

Activities and Achievement: 2009 -2010

TIFAC-Centre Of Relevance and Excellence (CORE)

in

**Fiber Optics and Optical Communication
Delhi Technological University, Bawana Road,
Delhi-110042, India**

Homepage: www.tifaccore.dce.edu

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TIFAC-CORE in Fiber Optics and Optical Communications
@DTU(formerly DCE), Delhi
Activities & Achievements 2009-2010

1. Research Publications in international journals in the year 2009-2010 (Impact Factor Wise)

S. No.	Name of Research Paper, Author and Journal	Publisher	Impact Factor Source(http://www.kg.ac.rs/doc/sci_2008.pdf)
1.	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, Vol. 17, No.16, pp. 13315-13325, 2009	Optical Society of America	3.880
2.	Slow light propagation in liquid crystal infiltrated silicon on insulator photonic crystal channel waveguides”, Swati Rawal, R.K.Sinha and Richard M De La Rue, Accepted for publication in IEEE/OSA Journal of Lightwave Technology, Vol.28, No.17, pp. 2560-2571, 2010	IEEE	2.736
3.	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.	IEEE	2.736
4.	“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.	IEEE	2.736
5.	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, Vol. 98, pp 99-106, 2010	Springer	2.20
6.	Titanium Buffer layer for improved field emission of CNT based cold cathode” S Srividya, S. Gautam, P.Jha, P.Kumar, A. Kumar, US Ojha, JSBS Rawat, S. Pal, P.K. Choudhary, Harsh and R. K. Sinha, Applied Surface Science, Vol. 256, Issue 11, pp 3563-3566, 2010	Elsevier	1.576
7.	“Design, Analysis and Optimization of Silicon-on-Insulator Photonic Crystal dual band wavelength Demultiplexure”, Swati Rawal & R. K. Sinha, Optics Communications, vol. 282, pp. 3889-3894, Oct 2009.	Elsevier	1.550
8.	Characterization of specially designed Polarization Maintaining Photonic Crystal Fiber : Theory and experiment”, Kamal Kishor, R. K. Sinha, Anshu D Varshney and Jaspreet Singh, , Optics Communication,	Elsevier	1.550

	Vol.283, pp 5007-5011, 2010		
9.	Design of highly birefringent chalcogenide glass PCF: A simplest design”, Bhawana Dabas and R. K. Sinha, Optics Communication, doi: 10.1016/j.optcom.2010.10.045, Article in Press, 2010	Elsevier	1.550
10.	Dispersion characteristics of Hexagonal and Square lattice Chalcogenide As_2Se_3 glass Photonic crystal Fiber”, Bhawana Dabas and R. K. Sinha, Optics Communications, Vol. 283, pp 1331-1337, 2010	Elsevier	1.550
11.	“Anti-resonant reflecting Photonic Crystal Waveguide (ARROW): Modelling and Design, Shruti, R. K. Sinha and R. Bhattacharya, Optical and Quantum Electronics, Vol. 4, pp 181-187, 2009.	Springer	0.767
12.	Blue light emission and amplification in left-handed isotropic Metallo-Semiconductor Photonic Crystal”, Monika Rajput and R. K. Sinha, Online published in Optik [doi:10.1016/j.ijleo.2010.09.018], 2010.	Elsevier	0.607
13.	Broad angle and frequency tunable photonic crystal polarization beam splitter based on negative refraction: Transition from right handed to left handed medium”, Monika Rajput and R.K.Sinha, Accepted for publication in Optica Applicata	Institute of Physics	0.300
14.	“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.	Published from Taiwan	0.27
15.	Effect of different plasmonic Nano-inclusion on Double Negative-semiconductor photonic crystal in visible region: Gain assistance and All-Angle Negative Refraction” Monika Rajput and R. K. Sinha, Journal of Electronic Science and Technology, Vol. 8, No. 1, pp 10-15, 2010	ISSN: 1674-862X Collaborated with IEEE, IAC, SIT and IET	0.2334 (www.ourglocal.com/journal/issn=1674862x)
16.	Low-Loss Slow Light Transmission in Photonic Crystal Waveguides Comprising of Liquid Crystal Infiltration”, Swati Rawal and R. K. Sinha, Journal of Electronic Science and Technology, Vol. 8, No. 1, pp 35-38, 2010	ISSN: 1674-862X Collaborated with IEEE, IAC, SIT and IET	0.2334 (www.ourglocal.com/journal/issn=1674862x)
17.	“Analysis of Electrical Conductance of Carbon Nanotubes “, Neeraj Jain, Harsh & R.K.Sinha, Advanced Materials Research, Vol 67, pp 109-114, 2009.	Trans Tech publication Swizerland	-
18.	"Ultrahigh birefringent photonic crystal fiber: An Improved Design", Anshu D Varshney and Ravindra K. Sinha, International Journal of Microwave and optical technology, Vol. 4(5), pp. 324-327, September 2009.	Published from ISRAMT, USA	-

