

## EVALUATIVE REPORT OF THE CENTRE FOR NANOSCIENCE AND NANOTECHNOLOGY

1. Name of the Centre: **Centre for Nanoscience and Nanotechnology**
2. Year of establishment: **2011**
3. Is the Department part of a School/Faculty of the University? **No**
4. Names of Programmes offered (UG, PG, M. Phil., Ph.D., Integrated Masters; Integrated Ph.D., D.Sc., D. Litt etc.)

S. No.	Programme	Type of Programme	Annual Intake
1.	M. Tech Nanotechnology	Self financing	20
2.	Ph.D.	Regular	---

5. Interdisciplinary Programs and Departments involved **Yes**  
Department of Physics, Mathematics and Applied Sci.& Humanities. (F/o Engg. &Tech.)
6. Courses in collaboration with other universities, industries, foreign institutions, etc. **Nil**
7. Details of programmes discontinued, if any, with reasons **Nil**
8. Examination System:

S.	Programme	Examination System
1	M. Tech (Nanotechnology)	Semester
2	Ph.D.(tostartfrom2015)	Semester

9. Participation of the Department in the courses offered by other Departments **Nil**
10. Number of teaching posts sanctioned, filled and actual (Professors/Associate Professors/ Asst. Professors/others)

S. No.	Post	Sanctioned	Filled	Actual
1.	Professor	01	0	0
2.	Associate Professor	01	0	0
3.	Assistant Professor	03	0	0

11. Faculty profile with name, qualification, designation, area of specialization, experience and research under guidance

Name	Qualification	Designation	Specialization	No. of years of Experience	No. of Ph.D. students guided for the last four years		M. Tech Students guided
					Awar ded	Under Supervi sion	

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Prof. Mushahid Husain	Ph.D.	Hony. Director & Professor (Upto 17.12.2013)	Nanoscience and Nanotechnology, Materials Science	30	19	12	17
Prof. Mohammad Zulfequar	Ph.D	Offg. Hony. Director & Professor (from 18.12.2013)	Nanoscience and Nanotechnology, Materials Science	24	16	09	11

12. List of senior Visiting Fellows, adjunct faculty, emeritus professors etc.

S. No.	Name	Position	Area	Duration
1	Prof. Harsh, Ex. Associate Director, SSPL, Timarpur, Delhi	Visiting Professor	Nanotechnology	Jan. 2013 to Till date
2	Prof. Harsh, Ex. Associate Director, SSPL, Timarpur, Delhi	Project Consultant, Deit Y Project	Nanotechnology	February 2011 to till date

13. Percentage of classes taken by temporary faculty—programme-wise information at present, the centre has no filled positions for faculty. M. Tech. Nanotechnology (self financing) programme has been using the services of the following resource persons

S. No.	Program	Name of Temporary Faculty/ Resource persons	Remarks
1.	M. Tech	Prof. M. Zulfequar	Department of Physics, JMI
2.	M. Tech Nanotechnology	Prof. Harsh	Visiting Professor, Centre for Nanoscience and Nanotechnology
3.	M. Tech Nanotechnology	Prof. Ayub Khan	Department of Mathematics, JMI
4.	M. Tech	Dr. Mohd. Shahid Khan	Department of Physics, JMI
5.	M. Tech	Dr. S. R. Ahmad	Department of Physics, JMI
6.	M. Tech	Dr. A.M. Siddiqui	Department of Physics, JMI
7.	M. Tech	DR.A. K. Hafiz	Department of Physics, JMI

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8.	M. Tech Nanotechnology	Dr. S. A. Lone	Department of Electronics and communication, JMI
9.	M. Tech Nanotechnology	Prof. Sharif Ahmad	Department of Chemistry, JMI
10.	M. Tech Nanotechnology	Dr. Samina Husain	Guest Faculty, Centre for Nanoscience and Nanotechnology

14. Student Teacher Ratio. 4:1

15. Number of academic support staff (technical) and administrative staff sanctioned, filled and actual.

S. No.	Post	Sanctioned	Filled	Actual
1.	Computer Operator/clerk	01	01*	01*
2.	Lab Attendant	01	01*	01*
3.	Peon	01	01	01

\* Contractual (Through Outsourcing)

16. Research thrust areas as recognized by major funding agencies.  
Synthesis of Single Wall Carbon Nanotubes for Semiconducting applications

17. Number of faculty with ongoing projects from a) national b) international funding agencies and c) Total grants received. Give the names of the funding agencies, project title, duration and grants received project-wise.

