M. Tech. PHA (Applied Optics and Quantum Photonics) Students

Welcome!
Applied Optics and Quantum Photonics Group,
Department of Physics, IIT Delhi

Prof. Sunil Kumar
Programme Coordinator M. Tech. PHA
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Tel:+91-11-2659 1515 (O),
Email: kumarsunil@physics.iitd.ac.in

"**Optics and Photonic sciences**" is one of the major domains of academics (teaching and research) at the Physics department

Faculty members (~16)











Joint Faculty





M. Tech. PHA (Applied Optics and Quantum Photonics)

- The Applied Optics programme has been running in IIT Delhi since 1966.
- Primarily designed to emphasize the "Applied" nature of optics and photonics.
- Suited to the requirements of various Optics, Optoelectronics and Photonics Industries, R&D Organizations and Institutions.
- Open to students having M.Sc. (Physics / Electronics) degree or B.Tech. (Engineering Physics /Electrical /Electronics and Instrumentation).

VISION

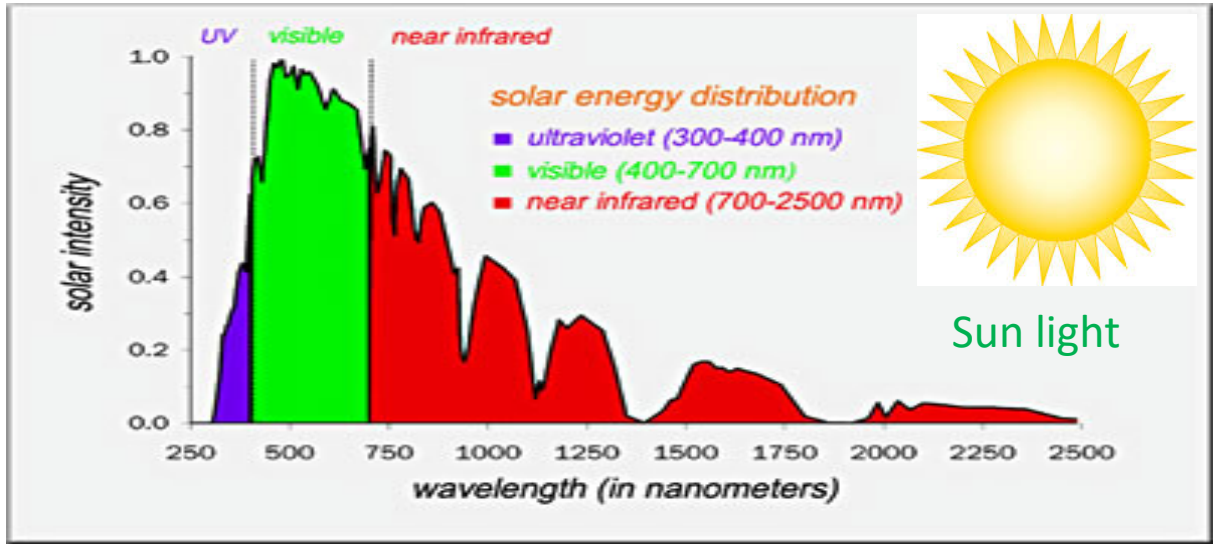
To contribute to India and Indian society through excellence in scientific and technical education and research in optics and photonics; to serve as a valuable resource for industry and society; and remain a source of pride for all Indians.

MISSION

To generate new knowledge by engaging in cutting-edge research and technology in optics and photonics. To develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in area of optics and photonics.

Why to Study about Applied Optics and Photonics ?

And God said, "Let there be light," and there was Sun light.