2. Research Publications in national & international conferences in the year 2009-2010

1. "Blue light emission through second harmonic generation in Left-handed Plasmonic Nano-antenna", Monika Rajput and R. K. Sinha and S. K. Varshney, presented in International conference in Fiber Optics and Photonics -PHOTONICS-2010, at IIT Guwahati during December 11-15, 2010
2. "Impact of slow light on non-linear phase sensitivity in SOI photonic crystals", Swati Rawal, R. K. Sinha and Richard M. De La Rue presented in International conference in Fiber Optics and Photonics -PHOTONICS-2010, at IIT Guwahati during December 11-15, 2010
3. "Soliton evolution in chalcogenide based photonic crystal fiber", Bhawana Dabas, Jivesh Kaushal and R. K. Sinha, presented in International conference in Fiber Optics and Photonics - PHOTONICS-2010, at IIT Guwahati during December 11-15, 2010
4. "One dimensional tunable surface-plasmonic photonic crystal cavity", Shruti, Venus Dillu, **R.K Sinha** and R. Bhattacharyya, presented in International conference in Fiber Optics and Photonics - PHOTONICS-2010, at IIT Guwahati during December 11-15, 2010
5. "Determination of waveguiding and geometrical parameters of endlessly single mode photonic crystal fiber: theory and experiment", Kamal Kishor, R.K.Sinha, Anshu D Varshney and Jaspreet Singh, Proceedings of SPIE, Vol. 7781, 2010
6. "Low velocity propagation in liquid filled photonic crystal waveguides", Swati Rawal, **R.K.Sinha**, Proceedings of SPIE, Vol 7781, 2010.
7. "Superior gain-assisted double negative plasmonic nanoantenna: Generation of non-linear effects", Monika Rajput, R.K.Sinha, Proceedings of SPIE, Vol. 7781, 2010.
8. "Effect of Slow light on self phase modulation in Photonic Crystal Channel waveguides", Swati Rawal, R.K.Sinha & Richard M. De La Rue, presented in Ninth International Conference on Photonic and Electromagnetic Crystal Structures (PECS-IX) held in Granada (Spain) on 26-30 September 2010.
9. " Design and characterization of highly birefringent chalcogenide As₂Se₃ glass photonic crystal fiber with low confinement loss", Bhawana Dabas, & R. K. Sinha, Proceedings of SPIE, Vol. 7781, 2010
10. "Demonstration of All-Angle Negative Refraction in Plasmonic metamaterial for blue light and nanophotonic device application", Monika Rajput and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009.
11. "Slow light Propagation in Photonic Crystal Waveguides due to Liquid Crystal infiltration: Design and Applications", Swati Rawal and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009.
12. "Demonstration of All-Angle Negative Refraction in Plasmonic metamaterial for blue light and nanophotonic device application", Monika Rajput and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009.
13. "Slow light Propagation in Photonic Crystal Waveguides due to Liquid Crystal infiltration: Design and Applications", Swati Rawal and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009 .
14. "Polarization maintaining chalcogenide glass Photonic Crystal Fiber", Bhawana Dabas and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi New Delhi during 16th-19th December 2009.