S. No.	Principal Investigator	Title of Project	Amount Sanctioned (Rs. Lakhs)	Funding Agency	Duration
1.	Prof. Mohammad Zulfequar & Prof. Mushahid Husain	Growth of Single- Walled Carbon Nanotubes for Semiconducting Applications	380.76	Deit Y	2010-2015

18. Inter-institutional collaborative projects and associated grants received  
a) National collaboration b) International collaborations NA

19. Departmental projects funded by DST-FIST;UGC-SAP/CAS, DPE;DBT,ICSSR,AICTE etc.; total grants received. NA

20. Research facility/ centre with

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- State recognition Yes
- National recognition Yes
- International recognition Yes

There search facility available in the centre has been recognized by various National and International Research groups. Scientists from USNaval Research Laboratory, Washington, Centre DeEnergia Termica, Maxico, Department of Physics, King Abdul Aziz University, Jeddah, Saudi Arabia, IIT Delhi, Solid State Physics Laboratory (DRDO), Delhi, IIT Kanpur and National Physical Laboratory, New Delhi visited the Centre.

21. Special research laboratories sponsored by/created by industry or corporate bodies. Nil

22. Publications of Faculty members during (2007-2014) in the area of Nanotechnology; Details are included in the publications list of Department of Physics

S. No.	Name of Faculty	Designation	Book(s) Published (2007-2014)	No. of Research Papers (Nanotechnology) (2007-2014)	h-index
1	Mushahid Husain	Professor	01	46	24
2	M. Zulfequar	Professor	02	10	19
3	Harsh	Visiting Professor	---	66	----

23. Details of patents and income generated. Nil

24. Areas of consultancy and income generated. Nil

25. Faculty selectednationally/internationallytovisitotherlaboratories/institutions / Industries in India and abroad (2011-2013).

- i). Prof. M. Husain, Hony. Director (upto December 17, 2013) visited Singapore from 29<sup>th</sup> December, 2012 to 2<sup>nd</sup> January, 2013 and delivered an Invited talk in an International Conference on Optical Materials and Communication.
- ii). Prof. M. Husain, Hony. Director, Centre for Nanoscience and Nanotechnology was invited to visit and to deliver the lectures in the Department of Physics, King Abdul Aziz University, Jeddah and was also invited by King Saud University to deliver a lecture, from 18<sup>th</sup> April 2013 to 26<sup>th</sup> April 2013.
- iii). Prof. M. Zulfequar, Offg. Hony. Director, visited and received training and introduction about PECVD and MOCVD system at AIXTRON Ltd. Cambridge U.K. from 15 – 20<sup>th</sup> December, 2014.

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26. Faculty serving in

- a) National committees b) International committees c) Editorial Boards d) any other (Please specify).