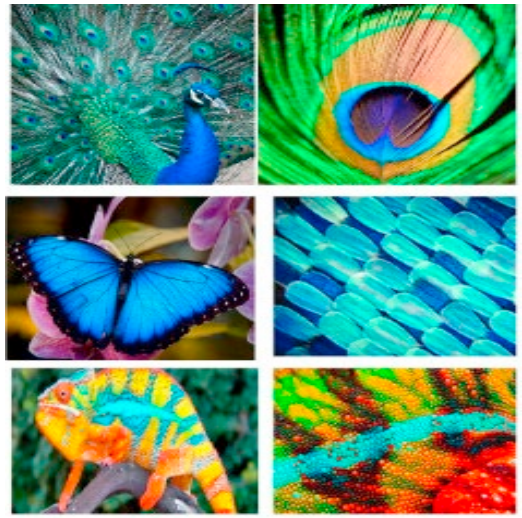


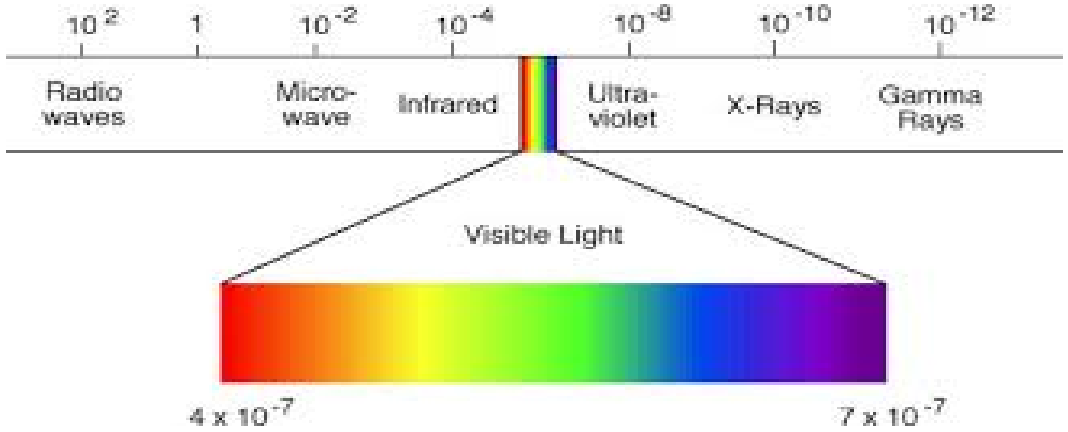
Sun light

Most precious gift for human being and life on Earth

Photosynthesis

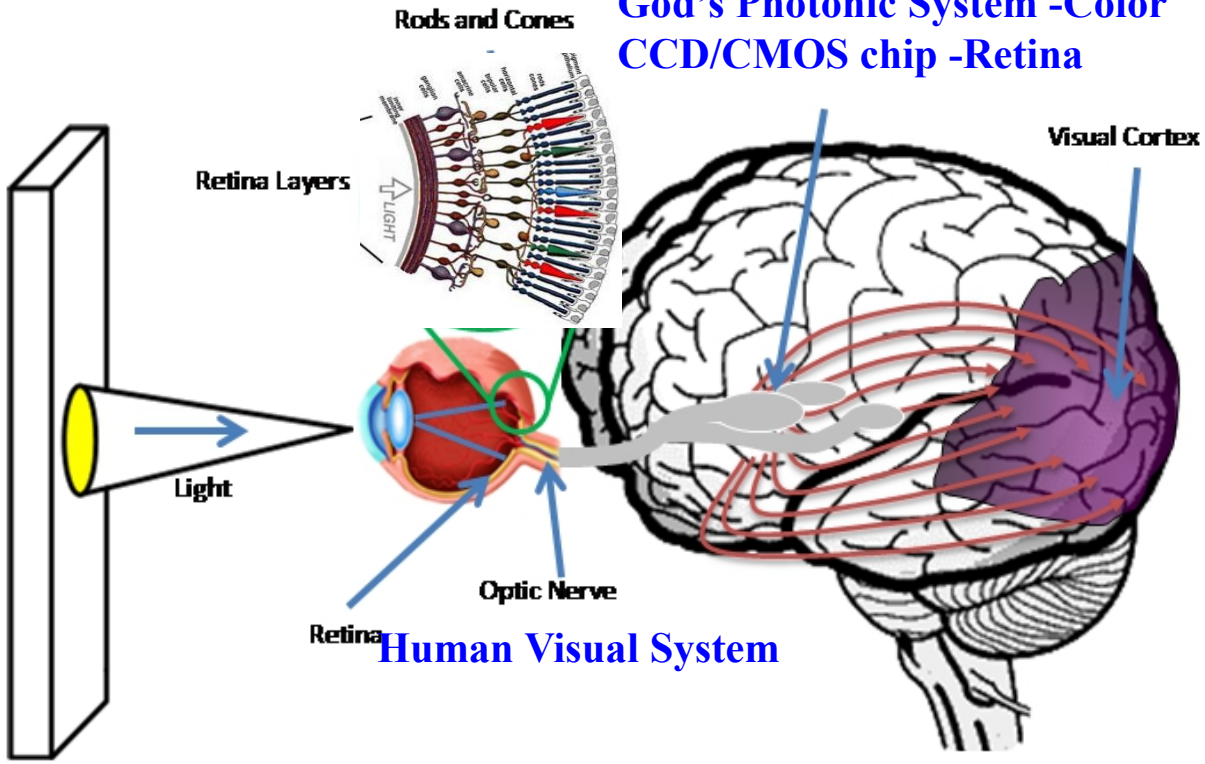
Natural Photonic Crystals





Who Made First Applied Optics and Photonics System?

God's Photonic System -Color CCD/CMOS chip -Retina



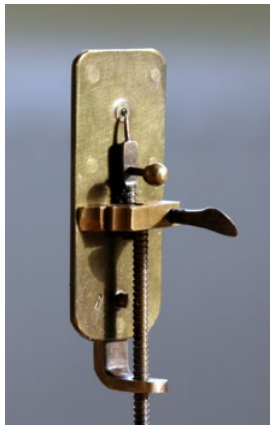
Human Visual System

Journey of Applied Optics and Photonics

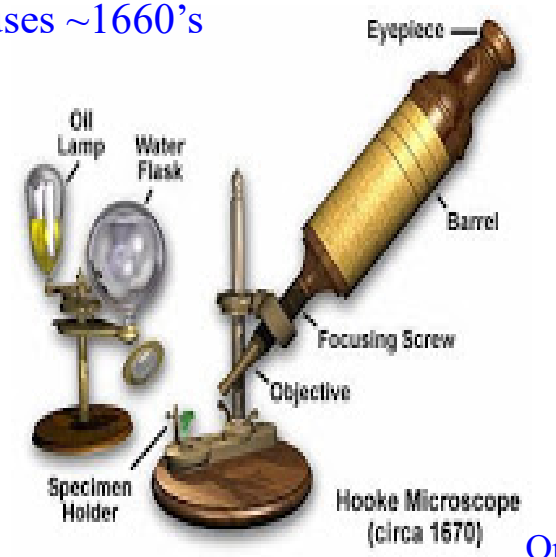
Today we have

Most powerful Hubble space telescope and LIGO - Gravitational Wave Detection using light

Antonie van Leeuwenhoek and **Robert Hook** –Turned their lenses down to small objects and found bacteria and viruses ~1660's



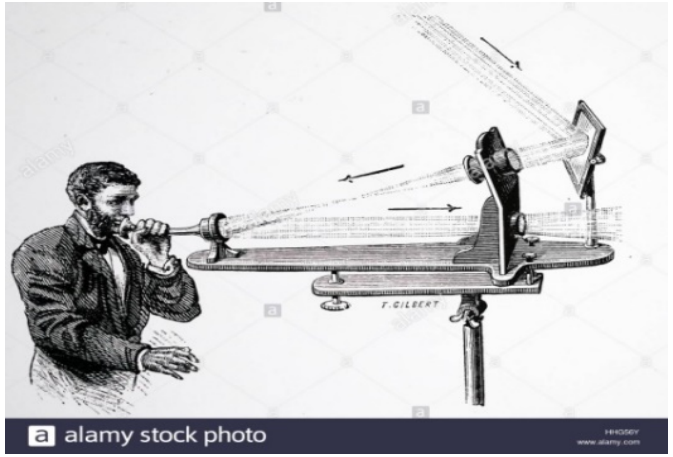
A replica of a microscope by van Leeuwenhoek



Today we have

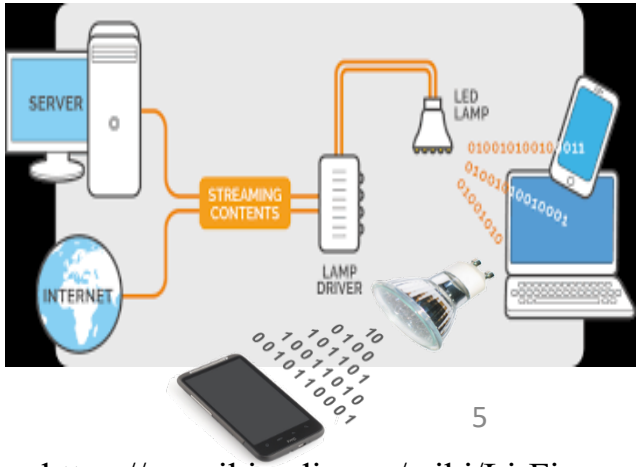
Optical Nanoscope - Imaging of single molecule ~ 10-50 A^0

Alexander Graham Bell
Photophone (1880)
(First successful wireless voice communications using light)



Today we have

Optical fiber communication and Li-Fi (Light Fidelity)/ Visible light communication (VLC), Quantum Communication and Quantum Computing



https://en.wikipedia.org/wiki/Li-Fi

First Laser was developed in 1960 by **Charles H. Townes** **Theodore Harold Maiman**

Now the application of lasers in almost in all fields including manufacturing.