15. "Photonic Crystal as k-vector superprism", Anshu D Varshney and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009 .
16. "Double Clad Photonic Crystal Fiber:Flattened dispersion with low loss", Anshu D Varshney and R. K. Sinha, Presented in International conference ISMOT-2009 held at New Delhi during 16th-19th December 2009 .
17. "All-angle negative refraction in gain assisted Metallo-Semiconductor Photonic Crystal for visible light: Effect of Plasmonic Metals and Nano-photonic device application", Monika Rajput and R. K. Sinha, Presented in an international conference ELECTRO-2009 held at Banaras Hindu University, Varanasi during 22th -24th December,2009 and published in "**Macmillan Advanced research series**" (**Proc. of ELECTRO**), pp 512-515, 2009 and in **Pro. of IEEE**, pp-500-503, 2010
18. "Liquid Crystal Tuning of Slow light Propagation in Photonic Crystal Waveguides" Swati Rawal and R. K. Sinha, Presented in an international conference ELECTRO-2009 held at Banaras Hindu University, Banars during 22th -24th December,2009 and published in "**Macmillan Advanced research series**" (**Proc. of ELECTRO**), pp 593-595, 2009. Later will be published in **Pro. of IEEE**, pp 580-582, 2010
19. "Zero dispersion demonstration of chalcogenide glass Photonic Crystal Fiber :analysis and evolution" Bhawana Dabas and R. K. Sinha, Presented in an international conference ELECTRO-2009 held at Banaras Hindu University, Banars during 22th -24th December,2009 and published in "**Macmillan Advanced research series**" (**Proc. of ELECTRO**), pp 516-519, 2009. Later will be published in **Pro. of IEEE**, pp 504-507, 2010.
20. "Slow Light Devices in Silicon-on-Insulator Photonic Crystal", Swati Rawal and R. K. Sinha, Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
21. "Theory and Experiment on characterization of polarization maintaining photonic crystal fiber from its far-field measurements," Kamal Kishor, R. K. Sinha, Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
22. "Negative Refraction in visible region from Metallo-dielectric Photonic Crystal: Design, Characterization and Device Application" Monika Rajput and R. K. Sinha, , Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
23. "Dispersion Properties of Chalcogenide As₂Se₃ Glass Photonic Crystal Fiber", Bhawana Dabas and R. K. Sinha, Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
24. Shruti and R. K. Sinha, Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
25. "Analysis of rectangular core photonic crystal fiber: first order perturbation approach," Anshu D Varshney and R. K. Sinha, Presented in an International conference ICOP-2009 International Conference on Optics and Photonics held at Chandigarh, India during 30th October to 1st November, 2009.
26. "Liquid Crystal Assisted slow light propagation in Photonic Crystal and Device Application", Swati Rawal and R. K. Sinha, Presented in an international conference **OSA Frontiers in Optics** held at San Jose, California, USA during October 11-15th, 2009 and is published in **Proceedings of OSA Frontiers in Optics 2009**, Oct, 2009,
27. "Negative Refraction in visible region using nano-structured Metallo dielectric photonic crystal", Monika Rajput, R.K.Sinha, Presented in SPIE International conference on Optics and Photonics,

held at San Diego during August 02-06, 2009, published in **Proc. Of SPIE , Vol 7420, pp 742009, August 2009.**

28. “High delay bandwidth product and low dispersion slow light in silicon-on-insulator based photonic crystal waveguides”, Swati Rawal and R. K. Sinha, Presented in SPIE International conference on Optics and Photonics, held at San Diego during August 02-06, 2009, published in **Proc. Of SPIE, vol. 7420, pp-742014, 2009.**
29. “Dispersion properties of chalcogenide photonic crystal fiber”, Bhawana Dabas, R. K. Sinha and Anshu D. Varshney, Presented in SPIE International conference on Optics and Photonics, held at San Diego during August 02-06, 2009, published in **Proc. Of SPIE, Vol. 7420, pp-74200A, 2009.**
30. “Characterization of polarization maintaining photonic crystal fiber from far field measurement”, Kamal Kishor, R. K. Sinha, Anshu D. Varshney and Jaspreet singh, Presented in SPIE International conference on Optics and Photonics, held at San Diego during August 02-06, 2009, published in **Proc. Of SPIE, Vol. 7420, pp-742015, 2009.**

3. Research papers appeared in Books/Lecture Notes

1. “Left handed materials and nanophotonic devices application”, Monika Rajput and R. K. Sinha, Chapter-7 for the book entitled “Photonic crystal: Optical properties, Fabrication and Application” by Nova publication, New York, USA.
2. “Slow Light in Photonic Crystal Channel Waveguides: Theory and Applications”, R.K. Sinha and Swati Rawal, Chapter-6 for the book entitled “Photonic crystal: Optical properties, Fabrication and Application” by Nova publication, New York, USA.
3. “Chalcogenide photonic crystal fiber: Dispersion compensating application”, Bhawana Dabas and R. K. Sinha, Chapter-9 for the book entitled “Photonic crystal: Optical properties, Fabrication and Application” by Nova publication, New York, USA.