Prof. Mushahid Husain, Hony. Director (upto December 17, 2013) serving in

1. Member, Editorial Board of Indian Science Abstract, the Council of Scientific and Industrial Research, New Delhi 2008
2. Member, Board of Management of the Centre for Theoretical Physics, JMI
3. Ex-UGC Nominee–Member, Board of Governors, NIT Kurukshetra.
4. External Member Academic Council:
  - a) Dr. B.R. Ambedkar University, Agra.
  - b) Central University of Punjab, Bhatinda
  - c) ITM University, Gurgaon, Haryana
5. External Member, Board of Studies:
  - a) Dept. of Physics National Institute of Technology, Srinagar.
  - b) Dept. of Applied Sciences, F/O Engg. & Technology, JMI.
  - c) Dept. of Electronics Engg, F/O Engg. & Technology, JMI.
  - d) Dept. of Physics, Vanasthali Vidhyapeeth
  - e) Dept. of Physics, Jiwaji University Gwalior
  - f) Dept. of Applied Physics, F/O Engg. & Technology, AMU
6. External Member, Faculty Committee, Punjab University, Patiala
  - a) Ex-Associate Member, Third World Academy of Sciences, ICTP, Trieste (Italy)
  - b) Fellow, Meteorological Society of India.
  - c) Referee, X-ray Spectrometry (A Scientific Journal of USA)
  - d) Referee, Physica B (U.S.A.)
  - e) Referee, Indian Journal of Pure & Applied Physics (CSIR)
  - f) Referee, Indian Journal of Physics, (IPA)
  - g) Referee, Central European J. of Physics (Poland)
  - h) Referee, J. of Non-Crystalline Solids (U.K.)

27. Faculty recharging strategies

NA

28. Student projects

- Percentage of students who have done in-house projects including inter-departmental project. 100%
- Percentage of students doing projects in collaboration with other universities/ Industry/ Institute. 75%

Details of M. Tech (Nanotechnology) Projects guided by

- (i) Prof. M. Husain (2008 onwards).

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<b>S. No.</b>	<b>Name of AME of Student</b>	<b>Class &amp; Session</b>	<b>Title of Project</b>	<b>In-house/In Collaboration with</b>
1	Maruph Hasan	2009	Synthesis and characterization of Zinc Oxide nanostructures using thermal evaporation technique and sol-gel spin method	In-house
2	M. Nizamuddin	2009	Synthesis and characterization of Zinc Oxide nanostructures using thermal evaporation technique and sol-gel spin coating method	In-house
3	Bal Krishan	2009	Synthesis, characterization and I-V studies of Carbon nanotubes	In-house
4	Mubashshir Husain	2009	Synthesis, characterization and field emission studies of Carbon nanotubes	In-house
5	Sonal Singh	2011	Synthesis of Gold nanoparticles decorated on Boron Nitride nanosheets synthesis and characterization	In collaboration with NPL
6	Simrjit Singh	2011	Microwave flash combustion synthesis of Bismuth Telluride	In collaboration with NPL
7	Mohammad Intekhab	2011	Nanoscale MOSFET device modeling, design and simulation using non-equilibrium Green function	In-house
8	Zakiya Shireen	2011	Synthesis and characterization of Carbon Nanotubes and the study of their field emission properties	In-house
9	Rishabh Sharma	2011	Development of Bismuth Telluride thermoelectric nanocomposites reinforced with MWCNT	In collaboration with NPL
10.	Gulshanaz Ali Qureshi	2012	The study of simulation and modeling of nanowire biosensors	In-house
11	Sucheta Juneja	2013	Deposition and characterization Of silicon thin films by PECVD technique	In collaboration with NPL, New Delhi

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12	Noor Jahan	2013	Rheological investigation of Fe <sub>3</sub> O <sub>4</sub> based ferro fluid	In collaboration with NPL, New Delhi
13	Ashu Jain	2013	Mathematical modeling for green synthesis of silver nanoparticles by reduction from solution	In collaboration with IIT Delhi
14	Ishteyaque Ahmad	2013	Modeling and simulation of certain nanosystems	In-house
15	Ranu Pal	2013	Nanocolloidal solution phase deposition for photonic devices and patterning of chalcogenide glasses	In collaboration with IIT Kanpur
16	Mahfooz Alam	2013	Carbon Nanotube composite based microstrip patch antenna	In-house
17	Taufique Alam	2013	Nonlinear force vibrations of Carbon Nanotubes	In-house

(ii) Prof. M. Zulfequar (2008 onwards).