Source https://en.wikipedia.org/wiki

Applied Optics and Photonics Technologies Everywhere in Our Daily Life

Advanced Lighting Applications

Energy Efficient Lighting, HB-LEDs, OLEDs/PLEDs TVS, Display, Solar and alternative light sources, Day Light Saving and Light Harvesting

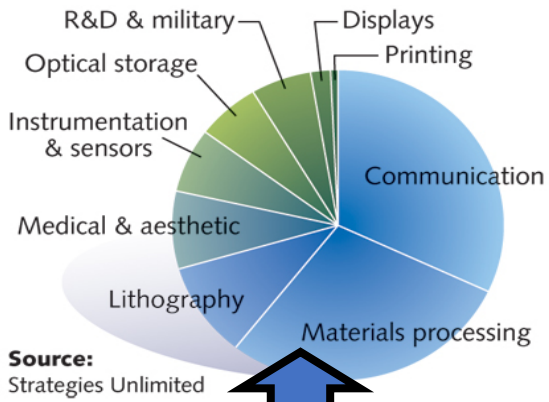
Bio-medical Applications and Bio-photonics

Advanced bio-medical Optical Imaging, Sensing & Diagnostics, Laser Based Therapy, Confocal microscopy, OCT, Fluorescence microscopy, Multiphoton Microscopy, Nanoscopy

Information Technology

High speed Optical Communication, integrated photonics Optical Networking and Optical Interconnects, WDM, Quantum Computing, Quantum Computers, Quantum Cryptography, Quantum Information Processing

Future Warfare using lasers



Advanced Optics Photonics Technologies

Quantum communications, Quantum computing, Quantum Materials, Robotics, Machine vision, Sensing, Artificial intelligence Internet of Things (IoT)

Industrial Revolution using lasers

Laser Based High Precision Manufacturing and Machining, Machine Vision and Inspection, Digital Holography, NDT, Holographic Storage Holographic Lithography etc.

Ultrafast Optics/ Femto-science & technology

Applications of femto-science and Technology : Biotechnology, Medicine, Information Technology, Nanotechnology, Basic Science

Nano-photonics

Components, Systems, sensors, actuators photonic crystals, Nanometrology (NSOM), Optical Tweezers

Credit structure (new)

SEM.	Courses (Number, Abbreviated Title, L-T-P, Credits)							Lecture courses	Contact hr/week				Credits
									L	T	P	Total	
I	PYL7047 (3-0-0) 3	PYL7051 (3-0-0) 3	PYL7053 (2-0-2) 3	PYL7055 (3-0-0) 3	PYP7061 (0-0-6) 3		Teaching\ Research Practicum (0-0-8)	5	11	0	8	17	15
Winter	Cornerstone project, PYDxxxx (0-0-4) 2							0	0	0	4	4	2
II	PYL7052 (3-0-0) 3	PYL7057 (3-0-0) 3	PYP7062 (0-0-6) 3	PE-1 (3-0-0) 3	OE -1 (3-0-0) 3	PYDxxxx (0-0-2) 1	Teaching\ Research Practicum (0-0-8)	4	12	0	8	20	16
Summer	Summer training (ST), PYTxxxx (0-0-6) 3							0	0	0	6	6	3
III	PE – 2 (3-0-0) 3	OE – 2 (3-0-0) 3	PYD8051 (0-0-12) 6		VEVxxxx (0-0-2) 1		Teaching\ Research Practicum (0-0-8)	2	6	0	14	20	13
IV	PYD8052 (0-0-24) 12						Teaching\ Research Practicum (0-0-8)	0	0	0	24	24	12
											Total	95	61

Program Core

PYL7047	Nonlinear optics : Prof. Sunil Kumar	3-0-0	3
PYL7051	Optical sources, photometry and metrology : Prof. Bhaskar Kanseri	3-0-0	3
PYL7052	Laser systems and applications: Prof. Aloka Sinha	3-0-0	3
PYL7053	Optical systems design: Prof. D. S. Mehta	2-0-2	3
PYL7055	Basic optics and optical instrumentation: Prof. Bodhaditya	3-0-0	3
PYL7057	Statistical and quantum optics: Prof. Bhaskar Kanseri	3-0-0	3
PYP7061	Optical fabrication and metrology laboratory	0-0-6	3
PYP7062	Advanced optics laboratory	0-0-6	3
PYD8051	Major project - I	0-0-12	6
PYD8052	Major project - II	0-0-24	12

Program Electives

PYL7060	Biomedical optics and bio-photonics	3-0-0	3
PYL7059	Computational optical imaging	3-0-0	3
PYP7063	Computational optics laboratory	0-0-6	3
PYL7056	Fourier optics and holography	3-0-0	3
PYL8058	Advanced holographic techniques	3-0-0	3
PYL7080	Diffractive and micro-optics	3-0-0	3
PYL7074	Polarised light and its applications	3-0-0	3
PYL7091	Fiber optics	3-0-0	3
PYL8092	Guided wave photonic sensors	3-0-0	3
PYL7072	Plasmonic sensors	3-0-0	3
PYL7095	Optics and lasers	3-0-0	3
PYL7092	Optical electronics	3-0-0	3

PYL7070	Ultrafast optics and applications	3-0-0	3
PYP7064	Advanced optical workshop	0-0-6	3
PYS8055	Independent study	3-0-0	3
PYL8079	Selected topics in applied optics	3-0-0	3
PYL8081	Selected topics – I	1-0-0	1
PYL8082	Selected topics – II	1-0-0	1
PYL8083	Minor project	0-0-6	3
PYL7048	Quantum optics	3-0-0	3
PYL7058	Advanced quantum optics and applications	3-0-0	3
PYL7049	Quantum information and computation	3-0-0	3
PYL7xxx	Quantum communication	3-0-0	3
PYL7071	Green photonics	3-0-0	3

Open Electives

Courses above 700 level from other programmes/departments

Laboratory courses

Prof. Bhaskar Kanseri

Prof. D. S. Mehta

Semester I

Course No.	Course	Type	L-T-P	Credits
PYL755	Basic optics and optical instrumentation	PC	3-0-0	3
PYL751	Optical sources, photometry and metrology	PC	3-0-0	3
PYL753	Optical systems design	PC	3-0-0	3
PYP761	Optical fabrication and metrology laboratory	PC	0-0-6	3
	Programme Elective-I	PE	3-0-0	3

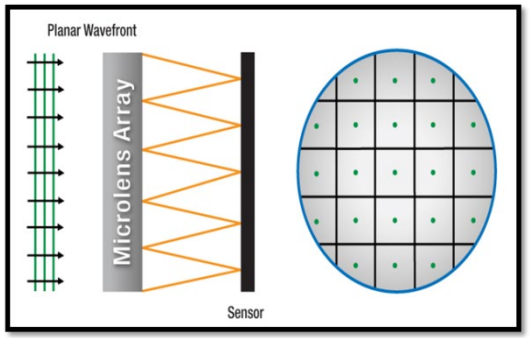
Semester II

Course No.	Course	Type	L-T-P	Credits
PYL752	Laser Systems and Applications	PC	3-0-0	3
PYL756	Fourier Optics and Holography	PC	3-0-0	3
PYP762	Advanced Optics Laboratory	PC	0-0-6	3
	Elective-II	PE	3-0-0	3
	Elective III	PE	3-0-0	3
	Semester total		12-0-6	15

