degree, the department has to increase the intake of Ph. D. students. However, for this to happen, substantial improvement in the existing infrastructure and available facilities is required. Presently there is not enough laboratory space, as well as sitting place for the Ph.D. students.
- To prepare our Ph. D. students for carrying out high quality research, it is planned to introduce at least half a dozen new/advanced level Pre Ph. D. courses.

- Department will also make efforts to increase interactions among Ph. D. students.
- Department will also execute plans to motivate good M.Sc./M.Tech. students to join the Ph.D. program.

General:

- It is observed that several students attend the department library during their off time between the classes. Thus it is proposed to strengthen and improve the departmental library. A pool of essential text books will be identified for all courses and will be made available in the departmental library.
- It is also proposed that B.Tech./M.Sc./M.Tech. labs should also have basic reference book related to the experiments.
- There is also no earmarked space within the Department where faculty and students can sit and discuss; this is essential for a greater interaction among the faculty and students and also among the students. Apart from requesting the Institute to allocate greater space for the Department efforts will also be made to rearrange the existing space and to create more space and infrastructure.
- Department has already started a regular colloquium by faculty members of the department. These colloquia are meant to introduce the students to the emerging areas of research and to generate interest among the student community for a healthier overall growth with the students getting exposed to other important contemporary areas of Physics. This is also expected to increase the interaction and collaboration among the faculty members of the Department.

10.4 New areas for research and master's program and industry participation in these

New areas for research:

- Computational material science
- Ultrafast dynamics
- High Pressure Physics
- Physics of Advanced Materials
- Quantum Photonics
- Biophysics/biological physics, Biomedical optical imaging and bio-photonics
- Physics at low temperatures
- Green Photonics

Master's program

- The Institute is currently in the process of reviewing all the Master's programs. The Department of Physics will discuss the changes needed in the M. Sc. program as well as in the M. Tech. programs. Plans include changes in credit requirements to provide more time to the students to carry out self study, new courses in keeping with the development taking

place in the world, new experiments in the laboratories, relook at the course contents of various courses etc.

Industry participation

- The Department plans to take inputs from different related industries in respect of coverage of topics in the different programs and incorporate suggestions in the revised program.
- Scientists and engineers working in different industries will be invited from time to time to visit the Department and interact with the students, giving a talk to motivate the students and to advice the Department
- The Department will proactively look at having some of the students carry out the Major Project dissertations in collaboration with industry to get a better feel of the subject and understand issues other than Physics in realizing products

10.5 Projections for (i) funded projects, (ii) Journal Publications

- It is difficult to project the quantitative figures. Department will make efforts to get more externally funded projects. New faculty joining the Institute should be able to attract funding in new areas.
- The department plans to increase collaboration with R & D laboratories of the country
- The department will work towards increasing the number of publications as well as targeting high impact factor journals

10.6 Projected graduation numbers-Ph.D., M.Tech. and B.Tech.

(a) Master's programs:

- MSc Physics (~50 every year)
- M.Tech. in Solid State Materials (~25 per year)
- M.Tech. in Applied Optics (~25 per year)
- M.Tech. in Optoelectronics and Optical Communications (~ 30 per year)

(b)Bachelor Program:

- B.Tech in Engineering Physics (~60 per year)

(c)**Ph.D. Program:**

- 30-40 every year

10.7 Projected faculty Profile, and areas for recruiting new faculty

Recruiting New Faculty:

- Efforts will be made to recruit quality faculty against the vacant positions. New faculty will be recruited keeping in mind the teaching requirements specific to core courses in B.

Tech. (Engineering Physics) and M. Sc. Programs, areas of Physics not well represented in the Department and also new areas of research.

- A good Department of Physics should have faculty in diverse areas of physics. Such a diverse faculty form different experimental and theoretical areas would enrich the interaction among the faculty and would also provide the students a broader education and cater to different interests of the variety of students in the Department. In this context the Department will proactively look for outstanding faculty in different areas and attract them to join the Department.
- Create greater interaction between theoretical and experimental research groups in different areas to understand fundamentals as well as to generate new applications.
- Intellectual property rights based on the research work performed in the department can bring long term benefits to the department and the institute. Efforts will be made to increase the number of intellectual property/patent filings from the department in addition to the journal publications. This activity will provide a natural way for us to increase industry interaction.

10.8 Projections for future Benchmarking (for comparisons after 5 years)- Institutions in India and abroad, and methods to overcome these.

