



TIFAC-CORE IN FIBER OPTICS AND OPTICAL COMMUNICATION



Delhi College of Engineering
DELHI TECHNOLOGICAL UNIVERSITY
Bawana Road, Delhi-110 042, INDIA



INTRODUCTION

TIFAC (Technology Information Forecasting & Assessment Council)

TIFAC is an autonomous society under the Department of Science and Technology, Government of India. It keeps technology watch on global trends and formulates preferred technology options for India.

MISSION REACH

Today's liberalized economic order is witnessing silent competitions for sustenance and excellence in almost every sector of the economy. Focusing on such competition-both national and global levels, TIFAC launched Mission **REACH** (**R**elevance and **E**xcellence in **ACH**ieving new heights in educational institutions) in the year 2000 - a mission embedded in Technology Vision - 2020, Government of India. Under the Mission REACH program, institutions of proven potential are being selected for creating **Centers Of Relevance and Excellence (CORE)**.

These TIFAC-COREs are mandated for excelling in focused areas. The prime objective of establishing the COREs is to mobilize human resources of international standards by imparting quality education and involving them in frontier research in diverse disciplines that are of immediate and high relevance to the Indian industry and the society. These COREs will leverage the synergy of a triangular linkage among educational institutions, government and industries or user organizations to create world class centers which will be the leaders in their respective fields. Through these centers, technology generation and skill upgradation of work force is to be done on a continuous basis. One such TIFAC-CORE in the area of **Fiber Optics & Optical Communication** has been established in Delhi College of Engineering, Delhi, now transformed into Delhi Technological University, Delhi.



Experimental Setup on Electro-Optic Effect



Entrance of Delhi College of Engineering (DCE) Campus



DELHI TECHNOLOGICAL UNIVERSITY (Delhi College of Engineering-DCE)

Delhi Technological University formerly Delhi College of Engineering-DCE, Delhi, is a premier engineering & technology institute established in 1941, has been imparting education in various field of Engineering and Applied Sciences at Under Graduate, Post Graduate & Ph.D. (Doctoral) Levels.

The graduates of this institution are in demand in industries & scientific organizations within the country and abroad. This institute is consistently ranked as one of the top 10 institutions in the country. DTU formerly DCE today imparts education and training in 14 branches of engineering at Under Graduate level with an intake of 910, 4 branches of B.Tech. (Evening Program) degree are being run with an intake of 120. Full-time and part-time Post Graduate education is given in 18 specialized fields of science, engineering & technology management with an intake of 340. In our Ph.D. program 75 scholarships are offered to students selected through a common interview.

In addition, sponsored research and development activities are also supported by Government funding agencies and Industries in large number of areas of mutual interest. The key to success is our emphasis on quality research and innovative design in technical education.

TIFAC-CORE in the area of Fiber Optics & Optical Communication has been established in Delhi Technological University (Delhi College of Engineering), Delhi for which an agreement was signed between TIFAC & DCE on July 6, 2004. The activities of this TIFAC-CORE at DCE is supported by TIFAC/DST, Govt. of NCT of Delhi and partners from industries under Mission REACH Program, Technology Vision-2020, Govt. of India.

Detailed informations about DTU (formerly DCE), Delhi is available at its official websites www.dce.edu and www.dce.ac.in



Agreement Signing Ceremony at Vigyan Bhawan, Delhi in presence of Dr. R. Chidambaram, Chairman-TIFAC&PSA and Prof. V.S. Ramamurtthy, Secretary DST, Govt. of India



Visit of Sh. B.L. Joshi, Hon. U. Governor-GNCTD at TIFAC-CORE @ DCE Exhibition.



Experiments on High Voltage Measurement



Prof. D. Goldman, Principal, DCE with Prof. G. Atkinson, Scientific Advisor-USA



Dr. U.P.S. Sethi, Chairman-RMC alongwith co-ordinators of TIFAC-CORE @ DCE.



VISION

"To establish a world class knowledge centre providing education in the area of Fiber Optics and Optical Communication System that promotes research and development leading to innovative applications of Fiber Optics, fostering institute-industry linkages and entrepreneurial culture encompassing all aspects of interaction of light and matter for the betterment of the society."



Optical Fiber Fusion Splicing Machine





OBJECTIVES

- Development of Laboratories in the area of Fiber Optics and Optical Communication to support on-going program at B.E. / M.Sc. / M.E. level.
- Starting new academic program (M.E. - Microwave & Optical Communication)
- Offering special courses related to Fiber Optics and Optical communication at B.E. / M.Sc. / M.E. / Ph.D. catering to the emerging needs of the industry.
- Ph.D. programs supported by experiments and simulation work in the field related to Fiber Optics, Optical Communication Systems and Networks.
- Undertaking joint R&D projects in collaboration with industrial partner and other academic/scientific organizations
- Exploring & Establishing international collaborations.
- To conduct workshops, short term training programs, organize seminars and conferences related to the general area of optics and telecommunication systems.