Optical Workshop Facility

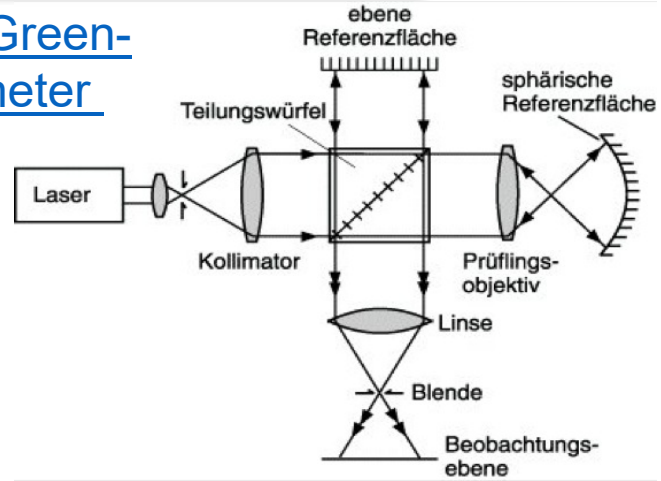
(Design/fabrication/testing of lens, prisms, etc.)

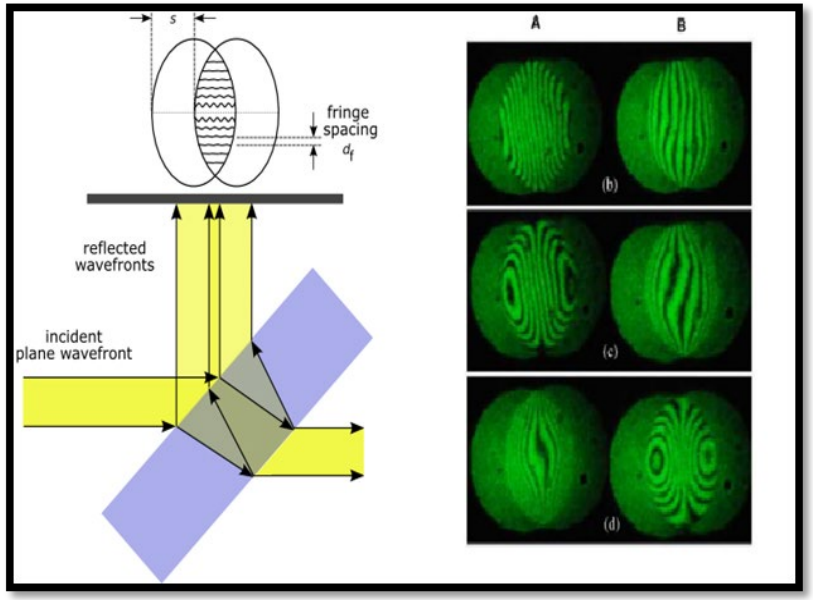
Shack Hartmann Wave Front Sensor



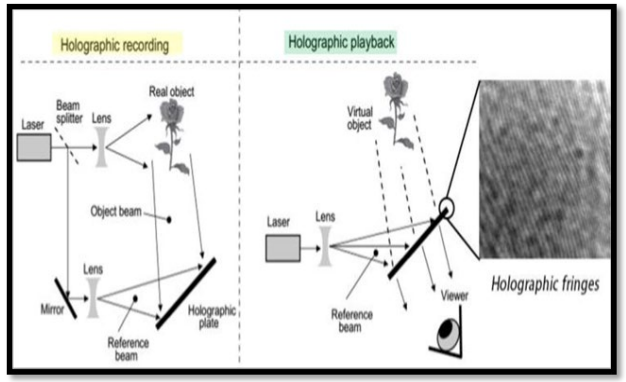
Autocollimator

Twyman-Green-Interferometer



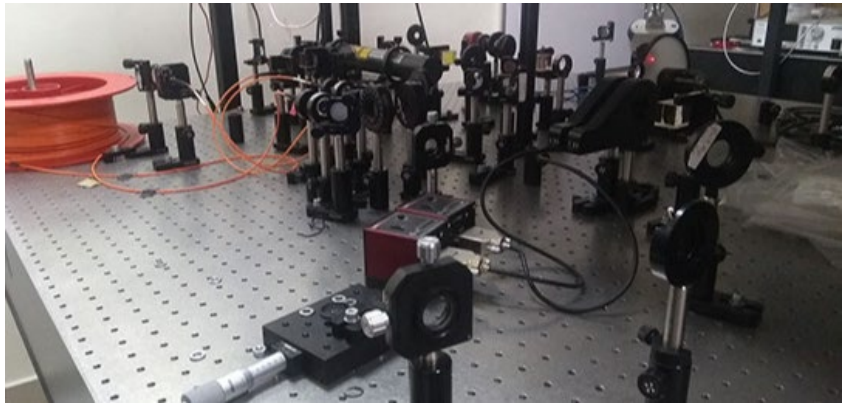


Digital Holography

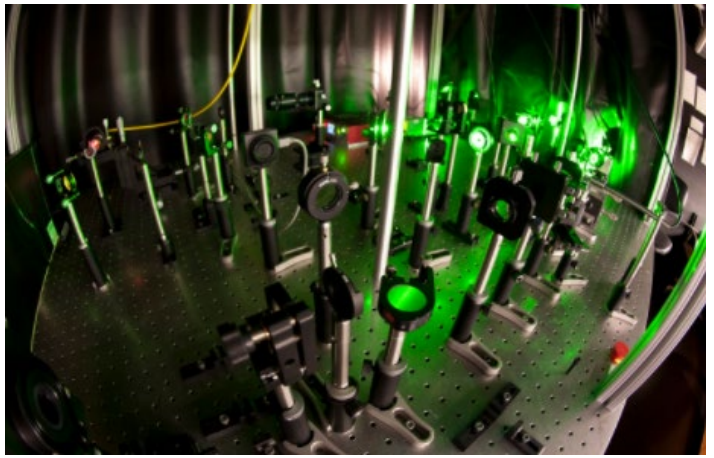


Abbe Refractometer

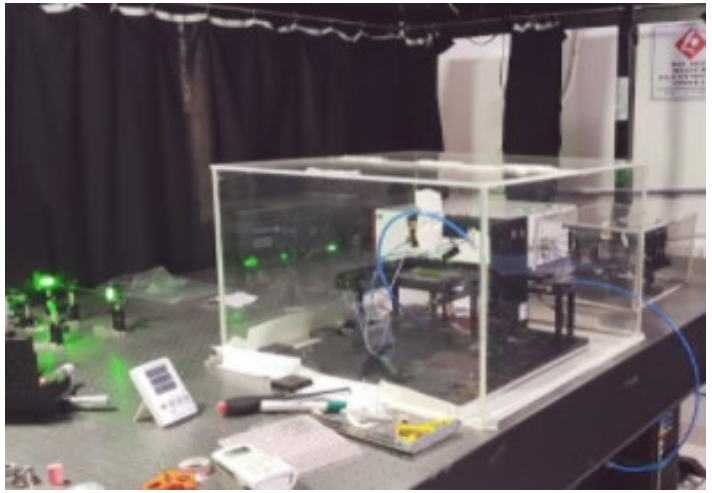
Advanced Optics and Photonics Labs to Carry out Major Projects