4. Technology/Experiments developed:

(i) An experimental set up is developed for the characterization of Polarization Maintaining Photonic Crystal Fibers from Far Field Measurements and the finding has already been published in Optics Communication Journal in the year 2010.

(ii) In the same way, a new technique is developed to set up low cost experiments for the characterization of normal telecom grade optical fibers in terms of its wave guiding characteristics and is being offered to M.Tech (Microwave and Optical Communication) students as routine experiment.

(iii) Experiments based on DWDM optical Communication is also set up with tunable laser based on Temperature controlled Bragg Grating with variation of 0.08nm in their wavelength. SNR and Bit Error rate including Eye diagram analysis for DWDM Optical Communication set up is also being carried out in the TIFAC-CORE Lab for M.Tech (MPCE) students.

5. Academic Programs

(i) M.Tech program in Microwave and Optical communication Engineering

Currently M.Tech 1st year and M.Tech 2nd year students with a total intake of over 35 students are pursuing their M.Tech Program with and are involved in Minor and Major project related with advanced topics of Telecom Technologies.

(ii) M.Tech program in Nanoscience and Technology and B.Tech. (Engg. Physics) is offered since academic year 2009-2010 with focus on Nanophotonics and Nano Scale Devices

(iii) B.Tech (Engineering Physics) with minors in Photonics. This category of students have already done their summer project during June/July on the basics of Fiber Optics and Optical Communication and it is expected that some of them will be involved for their major and minor projects in the area related to Fiber Optics and Photonics.

6. Awards and Fellowships/Grants received by Ph.D. students in the year 2009-2010

- **Monika Rajput** received the Sterlite Technologies Innovation Award for her Research Paper on “Blue light emission in nonlinear photonic crystals” in the international conference, Photonics 2010, held at IIT Guwahati in December 2010
- **Kamal Kishor** received the Research Excellence Award from Newport Spectra, USA for presenting his research paper based on characterization of polarization maintaining photonic crystal fiber in August 2010, held at San Diego, CA, USA.
- **Swati Rawal** received the Best Research Paper Award at National Physical Laboratory (NPL) in Feb.-2010 based on her research work for achieving slow light and enhancement of non-linear effects which can be used for decreasing the length of the device and input power required for its working
- **Monika Rajput** received Student Leadership Award from Optical Society of America for attending Frontiers in Optics 2010, held at Rochester, NY, USA
- **Bhawana Dabas** got the Student Leadership Award from SPIE for attending and presenting her research paper in Optics & Photonics 2010, held at CA, USA.
- **Swati Rawal** received the travel grant from CSIR, India, for presenting her research paper in Frontiers in Optics 2010 held at Rochester, NY, USA.
- **Monika Rajput** received the travel grant from Department of Science and Technology, Govt. of India, in August 2010 for presenting research paper in Optics & Photonics 2010, held at San Diego, CA, USA.
- **Monika Rajput** selected for \$1200 grant from National Science Foundation of America to present her research work in University of California, USA.

- **Swati Rawal** received the SPIE Student Best Research Paper Award, at International Conference on Optics and Photonics (ICOP 2009) held at CSIO Chandigarh in November 2009, for her research work based on the design of nano-photonic device utilizing slow light, which can act as a memory device.
- **Swati Rawal** received the Student Leadership Award from Optical Society of America for attending Frontiers in Optics 2009 held at San Jose, CA.
- **Monika Rajput** received the travel grant of \$300 for presenting research paper on Left Handed Metamaterials in Optics & Photonics 2009, held at San Diego, CA, USA.
- **Kamal Kishor** received the Student Leadership Award from SPIE for attending Optics & Photonics 2009 held at San Diego, CA, USA.
- **Swati Rawal** received the travel grant from Department of Science and Technology, Govt. of India, in August 2009 for presenting the research paper in Optics & Photonics 2009 held at San Diego, CA, USA.