Optical Fiber Talk Set



Optical Imaging Experiments using CCD Camera



TEAM

- Prof. P.B. Sharma, Vice-Chancellor, DTU
- Prof. A. Bhattacharya, Head of Department, ECE, DTU
- Prof. R.K. Sinha, Head of Department, Applied Physics, DTU
- Prof. O.P. Verma Head of Department, IT, DTU
- Prof. R.K. Sinha, Chief Co-ordinator
- Mr. Rajesh, Co-ordinator
- Mr. N.S. Raghava, Co-ordinator

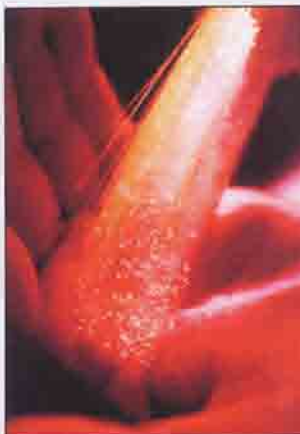
MONITORING COMMITTEE

- Dr. D.P.S. Seth
Member TRAI, Chairman - RMC
- Dr. O.P. Nijhawan
Former Director IRDE &
Former President of Optical Society of India, Member
- Shri A. Razdan
Associate General Manager
Sterlite Optical Technologies Limited, Aurangabad, Member
- Dr. Y.N. Singh
EE Department, IIT Kanpur, Member
- Mr. S. Muneshwar
SSO, TIFAC
- Prof. P.B. Sharma
Vice-Chancellor, Delhi Technological University, Delhi
- Representative of Industrial Partners
Permanent Invitee
- Prof. R.K. Sinha
Chief Co-ordinator

DEPARTMENTS INVOLVED

Currently following departments of Delhi Technological University (formerly Delhi College of Engineering), are involved in this project:

- Applied Physics
- Electronics & Communication Engineering
- Information Technology





RESEARCH SCHOLARS

- Ms Anshu Varshney
Photonic Crystal Fibers and Devices
- Ms Swati Rawal
Photonic Crystal Waveguides and Devices
- Ms Monika Rajput
Devices and componenets based on negative refraction
- Ms SriVidya Sridhar
Growth and field emission studies of carbon nanotubes
- Ms Shruti Singh
Design and development of planar waveguide devices
- Mr Kamal Kishor
Photonic Crytal Fiber and Metamaterials
- Ms Bhavna Dabas
Linear and Nonlinear characteristics of Photonic Crystal Fibres

B.E. / M.E. / M.Sc. STUDENTS

- Jivesh Kaushal, Optical Soliton
- Anoop Ramakrishna, Optical Communication
- Rishik Bazaz, Optical Network
- Over 40 student members of the International Society for Optical Engineering, (SPIE) DCE Chapter.
- Over 10 student members of Optical Society of America, OSA-DCE Chapter
- Medhavin: Website Administrator

COURSES & PROGRAM

- Special Courses on Fiber Optics and Optical Communication at B.E. and M.Sc. / M.E. level with adequate laboratory facilities.
- New Academic Program - M.E. in Microwave and Optical Communication.
- Specialization in Fiber Optics/Photonics at M.Sc. (Applied Physics).
- Ph.D. in the area of Optical Fiber Communication with emphasis on experimental and simulation work.
- Short term / training oriented courses in the areas covering Fiber Optics, Optoelectronics, Photonics and Telecommunication systems and Networks.



Optical Time Domain Reflectometer



Members of TFAC-CORE @ DCE



Administrative Block, Delhi College of Engineering



RESEARCH & DEVELOPMENT

- Theoretical and Experimental studies of specialty optical fibers and integrated optical waveguides.
- Nano - Photonic and Nano-optoelectronic devices.
- Multiple accesses techniques in Optical Fiber Communication Systems and Networks.
- Design & Development of optical fiber sensors & Opto Transceiver.
- Development of numerical techniques of light wave and electron wave propagation.
- Theory and Experiments on Photonic Crystal Fibers and on Photonic Bandgap Devices.
- Optical Systems for measurement of high electrical voltage and current.
- Development of Educational Kits related to Optical Fiber Communication System.