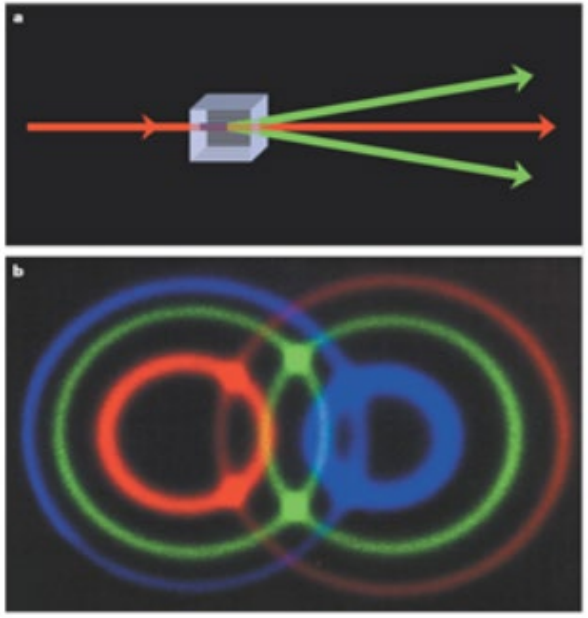
Experimental Quantum Interferometry and Polarization Lab



Raman Spectroscopy Lab

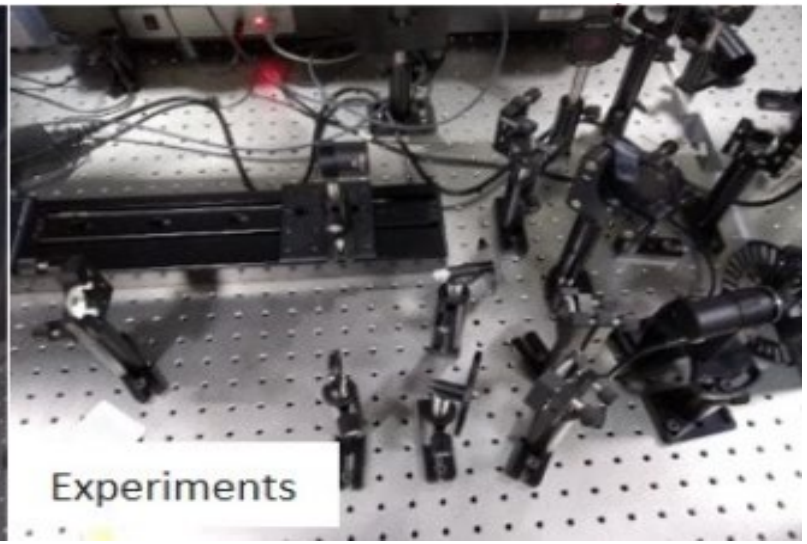


High Precision Spectroscopy Lab



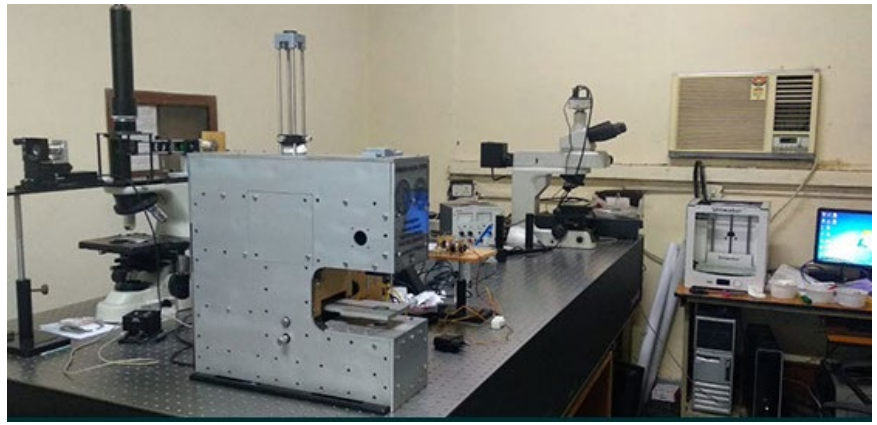
Quantum Photonics Lab

Femtosecond Spectroscopy Lab.

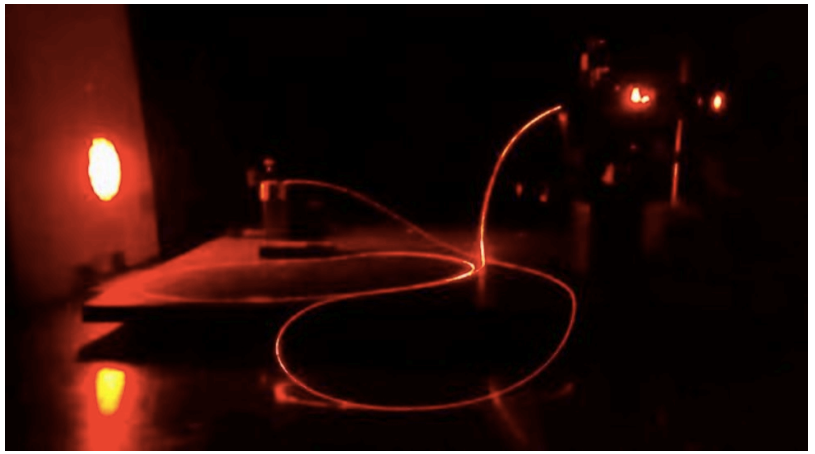


Nonlinear Photonics Lab.