S. No.	Name of AME of Student	Class & Session	Title of Project	In-house/ In Collaboration with
1	Marup Hasan	2009	Synthesis and characterization of Zinc Oxide nanostructures using thermal evaporation technique and sol-gel spin method	In-house
2	M. Nizamuddin	2009	Synthesis and characterization of Zinc Oxide nanostructures using thermal evaporation technique and sol-gel spin coating method	In-house
3	Bal Krishan	2009	Synthesis, characterization and I-V studies of Carbon nanotubes	In-house
4	Mubashshir Husain	2009	Synthesis, characterization and field emission studies of Carbon nanotubes	In-house
5	Roopa Bohra	2010	Synthesis of doped ZnO nanostructures by sol-gel method and its characterization	In-house
6	Afzal Khan	2010	Synthesis and characterization of nano-ceramic materials	In-house

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7	Mohammad Razi Akhtar	2011	Synthesis, Properties and characterization of Zinc Oxide nanomaterials	In-house
8	Puneet Kumar Rai	2013	Synthesis and Characterization of Nano-structures Zinc Selenide (ZnSe) and Cadmium Sulphide (CdS)	In-house
9	Mohd. Aamir	2013	Study of Field emission by ZnO Nanoneedles	In-house
10	Zaya Fatima	2014	Chalcogenide thin films prepared by solution based method	In collaboration with IIT, Kanpur
11	Vijendra Singh Bhati	2014	Purification of Carbon Nanotubes and its Functionalization	In collaboration with CEERI

(iii) Prof. Harsh, Visiting Professor, Centre for Nanoscience and Nanotechnology, JMI.

S. No.	Name of AME of Student	Class & Session	Title of Project	In-house/In Collaboration with
1.	Richa Dewan	2009	Synthesis and field emission studies of Carbon nanotubes evaporation	SSPL, DRDO
2.	Shweta Malik	2010	Chemical processing of Carbon nanotubes for Carbon nanotube based gas sensors	SSPL, DRDO
3.	Shama Parveen	2010	Carbon nanotube field emitters for device application	SSPL, DRDO
4.	Mahfooz Alam	2013	Carbon Nanotube composite based microstrip patch antenna	In-house

29. Awards/recognitions received at the national and international level by

- Faculty

Prof. M. Husain, Hony. Director, was appointed as Vice Chancellor, M.J.P. Rohil khand University, Bareilly w.e.f 18.12.2013.

Prof. M.Husain, Hony. Director, upto December 17, 2013 has been invited by several national and international institutions, where he has delivered several invited talks.

- Doctoral/post doctoral fellows
- Students (Associated with the centre)

SRF: - 04



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JRF: - 01

30. Seminars/Conferences/Workshops organized and the source of funding (national /International) with details of outstanding participants, if any.
1. Interaction Programme (M. Tech Nanotechnology) held at Seminar Room, Department of Physics, 4<sup>th</sup> May, 2013.
  2. 15th International Workshop on Physics of Semiconductor Devices, IWPSD-2009 Jamia Millia Islamia, (Dec. 15-19, 2009).
  3. M. Tech Interaction Programme, held at Seminar Room, Department of Physics, Jamia Millia Islamia, 03<sup>rd</sup> May, 2009.
  4. Workshop on “Nano-materials and Devices”, Jamia Millia Islamia, (Jan. 30, 2008).
31. Code of ethics for research followed by the departments  
The centre strives for the professional integrity in teaching and research in nanotechnology.
32. Student profile program-wise:  
(2007-2008)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	88	13	02	15

(2008-2009)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	95	10	05	15

(2009-2010)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	122	14	01	15

(2010-2011)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	205	10	05	15

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(2011-2012)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech(Nanotechnology)	159	10	05	15

(2012-2013)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	317	15	5	20

(2013 - 2014)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M. Tech (Nanotechnology)	277	12	8	20

(2014-2015)

S. No.	Name of the Course (refer to question no.4)	Applications received	Selected		Total Admitted
			Male	Female	
1	M.Tech (Nanotechnology)	217	16	7	23*

\* 01 NRI, 02 Foreign National

33. Diversity of students

S. No.	Name of the Course (refer to question no.4)	% of students from the same university	%of students from other universities within the	%of students from universities outside the	% of students from other countries
1	M. Tech Nanotechnology	20	5	75	Nil

34. How many students have cleared Civil Services and Defence Services examinations, NET, SET, GATE and other competitive examinations? Give details category- wise. 1