MAJOR RESEARCH PUBLICATIONS: 2007-2009

Journals:

- "Slow Light Miniature Devices with Ultra-flattened dispersion in Silicon-on-Insulator Photonic Crystal", Swati Rawal, R.K.Sinha and Richard M. De La Rue, Optics Express (OSA,USA), Vol. 17, No.16, pp. 13315-13325, 2009
- "All Angle Negative Refraction for visible light from left handed Metallo-Dielectric Photonic Crystal: Theoretical and Numerical demonstration with Nano-Photonic Device Applications" Monika Rajput and R.K.Sinha, Applied Physics B: Laser and Optics, Manuscript ID: 5932B, DOI:10.1007/s00340-009-3685-7, 2009
- "Design, Analysis and Optimization of Silicon-on-Insulator Photonic Crystal dual band wavelength De-multiplexure" , Swati Rawal & R. K. Sinha, Optics Communications, MS ID: 14305, doi :10.1016. Optcom 2009.06.046, available online on July 05, 2009
- "Design of S-band Erbium Doped Concentric Dual-core Photonic Crystal Fiber Amplifiers with ASE suppression", Shailendra K Varshney, K. Saitoh, M.Koshiba, B.P.Pal, R.K.Sinha, IEEE/OSA J. of Lightwave Technology, (USA), Vol.27, No. 11, pp 1725-1733, 2009
- "Non-linear Properties of Photonic Crystal Fiber: Improved effective index method", A.D. Varshney & R. K. Sinha, Chinese Journal of Physics, Vol.47, No.2, pp185-192, 2009
- "Analysis of Electrical Conductance of Carbon Nanotubes" , Neeraj Jain, Harsh & R.K.Sinha, Advanced Materials Research, Vol 67, pp 109-114, 2009
- "Coupling Characteristics of multicore photonic crystal Fiber based 1x4 power splitters", S. K. Varshney, K. Saitoh, R.K.Sinha & M.Koshiba IEEE/OSA, J. Lightwave Technology (USA), Vol.27, No.13, pp.2062-2068, 2009





- "Modeling & Design of 2D- Photonic Crystal based Y type Dual Band Wavelength Demultiplexer", R.K.Sinha and Swati Rawal, Optical and Quantum Elect. (Springer Netherlands), Vol 40, No.9, pp 603-613, 2008
- "Raman Amplification Characteristics of AS₂Se₃ Photonic Crystal Fibers", S. K. Varshney, K.Iizawa, Y. Tsuchida, M. Koshiba & R.K.Sinha, Optics Letters (OSA,USA), Vol 43, issue 21, pp 2431-2433, 2008
- "Strategies for realizing Photonic Crystal Fiber Bandpass Filters", S.K. Varshney, K. Saitoh, N. Saitoh, Y. Tsuchida, M. Koshiba, R. K. Sinha, Optics Express (OSA,USA), Vol 16, Issue 13, pp 9459-9467, 2008.
- "Modelling and design of complete photonic band gaps in 2D photonic crystals", Yogita Kalra and R K Sinha, Pramana-Journal of Physics (India), Vol.70, No.1, pp.153-161, 2008
- "Study of Birefringence of Elliptical Core Photonic Crystal Fiber Using Mathieu Function", Anshu D. Varshney and R. K. Sinha, Applied Optics(OSA,USA), Vol.46, Issue 23, pp 5912-5916, 2007
- "Propagation Characteristics of Photonic Crystal Fiber: Scalar Effective index method and Vector Effective Index method", Anshu D. Varshney and R. K. Sinha, Journal of Advanced Studies in Theoretical Physics, Vol. 1, No.2, pp.75-85, 2007

Research Papers in Conferences / Proceedings:

- "Arrow based Photonic Critical Waveguides" Shruti, R. K. Sinha, R. Bhattacharya Presented in the 14th Opto-Electronic and Communication Conference (OECC), Paper no. 316 held in Honkong during July 13-17, 2009
- "Designed and Analysis of Planar arrow as sensors", Shruti, R. Bhattacharya, R. K. Sinha, Presented in 1st International Conference on trends Optics and Photonics, Paper no. FOIO-8 held in Kolkata during March 1-4, 2009
- "Polarization Mode Dispersion of Elliptical Core Photonic Crystal Fiber Using Mathieu Function", Anshu D Varshney & R. K. Sinha, Presented in the International Conference on Fiber Optics and Photonics 2008, held in New Delhi during December 14-17, 2008
- " Modeling and Design of Silicon - on - Insulator based 1.31 μ m / 1.55 μ m Photonic Crystal Demultiplexure", Swati Rawal & R. K. Sinha, Presented in the International Conference on Fiber Optics and Photonics 2008, held in New Delhi during December 14-17, 2008
- "Structural study of superprism phenomenon in Photonic Crystal" R. K. Sinha & Anshu D Varshney, Presented in SPIE International conference on Optics and Photonics, held at San Diego during August 10-14, 2008; Published in Proc. of SPIE, Vol. 7056 , 70561C, 2008
- "Planar ARROW as optical sensors - Design considerations", Shruti, R. Bhattacharyya, R. K. Sinha, Published in the International Conference on Fiber Optics and Photonics 2008, to be held in New Delhi during December 14-17, 2008