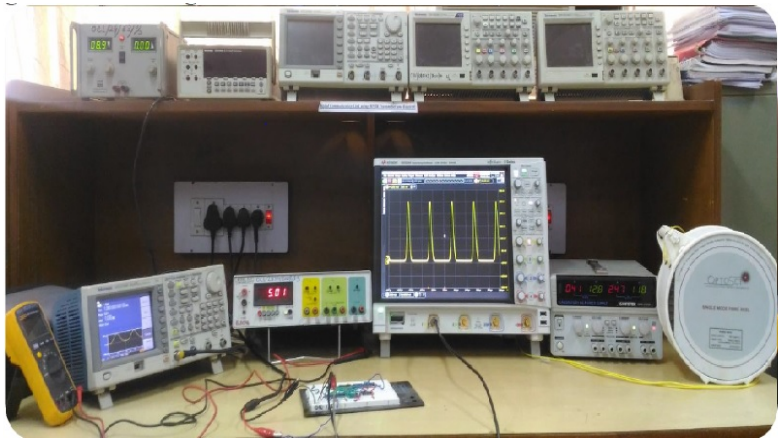
Advanced Optics and Photonics Labs to Carry out Major Projects



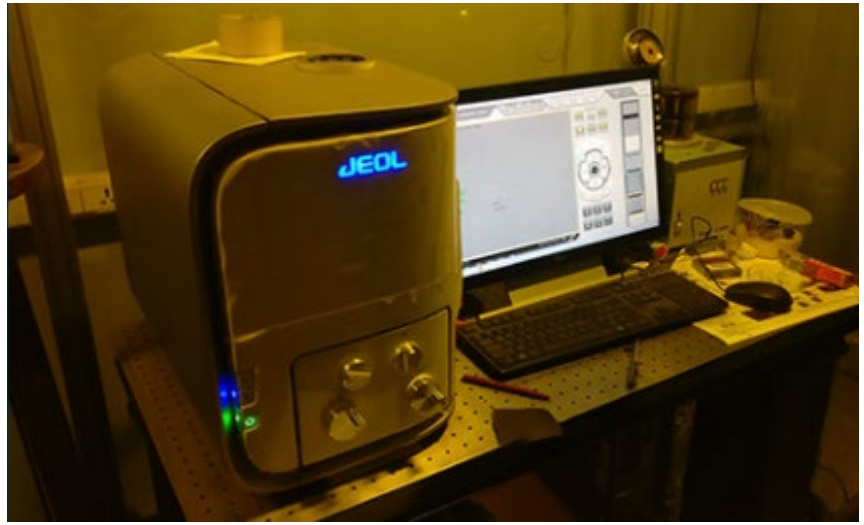
Bio-photonics and Green Photonics Lab



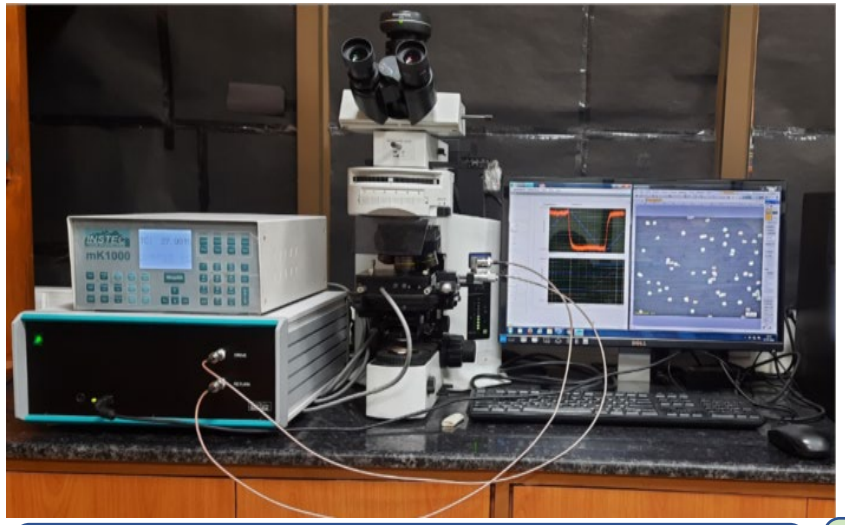
Fiber Optics Lab



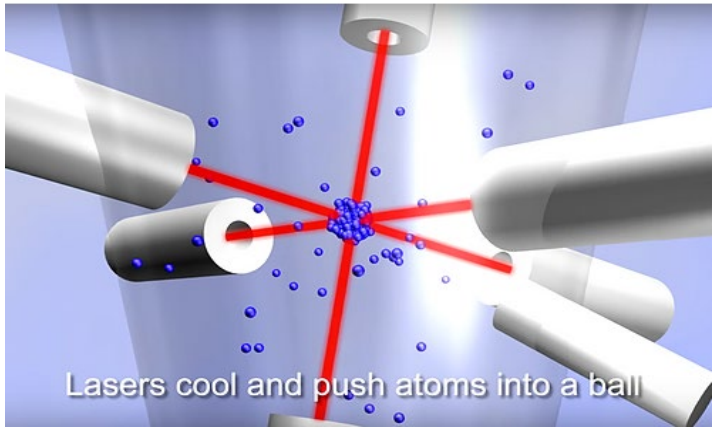
Optical Communication Lab



Photonics Lab



Liquid-Crystal Optical Devices Lab



Cold Atom Quantum Technology Lab

Winter and summer internships

- **Don’t leave station without informing.**
- **For continuation of assistantship, follow the rules with attendance and allowed leaves**

Semester I

Winter

Semester II

Summer

Semester III

S.No.	Course	Type	L-T-P	Credits
	Elective IV (Open elective)	OE	3-0-0	3
PYD851	Major Project Part-I	PC	0-0-12	6
	Semester total		6-0-12	9

Semester IV

Course	Title	Type	L-T-P	Credits
PYD852	Major Project Part-II	PC	0-0-24	12
	Total Credits		0-0-24	12

DAAD Fellowship

Important part of M.Tech. (AO) programme

PYP7063	Computational Optics laboratory	PE	0-0-6	3

Computer programing is an integral part of optics and photonics now.
Just look at your mobile phone without optics it is nothing.

Digital Imaging and Image Processing: (1) Recording and reading RGB color images from a camera in computer and their simple manipulation (2) Understanding sampling/aliasing by imaging of a bar-chart (3) Calibrating a camera sensor for gamma setting (4) Understanding image compression, other image processing tools etc.

Biomedical Optics and Biophotonics: Imaging, Sensing, Microscopy, endoscopy, Diagnostics and laser based operation and laser based therapy.

Hologram and Interferogram Analysis: Fourier Transform Method and Phase Shifting Method, Hilbert Transforms, Wavelet Transforms, Simulation of digital hologram recording and reconstruction etc.

Optical System Design: Ray tracing with commercial softwares: ZEMAX, CODE V, OSLO, TRACE PRO, OCTAVE, etc.

Applications of these: Ray tracing, Optical system design, lens and lens system design, endoscope/microscope design, lighting and illumination, optical fibers and fiber systems design etc.

You must learn by yourself: MATLAB, LABVIEW, and any other image processing programme you find at (WWW).

After completing M.Tech. programme

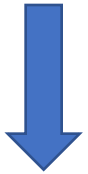
Govt. Jobs: (Scientists)

DRDO labs. IRDE Dehradun, TBRL Chandigarh, LASTEC Delhi, Hyderabad, Bengalore
ISRO Labs across India.
CSIR Labs. Across India.
BARC, IISC Bangalore, IISER labs. etc.