7. Awards , Fellowships and recognition received by Prof. R.K.Sinha Chief Coordinator, TIFAC-CORE@DTU/DCE in the year 2009-2010

Award/fellowship

- Awarded visiting fellowship from **National Science Council and NTHU, Taiwan** to explore joint research in the area of Photonic Crystal Waveguides and Devices at Electrical Engineering Department, NTHU, Taiwan during December 04-December 16, 2009
- Awarded “**EPFL-Switzerland/India Bilateral Invited Fellowship**” to carry out joint research project at Physics Department, EPFL Switzerland during September 29-October 13, 2009.
- Invited Participant in “Engineering Challenges of Solar Energy research in India” at Royal Society London organized by **Royal Academy of Engineering, UK** during September 25-27, 2009

Recognition/Invited/Key note Speaker:

- **General Chair** of International Conference on Nano Science and Technology (ICNST-2010). Sponsored by IACSIT and IEEE, December 17-19, 2010, Chengdu and Emei Mountain, China
- **Member:** Technical and organizing Committee, International Conference on Fiber Optics and Photonics, Photonics-2010, IIT Guwahati, December 11-15, 2010
- **Invited speaker** on topic of “ Photonic Crystal Fibers and Applications” in Continuing Education Program, CEP of DRDO organized by LASTECH, Delhi on August 11, 2010
- **Lead Member:** Brain Storming session on Plasmonic and Nanostructure Solar Cell, organized by DST, Govt. of India at University of Delhi on May 15, 2010

- **Invited Speaker** in Workshop for professional development of Physics Faculty, University of Delhi, Delhi on March 20, 2010 on topic related to “Glimpses on research opportunity in the area of Nanophotonics”
- **Keynote Speaker**- entitled “ Photonic Crystal Waveguides based Nanophotonic Devices International Conference on Nanotechnology, Optoelectronics and Photonics (NOPT)-2010 to be held in Singapore during February 26-28, 2010
- **Invited Speaker** – entitled “ Design and Development of Autonomous Under Water Vehicle- A case Study” in the seminar on Leveraging Offsets For Naval Self Reliance on February 17, 2010 during Defense Exposition 2010 at Pragati Madan, New Delhi
- **Invited speaker** at seminar on Photonics by DRDO on “Photonic Crystal based waveguides and Devices” during January 17-18, 2010 at Delhi, India.
- **Chairman**, session on Photonic Crystal” at International Symposium on Microwave and Optical Technology-2009, held at Hotel Asoka, New Delhi during December 16-19, 2009.
- **Invited Talk** on “ Photonic Crystal Waveguides and Device Research at TIFAC- CORE, DTU” on December 11, 2009, Photonic Technology Research Institute, NTHU, Taiwan.
- **Invited Talk** on “Research and Innovations @DTU”at Electrical and Electronic Engineering Department, National Tsing Hua University, Hsinchu, Taiwan on December 08, 2009.
- Invited Talk on “ Photonic Crystal Fibers, Waveguides and Devices @DTU” at Physics Department, EPFL Switzerland on October 06, 2009
- **Invited Lecture** on “ Lightwave Propagation through Photonic Crystal Fibers and nano scale Photonic Crystal Waveguides and Device” in the workshop for teachers of engineering colleges at ECE Department, IIT Khargapur on June 23 and 24, 2009.
- **Invited lecture** on “ Research and Development at TIFAC-CORE in Fiber Optics and Optical Communication” during seminar on “Photonics and Hands on experiment in the area of Optical Fiber Communication” for students and teachers of colleges of Delhi University, Delhi, India during May 20-22, 2009

8. Summer/Winter Project

(i) Over 25 students including a few from IIT Roorkee and IIT KGP and others from DCE/DTU students have done their summer project in the area of Fiber Optics and Optical Communication at TIFAC-CORE lab during the month of June/July 2009.

(ii) Over 10 students have carried out their summer project on optoelectronic devices/simulation of optical communication systems and network during winter vacation for two weeks in December 2009/January 2010

(iii) Over 30 students including a few from IITs and others from B.Tech (EP) and ECE, DCE/DTU students have done their summer project in the area of Fiber Optics and Optical Communication at TIFAC-CORE lab during the month of June/July 2010.