- "Amplification characteristics of As₂Se₃ Photonic crystal fibers", S. K. Varshney, K. Saitoh, Y. Tsuchida, M. Koshida and R. K. Sinha, Presented in the International Conference on Fiber Optics and Photonics 2008, held in New Delhi during December 14-17, 2008
- "Photonic crystal based polarization beam splitter utilizing the phenomenon of negative refraction", Monika Rajput, R. K. Sinha, Presented in SPIE International conference on Optics and Photonics, held at San Diego during August 10-14, 2008; Published in Proc. of SPIE, Vol. 7056, 705620, 2008
- "Dual band wavelength demultiplexere consisting of SOI based Photonic Crystal : Design and Analysis", Swati Rawal & R. K. Sinha, Optics and Photonics Conference, held at San Diego during August 10-14, 2008 and to appear in Proc. of SPIE, Vol. 7056, 70560T, 2008
- "Effect of Titanium Buffer Layer for Improved Field Emission of CNT based cold cathode", S. Srividya, S. Gautum, P. Jha, S. Pal, U.S. Ojha, J.S.B.S. Rawat, PK. Chaudhary, Harsh and R.K. Sinha, Presented in International Conference on Nanoscience & Technology held at Chennai, India during Feb. 25-28, 2008.
- "CNT Density Control By Titanium Capping For Improved Field Emission", S. Srividya, S. Gautum, P. Jha, S. Pal, U.S. Ojha, J.S.B.S. Rawat, PK. Chaudhary, Harsh, R.K. Sinha and PK. Basu, Presented in National Conference on Electron Microscope & Allied Fields and XXIX Annual Meeting of EMSI held at University of Delhi during November 26-28, 2007.
- "Propagation Characteristics of highly elliptical core photonic crystal fibers", R. K. Sinha and A. D. Varshney, Paper Number 6480-23, Accepted for presentation in SPIE-Photonics West 2007, San Jose, CA, USA, January 20-25, 2007
- "Ultra compact photonic crystal polarization mode splitter", R. K. Sinha and Yogita Kalra, Paper Number 6480-53, Accepted for presentation in SPIE-Photonics West 2007, San Jose, CA, USA, January 20-25, 2007
- "Photonic Crystal Polarizer", R. K. Sinha and Yogita Kalra, Paper Number 6480-56, Accepted for presentation in SPIE- Photonics West 2007, San Jose, CA, USA, January 20-25, 2007



Optical Fiber Network Analysis Setup



Integrated Optical Wave Guide Characterization Setup (Prism Coupling Technique)



INDUSTRIAL PARTNERS

- Reliance Infocom Ltd.
- Sterlite Optical Technology Ltd.
- Bench Mark Electronics Systems Pvt. Ltd.
- HFCL Ltd.- R&D Division
- Railtel Corporation of India Ltd.
- Agilent India
- Trinity Microsystems Pvt. Ltd.
- Falcon Electro Tek Pvt. Ltd.
- Fiberonics, New Delhi (Business Partner, Opto Sci. Ltd., U.K.)

MAJOR FACILITIES

- High DC Voltage Measurement using Electro- Optics Effects
- High DC Current Measurement using Magneto-Optics Effects
- Fusion Splicing Machine
- Measurement of Dielectric Constant
- Characterization of Optical Fiber
- Optical Time Domain Reflectometer
- WDM Network Analyzer
- Characterization of Integrated Optical Waveguides
- CCD based Imaging System
- Erbium Doped Fiber Amplifier
- Measurement of Speed of Light using Optical Fiber
- Fiber Optics Voice and Video Links
- New Port Projects Setup in Fiber Optics
- Fiber Optic Ed Com (Opto Sci.)
- BER & EYE Diagram Analyzer
- Clean Room – Facility
- Vibration Free Optical Bench
- Computational Lab
- Matlab Release 14
- RSOF Simulation Suit
- OPTIWAVE Simulation Package
- VPI Photonics Software Package
- Photon Design Suit
- Machzender Interferometer set up
- Fiber Laser Characteristics set-up
- Optical Spectrum Analyzer
- DWDM optical communication set up





SPIE DCE CHAPTER

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OSA-DCE CHAPTER

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An Advance R&D Center



**TIFAC-CORE in Fiber Optics &
Optical Communication**

(Mission REACH, Technology Vision-2020, Govt. of India)

DELHI COLLEGE OF ENGINEERING

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**Supports Academic Programs
of**

**DELHI TECHNOLOGICAL UNIVERSITY (FORMERLY DCE)
ON**

B.Tech - Engineering Physics (Special Focus on PHOTONICS)

M.Tech - Microwave and Optical Communication

M.Tech - Nano-science & Technology

Prof. R.K. SINHA

Chief Co-ordinator

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