- Varieties of teaching courses offered to master and UG students
- Numbers of publications
- External funding through projects
- Ph.D. produced

Following are the proposed steps to overcome the presently faced constraints in achieving the objectives.

- The department plans to work towards greater collaboration with foreign universities and institutions which will enable our graduate students to interact with top foreign scientists as well as possibility of spending extended periods of time working in the foreign laboratories.
- The department already carries out interdisciplinary activity with other departments and centers of the Institute. It plans to further expand this base and develop interdisciplinary programs to further enhance the research and developmental activities of the department.

10.9 Infrastructure and governance- limiting factors that affect achievement of benchmark and methods to overcome these.

- **Limiting factors**

- The research areas covered by the Department are all globally accepted state-of-the art research fields. Although the Department produces a good number of publications in international journals of repute (over 800 during 2005-11), greater fraction of publications in high impact factor journals and generation of more patents is yet to be achieved. Major constraints to achieve these are timely non-availability of infrastructure (primarily space, uninterrupted and regulated power supply), characterization facilities and funds, and unavailability of appropriate space for research laboratories.

- **Some suggestions**

- Larger space allocation to the Department of Physics
- Creation of good infrastructure within the Institute including uninterrupted regulated power supply
- Funds for prototype development of the research and developmental work carried out by M.Tech./M.Sc./B.Tech. students under their major project.
- Appointing an Administrative Officer in the Department who could help faculty in technical documentation, purchase processing, communication and liasoning with R&D organizations, in respect of sponsored R&D and other administrative jobs.

10.10 Working with other departments/centers and institutions in teaching and research

The faculty of the department works closely with faculty members in many other departments and centers of the Institute and also scientists from other Institutions. Some of these are

1. CARE (Centre for Applied Research in Electronics), IITD
2. IDDC (Instrument Design and Development center), IITD
3. Department of Electrical Engineering, IITD
4. NPL (National Physical Laboratory), CSIR
5. SSPL (Solid State Physics Laboratory), DRDO
6. LASTEC (Laser Science and Technology Center), DRDO
7. IRDE (Instrument Research and Development Establishment), DRDO

The involvement is in terms of conducting joint sponsored projects, having joint students carrying out Major Project dissertations in undergraduate and post graduate programs and also have joint supervision of Ph. D. scholars with faculty from other departments of the Institute and scientists from other R & D organizations.

10.11 New initiatives that the department will take

i. The department will work towards increasing the number of research publications as well as targeting high impact factor journals.
ii. The department will work towards more increased collaboration with foreign universities and institutions which will enable our graduate students to interact with top foreign scientists as well as having the possibility of spending extended periods of time working in the foreign laboratories.
iii. Induct young and energetic faculty in new upcoming areas of research and setup new research facilities within the department to pursue research in these areas
iv. Plan separate Seminar Room, Meeting Room, and space for interaction between students and faculty.

10.12 Outreach goals and anticipated limitations in the attainment these

The departmental faculty takes part in many outreach activities including giving talks in various institutions within the country and organizing Short Courses, Workshops, Seminars etc. for the benefit of faculty and researchers from various academic and research institutions.

This helps the participants to get contacts and also approach any of the faculty member for any help or advice in setting up of experiments or framing new courses or beginning new programs in their institutions. Short courses for Industry personnel are also organized from time to time to spread awareness of some of the latest developments in various fields and which could be interesting from their point of view for expanding their product base or refining their processes etc.

10.13 Mechanisms for effective changes based on feedback received and development and implementation of corrective measures.

Department has various internal committees to look into students feedback, curriculum development, space requirement, staff requirement and welfare, etc. for development and implementation of corrective measures. Department will also form committees to look into the feedback of the Review Committee, and prepare the plan for the corrective measures

10.14 Questions to which the Department seeks answers from the Review Committee

The Department would appreciate suggestions in the following aspects:

a) Our focus in the teaching programs has been more towards applied physics areas. Does the committee have any comments and suggestions in this?
b) Publications versus Patents?
c) Means of encouraging performers in the Department?
d) Optimum class sizes for UG and PG courses?
e) Any other suggestion for improvement?

11. Information in Public Domain

The teaching and research programs offered by the department and their details are available in the web. Announcement of lectures organized by the Department are uploaded in the Physics Department website on a regular basis. The various research projects and consultancy projects that the Department faculty is associated with are also available in the Department website. The Ph D degrees awarded are also available in the Department's website.

The Minutes of all meetings are distributed to the members of the respective committees and are available in the Department. Vision documents, Space Allocation documents etc. are also circulated among all faculty members of the Department and are available in the Department's office.

End of Report