Higher Studies (Ph.D.)

In India and abroad

Startup company IIT Delhi



Requirement

Sound knowledge of basic optics and photonics, hands on experience with optical systems, sound knowledge of computer programming (Optical design softwares, image processing, optical signal processing).

Optics and Photonics Companies Abroad

1. Thorlabs Inc. USA, Newport Inc. USA.
2. Opto-Sigma, Laser Components GmbH, Light Guide Optics GmbH, IPG Photonics USA.
3. Edmund Optics Ltd. Ocean Optics.
4. Carl Ziess, Nikon Japan, Olympus Japan, Shimadzu Japan, HORIBA Jobin Yvon and many more.

Optics Related Companies in India

1. Paras defense (Optical instruments related to Defense)
2. Optica (Optics & Allied Engg. Pvt. Ltd, Bangalore, India.)
3. Holmarc Opto-Mechatronics P. Ltd . Kochi Kerala.
4. General Optics Asia limited (Goal), Pondicherry.
5. Light Guide Indore.
6. Universal Optics Roorkee, UK.
7. Sehjanand Laser, Gujarat.
8. Hind HIGH-VAC, Bangalore.

M.Tech Applied Optics Batch (2021-23) Placements

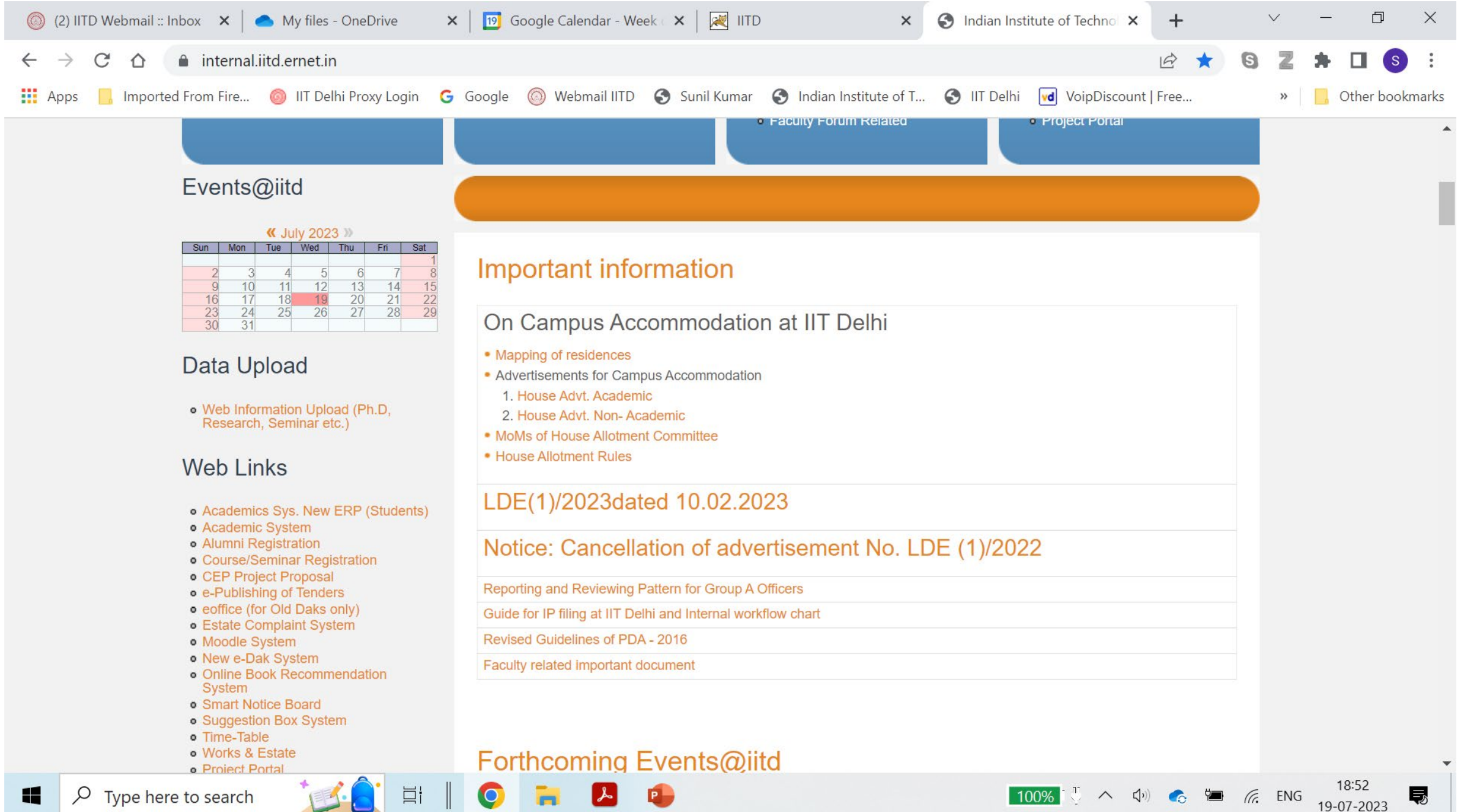
#	Name	Entry number	Lab/ Name of University/ Company	Position	Whereabouts
1	Kunal Singh	2021PHA2471	Max Planck Institute for Nuclear Physics (MPIK) - European Organization for Nuclear Research (CERN), Ruprecht Karl University of Heidelberg	PhD	*Heidelberg, Germany and Geneva, Switzerland*
2	Onima Bisht	2021PHA2194	QuTech- Kavli Institute of Nanoscience, Technische Universiteit Delft (TU Delft)	PhD	*Delft, Netherlands*
3	Manish Raj	2021PHA2473	Marie Skłodowska-Curie Actions (MSCA) Fellow, Chalmers University of Technology	PhD	*Gothenburg, Sweden*
4	Bhawna	2021PHA2191	Institut National de Recherche Scientifique (INRS)	PhD	*Montreal, Quebec, Canada*
5	Pitambar Mukherjee	2021PHA2476	CNRS France (IMS Bordeaux, LP2N Bordeaux and LKB ENS labs)	PhD	*France (Talence and Paris)*
6	Bhanu Pratap Singh	2021PHA2462	Swiss National Science Foundation (SNSF) Fellow, Institute of Applied Physics, University of Bern	PhD	*Bern, Switzerland.*
7	Meenakshi	2021PHA2474	Junior Research Fellow, Department of Physics, Indian Institute of Technology Delhi (IITD)	PhD	*New Delhi, India*
8	Chiranjeev V Gopal	2021PHA2464	Biotech Vision Care Pvt Ltd	Optical Engineer	*Ahmedabad, Gujarat, India*
9	Yogita	2021PHA2485	Leibniz Institute of Photonic Technology (IPHT), Friedrich Schiller University Jena (FSU Jena)	PhD	*Jena, Germany*
10	Jyoti Bej	2021PHA2469	CNRS (LPL , North Paris)	PHD	*Villetaneuse, France*
11	Arna Ghosh	2021PHA2461	Leibniz Institute of Photonic Technology (IPHT), Friedrich Schiller University Jena (FSU Jena)	PhD	*Jena, Germany*
12	Debanjan Adhikari	2021PHA2465	Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut) - LIGO Scientific Collaboration (LSC) and QuantumFrontiers, Leibniz University Hannover	PhD	*Hannover, Niedersachsen, Deutschland*
13	Deepak Kararwal	2021PHA2466	University of bordaeux & École de technologie supérieure (ETS, University of Quebec)	PhD	*Montreal, Canada & Talence, France*
14	Dibya Jyoti Sarangi	2021PHA2467	Flight Fellowship - Marie Skłodowska-Curie Actions (MSCA) cofund, Institute of Photonic Sciences (ICFO)	PhD	*Barcelona, Spain*
15	Vivek Kumar Jha	2021PHA2484	Biotech Vision Care	Optical Engineer	*Ahmedabad, Gujarat, India*
16	Anju Sajan	2021PHA2459	University of Birmingham	PhD	*Birmingham,UK*
17	Binit Prakash Agarwala	2021PHA2463	Bandhan Bank	Data Scientist	*Kolkata, West Bengal, India*
18	Amber Hastinapuri	2021PHA2458	Biotech Vision Care	Optical Engineer	*Ahmedabad, Gujarat, India*
19	Kamlesh Joshi	2021PHA2192	SeNSE, IIT Delhi	PhD	*New Delhi, India*
20	Vikram Bhandhari	2021PHA2483	SeNSE, IIT Delhi	PhD	*New Delhi, India*
21	Nasim Akhtar	2021PHA2193	Allen Career Institute	Job	*New Delhi, India*
22	Mohd Umar	2021PHA2475	Optics and Photonics Centre (OPC), IIT Delhi	PhD	*New Delhi, India*
23	Shubham Saxena	2021PHA2481	Heriot-Watt University	PhD	*Edinburgh, UK*
24	Sachin Pradhan	2021PHA2478	Heriot-Watt University	PhD	*Edinburgh, UK*
25	Ikbal Ahamed Biswas	2021PHA2468	Physikalisch-Technische Bundesanstalt (PTB), Leibniz University Hannover	PhD	*Braunschweig, Germany*
26	Sanjeet Kumar	2021PHA2480	Université Grenoble Alpes, CNRS Labs	PhD	*Grenoble, France*