9. Faculty newly recruited & associated/ with TIFAC-CORE from the Department of Applied Physics

- a. Dr. Yogita Kalra, M.Sc. (IIT D) & Ph.D (DU)
- b. Dr. Ajeet Kumar, M.Sc. (IITR) & Ph.D (IITR)
- c. Dr. M.S. Mehata, M.Sc. & Ph.D. (KU) + JSPS Fellow (Japan)

10. Faculty associated with TIFAC-CORE from the other departments for teaching and admin level job.

- a. Prof. Rajeev Kapoor, HOD, ECE Department
- b. Prof. O.P. verma, HOD, IT Department
- c. Mr. P.R. Chaddha, ECE, Department
- d. Mr. Rajesh, ECE DEpartment
- e. Mr. N.S. Raghava, ECE/IT Department
- f. Mr. Avinash Singh, ECE Department
- g. Mr. M.S. Choudhary, ECE Department

11. Grants/donation/aid received during 2009-2010 as Resource generation:

- (i) Laser Diode Modulator Ktt along with optical power meter and other accessories are received from M/S Bench Mark Electronics pvt. Ltd. (Approx: Rs.1.5 Lakh)
- (ii) Fiber Optic Services, Mumbai has also extended RP Fiber Power Software academic license for two years to TIFAC-CORE lab. (Approx: Rs. 3.5 Lakh)
- (iii) National Program on MEMS And Smart Structure – a DRDO initiative coordinated by IISc Bangalore has identified TIFAC-CORE@DTU/DCE as Photonic Design Center and has offered three major software package called (a) Rsoft-BEAM Prop (iii) Comsol-Multi physics (iii) Intellisuite and these are being effectively used in the center for teaching and research job (Approx: Rs. 10.00 Lakh)
- (iv) Major R&D project grant from UGC on “Characterization of PCF for Telecom and Sensing Application”, Rs 10.48 Lakh for during 2009-2010

12: Ph.D thesis awarded and Submitted:

- (i) Anshu D. Varshney awarded Ph.D. thesis on Propagation Characteristics of Photonic Crystal Fibers and Waveguides in August 2010.
- (ii) Swati Rawal submitted Ph.D. thesis on Photonic Crystal waveguides and Devices in November 2010.

13. National and International Collaboration:

- (i) Research work carried out in association with IITs, IISc Bangalore, DRDO Labs and NPL during this period. Joint publications of research papers have appeared with scientist/faculty from University of Glasgow, UK, Hokkaido University, Japan, IIT Delhi and SSPL (DRDO Labs)
- (ii) Development work with companies : Bench Mark Electronics Pvt. Ltd, Fiber Optic Services, OptoSci UK and Fibronics (India) has also been carried out.

14. Objectives set and current status

Objectives set forth while establishing TIFAC CORE @ DCE	Present status TIFAC-CORE@DTU
1. Development of laboratories in the area of fiber optics and optical communication to support ongoing program at B. E. /M.Sc. /M.E. level in the year 2004	1. Laboratories in the area of fiber optics and optical communication have been set up and experiments are being offered to the students at both B.E./B.Tech as well as M.Sc./M.E./M.Tech level since the year 2005
2. Starting new academic program (M.E. – Microwave and Optical Communication)	2. M.Tech programs in Microwave and Optical communication Engineering is offered since academic year 2009-2010.
3. Offering special courses related to Fiber Optics, Optical Communication at B. E. /M.Sc. /M.E. catering to the emerging needs of the industry.	3. Several short term programs/special seminars in focussed area of Optical Fiber Communication Systems and network including design of futuristic optical devices have been organized for students/teachers of this university as well as teachers/technical manpower of other academic institutions since 2006 onwards, which includes training on optical fiber cutting and splice workshop.
4. Ph.D. programs supported by experiments and simulation work in the field related to Fiber Optics, Optical Communication Systems and networks.	4. Three Ph.D. thesis have been completed since the inception of TIFAC CORE lab. Currently, six Ph.D. students are working in the field of fiber optics and optical communication systems covering both experimental and simulation work after 2005.
5. Under taking joint R&D projects in collaboration with industrial partner and other academic /scientific organizations	5. Research work is being carried out with other academic institutions including NIT/IITs/IISc Bangalore and some of the leading R&D organizations like NPL and DRDO labs, which are evident from joint publications/workshop and training programs.
6. Exploring and establishing international collaborations	6. Student's chapters of professional societies OSA and SPIE have been started and students have been presenting their research work every year in international conferences organized by these professional societies. In addition to these, research papers with joint authorship have been published with Glasgow University, UK and Hokkaido University, Japan.
7. To conduct workshops, short term training programs, organize seminars and conferences related to the general area of optics and telecommunication systems.	7. Several workshops, short term / training oriented courses in the areas covering fiber optics and optical communication have been conducted. Web based seminars have also been arranged in the area of design of optical network with RSOFT Inc, USA.