35. Student progression: NA

36. Diversity of staff NA

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37. Number of faculty who were awarded MPhil, Ph.D., D.Sc. and D.Litt. during the assessment period Nil
38. Present details of departmental infrastructural facilities with regard to the centre is in process of acquiring the building of its own and will soon have the requisite infrastructure.
- a) Library  
The Centre has already started the establishment of a library and has acquired nearly 100 books.
  - b) Internet facilities for staff and students
  - c) Total number of classrooms 02
  - d) Class rooms with ICT facility presently, utilizing the facility of Physics Department
  - e) Student's laboratories
  - f) Research laboratories developed A Nanotechnology Lab Procurement of New Equipments In the XI five year plan the UGC has sanctioned Rs.10 crore to star the Centre for Nanoscience and Nanotechnology Programme and outfit about 9.8 crore is sanctioned to procure equipments. We are in the process of the procuring the following equipments:
    - 1. HRTEM (High Resolution Transmission Electron Microscope)
    - 2. HRSEM (High Resolution Scanning Electron Microscope)(Arrived)
    - 3. HRXRD (High Resolution X-Ray Diffractometer)
    - 4. RF Sputtering
    - 5. Ball Mill (Arrived)
    - 6. Optical Microscope (Arrived)
39. List of doctoral, post-doctoral students and Research Associates NIL
- a) From the host Institution/university
  - b) From other Institution/universities
40. Number of postgraduate students getting financial assistance from the university. NIL
41. Was any need assessment exercise undertaken before the development of new programme (s)?  
If so, highlight the methodology.  
An assessment was made to explore the requirement of the growing nanotechnology based Industries. Apart of curriculum was accordingly designed.
42. Does the department obtain feedback from University has its own Performa to obtain feedback from students

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- a. Faculty on curriculum as well as teaching-learning-evaluation? If yes, how does the department utilize the feedback?

The Centre regularly holds its Committee of Studies meetings and incorporates the suggestions from the Experts/External Members of the Committee of Studies in the curriculum.

- b. Students on staff, curriculum and teaching-learning-evaluation and how does the department utilize the feed back? Feed back is taken from the students through Interaction Programme annually.

- c. Alumni and employers on the programmes offered and how does the department utilize the feed back?

43. List the distinguished alumni of the department (maximum10) NA

44. Give details of student enrichment programmes (special lectures/workshops/seminar) involving external experts.

Please see Annexure –ERD IV: student enrichment programmes.

45. List the teaching methods adopted by the faculty for different programmes.

Faculty members use multimedia technology in classrooms as and when needed. This includes

- Power point presentation,
- Videos using You Tube, Teacher tube and I Tunes U,

46. How does the department ensure that programme objectives are constantly met and learning outcomes are monitored?

The Committee of Studies of the centre meets regularly and reviews the academic programmes of the centre.

47. Highlight the participation of students and faculty in extension activities.

Please see Annexure –ERD V: participation of students and faculty in extension activities

48. Give details of “beyond syllabus scholarly activities” of the department. Nil

49. State whether the programme/Department is accredited/graded by other agencies? If yes, give details. No

50. Briefly highlight the contributions of the Centre in generating new knowledge, basic or applied.

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The Centre has setup a state of art facility for the growth and characterization of SWNTs. A unique facility on the synthesis of Single Wall Carbon Nanotube (SWNT) has been established at the Centre for Nanoscience and Nanotechnology and the same has been dedicated by Mr. Najeeb Jung, Hon. Vice Chancellor, Jamia Millia Islamia, to the Centre on December 28, 2012. This facility is exclusively dedicated for the synthesis of semi conducting single wall carbon nanotubes and graphene. Once perfected, the grown SWNTs shall be utilized for the fabrication of emerging nanoscale electronic devices, integrated circuits and MEMS/ NEMS by the Centre and other potential users in the country. This unique facility of its type in the country is exclusively focused to carry out the development of synthesis process for synthesizing semi conducting Single wall carbon nanotubes with reproducible and control lable properties, which still is a challenging g research are a world over and very limited technical data is available in the open literature. Scientist's world over are busy in securing patent sin the development of this novel material of 21<sup>st</sup> century for future is tic multi dimensional applications. The extra ordinary electrical, mechanical, thermal and coupled electro mechanical properties of these SWNTs make them very attractive material for nano sensors and futuristic VLSI circuits, especially beyond the silicon domain. The Centre has plans to channelize its research and development activities in the area of SWNT based nano-device fabrication with an emphasis on nanobiosensors, labonchip/drug delivery system, physical, chemical and biosensors and ultrahigh speed devices and circuits.

### PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD) BLACK MAGIC-2'SYSTEM FOR THEGROWTH OFSWCNTs

Initial growth results using this facility are very encouraging and very good CNT's; highly graphitized walls could be achieved. More experiments are in progress with different process parameters and catalysts to achieve the controlled growth of SWNTs with repetitive properties.

SCANNING PROBE MICROSCOPE (SPM): A latest version of scanning probe micro scope with atomic resolution, multimode 8, procured from M/S Bruker, has been installed at the Centre The SPM has three scanners ( $.4 \times .4 \mu\text{m}$ ,  $10 \times 10 \mu\text{m}$  and  $125 \times 125 \mu\text{m}$ ) to achieve enhanced resolution. The system is equipped with four modes as Scanasyst mode, Contact mode, tapping mode and STM mode. The system is dedicated for high resolution imaging of SWNTs and other nano structures.

51. Detail five major Strengths, Weaknesses, Opportunities and Challenges (SWOC) of the Department/Centre.

Nanotechnology is an emerging field world over. Scientists and technologists are developing various processes in the diverse field of nanotechnology, filing and securing patents for future exploitation. The main driving force to this emerging technology is nature and all efforts are being made to mimic the technology which is cost effective, do not create pollution and disturb our eco system, sustainable.

This being an emerging technology the research and development at most of the laces are at nascent level and as such no bottle neck/weaknesses are envisaged.

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Nanoscience and nanotechnology related research and development has been identified as major thrust area by most of science and technology departments of the country and abroad with substantial funding. Apart from the financial support available, there is huge opportunity for fundamental research in this inter disciplinary field. The understanding of new phenomenon, effects, reactions at nanoscale, modeling and simulation and characterization at this will require all together different type of understanding/extension of current physics/chemistry and related science and technology.

Center has already visualized these critical issues and strong academia national laboratory level interaction/collaboration is finding very effective to resolve some of the above challenges.

### 52. Future plans of the Centre

The main objective of the Centre is to promote fore front basic and applied research in the fields of Nanoscience and Nanotechnology, with potential applications towards fulfilling national strategic and societal needs. Apart from the science and technology to develop high skilled trained man power, finally contributing to national growth in various ways. The main research focus of the Centre includes fabrication of Nano-devices, development of Nano-materials, Nano-structures, Nano-biotechnology, Nano-medicine, and appropriate characterization techniques in a phased manner. The Centre has been planned and being equipped with state of art nano material preparation, nano device fabrication, nanomaterial characterization along with appropriate test and measurement equipments so as to become an important self-contained Centre among the few Nano- Centres within the country.

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## **Annexure: ERD IV: Participation of students and faculty in extension activities**