The students must register for these courses on the Web- based Academic Management System by using their login (Kerberos) ID and Password (provided to them on the ERP portal while filling Form A) preferably before July 24, 2025, and latest by Aug 7, 2025. Even if they cannot register online before July 24, they must start attending the classes from July 24, 2025 onwards, and complete the registration at the earliest (and definitely before Aug 7, 2025.)

Website for registration: https://eacademics.iitd.ac.in/sportal

Important rules regarding Attendance, Assistantship being followed in their Department/ Centre/School. Teaching Assistants (TAs) can be asked to help in accessing and understanding the timetable available on the website of the Institute. You can contact your senior batch students regarding all these.

Register on ERP (web based system) using your login (Kerberos) ID and Password



Register on ERP (web based system) using your login (Kerberos) ID and Password

S.No	Course Name	Code	Slot	Units	Instructor	Instructor Email	Lecture Time	Tut
37	OPTICAL SOURCES, PHOTOMETRY AN	PYL751	H	3.0-0.0-0.0	BHASKAR KANSERI	bkanseri@physics.iitd.ac.in	MW 11:00-12:00 ,Th 12:00-13:00	
38	OPTICAL SYSTEMS DESIGN	PYL753	E	3.0-0.0-0.0	ANURAG SHARMA	asharma@physics.iitd.ac.in	TWF 10:00-11:00	MT
39	BASIC OPTICS AND OPTICAL INSTR	PYL755	K	3.0-0.0-0.0	DALIP SINGH MEHTA	dsmehta@iddc.iitd.ac.in	W 12:00-13:00 ,TF 17:00-18:00	
52	OPTICAL FABRICATION AND METROL	PYP761	P	0.0-0.0-6.0	GUFRAN SAYEED KHAN	gufranskhan@sense.iitd.ac.in		
36	QUANTUM INFORMATION & COMPUTA.	PYL749	J	3.0-0.0-0.0	SARTHAK PARIKH	sarthak@physics.iitd.ac.in	MTF 12:00-13:00	
40	COMPUTATIONAL OPTICAL IMAGING	PYL759	L	3.0-0.0-0.0	KEDAR BHALCHANDRA KHARE	kedark@physics.iitd.ac.in	W 13:00-14:00 ,TF 18:00-19:00	
53	COMPUTATIONAL OPTICS LABORATORY	PYP763	D	0.0-0.0-6.0	KEDAR BHALCHANDRA KHARE	kedark@physics.iitd.ac.in	TWF 09:00-10:00	MT
41	ULTRA-FAST OPTICS & APPLICATI.	PYL770	F	3.0-0.0-0.0	ALOKA SINHA	aloka@physics.iitd.ernet.in	TThF 11:00-12:00	MT
42	FIBER OPTICS	PYL791	E	3.0-0.0-0.0	R.K. VARSHNEY	ravi@physics.iitd.ac.in	TWF 10:00-11:00	MT
43	PHOTONIC DEVICES	PYL793	D	3.0-0.0-0.0	AMARTYA SENGUPTA	amartya@physics.iitd.ac.in	TWF 09:00-10:00	MT
44	OPTICS AND LASERS	PYL795	J	3.0-0.0-0.0	GADDAM VIJAYA PRAKASH	prakash@physics.iitd.ernet.in	MTF 12:00-13:00	

Register immediately and start attending the classes

M.Tech Applied Optics (2021-23 batch)

From left to right (standing students): Ikbal Ahmed Biswas, Anju Sajan, Meenakshi, Onima Bisht, Kunal Singh, Chiranjeev V Gopal, Debanjan Adhikari, Pitambar Mukherjee, Dibya Jyoti Sarangi, Bhanu Pratap Singh, Kamlesh Joshi, Vikram Singh Bhandari, Manish Raj Nasim Akhtar, Mohd umar, Shubham Saxena, Amber Hastinapuri, Binit Prakash Agarwala, Vivek Jha, Sanjeet Kumar, Sachin Pradhan, Yogita, Bhawna, Jyoti Bej, Arna Ghosh (Deepak Karawal missing!)

Thank you

To create an optical system which can do one or a few functions, what all is required ?

The right mirrors, lenses, coating, materials, gratings/prisms, waveguides, and so on.

And not to mention

The sources and the detectors/sensors

Each one of the above is a great deal in R & D.