Talks Delivered by Prof. M. Husain, Hony. Director upto December 17, 2013

1. Carbon Nanotubes: Emerging cold cathode material for futuristic electron field emission devices, National Conference on Nanomaterials and Devices (NANOCAD-2013), organized by Department of Physics, NIT Srinagar, Kashmir.
2. Carbon Nanotubes: An emerging material of 21st Century for futuristic devices in the National Seminar on “Signal Processing and Communication Technology” organized by Delhi College of Technology and Management (DCTM) from 26-27 May, 2013.
3. Synthesis of Single wall Carbon Nanotubes for sensor applications, delivered in the Department of Physics, King Saud University, Riyadh, Saudi Arabia on 23rd April, 2013.
4. Carbon Nanotubes: Emerging cold cathode material for futuristic display devices and Recent Developments of Nanotechnology delivered in the Department of Physics, King Abdul Aziz University, Jeddah, Saudi Arabia on 22nd and 25th April, 2013 respectively.
5. Carbon Nanotubes: An emerging material of 21st century for futuristic device applications” at national seminar on recent trends and development in nano materials, organized by IIMT, Meerut
6. Carbon Nanotubes: An Emerging Material for Futuristic Device at National Workshop on Nanotechnology and its Applications in Science and Engineering (NASE-2013) in National Institute of Technology, Manipur from 23-24 March 2013.
7. Recent development in the field of Nanotechnology, at National Conference on Nanoscience and Nanotechnology organized by Aligarh Muslim University on 15th March 2013
8. Carbon Nanotubes: A Materials of 21<sup>st</sup> Century at Workshop on inspiring humanity for environmental protection and energy conservation organized by Al-Falah School of Engineering and Technology on 14<sup>th</sup> March 2013.
9. Carbon nanotubes and its applications at National Conference on Advanced Trends in Nanoscience and Nanotechnology, organized by Department of Applied Science and Humanities, JMI, 25<sup>th</sup> February 2013.
10. Potential Applications of Carbon Nanotubes as Electron Field Emitter at International conference on Material Science (ICMS-2013) in Department of Physics, Tripura University (A central University), Tripura from 21-23 Feb. 2013.
11. Carbon Nanotubes: An Emerging Electronic Material for Futuristic Devices at Second International Symposium on Semiconductor Materials and Devices (ISSMD-2), in University of Jammu, from 31 Jan. 2013 to 2 Feb. 2013.
12. Carbon Nanotubes: A material of 21<sup>st</sup> Century at National Conference on Indian Development in Recent and ideal Semiconductors for Novel Applications(NCIDRIS -2012) in

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Department of Physics, Arts, Commerce, Science college, Navapur Maharashtra from 5-7 October 2012.

13. Series of lectures in Refresher Course in Department of Physics, Manipur University, Canchipur, Imphal, on 14 and 15<sup>th</sup> September 2012.
14. Carbon nanotubes based field emission display, National Seminar on “Recent Trends in Material Science Research, Department of Chemistry and Physics”, NIT Srinagar, Kashmir, 3<sup>rd</sup>-5<sup>th</sup> September 2012.
15. Emerging scenario for Nanotechnology Applications-Challenges and Threats Also Chief Guest in “National Seminar on Nanoscience, Technology and their Societal Impact” Babu Banarsi Das Institute of Technology, 07<sup>th</sup> April 2012.
16. Carbon Nanotube based Field Emission Display, at “International Conference and Workshop on Nanostructured Ceramics & other Nanomaterials, University of Delhi, 14<sup>th</sup> March 2012.
17. Synthesis and characterization of Carbon Nanotubes, “National Conference on Materials for Advanced Technologies” ABV-Indian Institute of Information Technology and Management Gwalior, 27<sup>th</sup> –29<sup>th</sup> Feb 2012
18. Field Emission Properties of CNTs India Singapore Joint Physics Symposium (ISJPS2012) on “Advanced Materials” in Indian Institute of Technology Delhi, New Delhi, India from Feb. 21, 2012.
19. Carbon Nanotubes: A Materials of 21<sup>st</sup> Century 4<sup>th</sup> National Conference on Nanomaterials and Nanotechnology, Department of Physics, University of Lucknow, Lucknow From 21<sup>st</sup>-23<sup>rd</sup> Dec 2011
20. Carbon Nanotube: A 21<sup>st</sup> Century Material  
National Conference on Recent Trends in Synthesis and Applications of Advanced Materials (RTSAAM2011), Maharaja Agrasen Institute of Technology, Delhi from 5-6 Dec., 2011

Talks delivered by Prof. Harsh, Visiting Professor

1. CNT base Chemical Sensors, at National conference on Nanotechnology and renewable energy (NCNRE-14), April 28-29, 2014.
2. Work function engineering, An effective technique to significantly improve the field emission characteristics of CNT field emitters, at 17<sup>th</sup> International Workshop on Physics of Semiconductor Devices (IWPSD 2013), organized by Amity Institute of Advanced Research and Studies (materials & devices), Amity University, Noida, Uttar Pradesh, Dec 10-13, 2013
3. Carbon nanotubes based chemical sensor technology development, at National Workshop on Nanotechnology and its Applications in Science and Engineering (NASE-2013) in National Institute of Technology, Manipur from 23-24 March 2013.
4. Development of CNT based chemical sensor technology at Second International Symposium on Semiconductor Materials and Devices (ISSMD-2), in University of Jammu, from 31 Jan. 2013 to 2 Feb. 2013.



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## **Annexure –ERD III: Student enrichment programmes**

- i. Dr. Mohammad Yusuf, I. I. Sc. Bangalaoe, former senior physicist, Naval Research Laboratory, U.S.A., Faculty Member, The George Mason University and Programme leader, Indira Gandhi Centre for Atomic research, delivered a lecture on “Condensed material” on 16<sup>th</sup> July 2012.
- ii. Dr. Joel Oswalt from Horiba Jobin Yvon SAS, France delivered a lecture on “Micro-Raman, Spectroscopy, Instrumentation and Applications” on 7<sup>th</sup> August 2012.
- iii. Professor Poonam Tandon, Department of Physics, Lucknow University delivered a lecture on “German research landscapes and experience with German collaborators” on October 29<sup>th</sup>, 2012.
- iv. Professor P.K. Bhatnagar, Department of Electronics, Delhi University, South Campus delivered a lecture on “Biotechnology and DNA folding” on December 6<sup>th</sup>, 2012.
- v. Dr. Fozia Zia Haque, Co-ordinator M. Tech. (Nanotechnology), Maulana Azad National Institute of Technology, Bhopal delivered a lecture “Preparation and characterization of ZnO nanostructures by sol-gel techniques” on December 8<sup>th</sup>, 2012.
- vi. Dr. Prakash Murawala, SAMCO Inc. Japan, delivered a lecture on “Plasma CVD and reactive ion etching systems” on December 19<sup>th</sup>, 2012.
- vii. Dr. Cheng-Yao Lo, Institute of Nanocengineering and Micro systems, Taiwan visited the Centre on 24<sup>th</sup> January 2013.
- viii. Dr. Paul Coudray, KLOE, France delivered a lecture on “Photolithography” on January 28<sup>th</sup>, 2013.
- ix. Dr. Prabhat Dwivedi, Scientist, IIT Kanpur delivered a lecture on “Lithography techniques” on February 01<sup>st</sup>, 2013.
- x. Dr. Garima Tripathi from IIT Kanpur delivered a lecture on June 14<sup>th</sup> 2013.
- xi. Prof. P.K Bhatnagar, University of Delhi, south Campus delivered a lecture on November 23, 2013.
- xii. Dr. Prabhat Dwivedi, Scientist, IIT Kanpur visited the centre and discuss some collaborative work on December 5, 2013.
- xiii. Dr. Fozia Zia Haque, Co-ordinator M. Tech. (Nanotechnology), Maulana Azad National Institute of Technology, Bhopal delivered a lecture on December 8<sup>th</sup>, 2013.
- xiv. Dr. Renu Choithrani, Barakhtullah university delivered a lecture on February 8, 2014.
- xv. Dr. P. K Dwivedi from IIT Kanpur delivered a lecture on June 14<sup>th</sup>, 2014.

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- xvi. Prof. H. R. Khan, Associate Director, IVT- Institute for Ionenstrahl-und Vakuumverfahrenstechnik e. v. 73730 Esslingen, Germany delivered a seminar on “Optical properties of poly (2-methoxy-5-(2-ethyl-hexyloxy) phenylenevinylene) (MEH-PPV) deposited in nano pores of alumina substrate” on July 18, 2014.
- xvii. Prof. (Dr.) Samir Iqbal, University of Texas at Arlington, Arlington, Texas USA delivered a seminar lectures on “Functionalized Nano materials and Nanostructures for Biosensing Application” and “Role of Nanomaterials and Nanostructures in medical application” on August 4, 2014.