2014

INTERNAL REVIEW REPORT 2008-2013

OF

DEPARTMENT OF APPLIED MECHANICS

CURRENT ACTIVITIES

AND FUTURE PLANS

DEPARTMENT OF APPLIED MECHANICS

INDIAN INSTITUTE OF TECHNOLOGY DELHI

DEPARTMENT OF APPLIED MECHANICS

INTERNAL REVIEW (2008-2013)

March 7-8, 2014

The internal review of the Department of Applied Mechanics, Indian Institute of Technology Delhi (IITD) is being under taken to receive inputs from the experts in the areas of research with an aim to assess and improve our performance. It is part of a major review process being carried out all through the IIT system as per the recommendations of MHRD, Govt. of India.

The present document is a record of all academic activities, events, achievements and future plans of the department supported with necessary data. In general the information included here, pertains to the period of 2008 – 2013.

PREAMBLE

The Department of Applied Mechanics at Indian Institute of Technology Delhi is a unique engineering department involved in teaching, fundamental and applied research, and industrial consultancy. The broad areas of research are Solid Mechanics, Bio-Mechanics, Fluid Mechanics, Materials Sciences and to some extent comprehensive Design. The faculty members of the Department come from diverse backgrounds as Aeronautical and Aerospace Engineering, Civil Engineering, Mechanical Engineering, Metallurgy and Materials Science. The Department offers postgraduate degrees in Engineering Mechanics and Design Engineering. Apart from this, the department also offers Minor area in Computational Mechanics to undergraduates. It has a unique postgraduate diploma (DIIT) programme to the officers Indian Navy. Although, the Department does not have any B.Tech. programmes, but it is actively involved in teaching Mechanics (Engineering Mechanics, Solid Mechanics and Fluid Mechanics) and Materials Science to the undergraduate students from various departments of the institute.

The Department of Applied Mechanics has always been proactive in attracting bright young faculty members with an aptitude for high standard teaching and research. As a result of this the department has been successful in recruiting many such faculty members in the recent past from acclaimed institutions of international repute.

The faculty members of the department are engaged in a blend of fundamental and applied research. They have always been deeply involved in molding young bright undergraduate and graduate students into technologists, technocrats and researchers who are capable of providing the best of the solutions to the industrial challenges and the societal needs.

The laboratories of the department are consistently being upgraded and the department is in the process of setting up state-of-the-art laboratories in all major areas of research. Average annual journal publication count of the department is 50 with overall five year total of 249. In terms of benchmarking, Applied Mechanics Department at IIT Delhi fares better than its counterparts in other IITs in terms of publications count and citations.

This report is being submitted to the Review Committee to assess our performance and seek guidance to realise our vision. We look forward to receive fruitful suggestions and valuable recommendations.

March, 2014

Suhail Ahmad
Head, Applied Mechanics

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CURRICULUM

1

Executive Summary: Curriculum

The Department mainly offers postgraduate degree in Engineering Mechanics and Design Engineering to its PG students. Apart from this, the Department also offers Minor area in Computational Mechanics to undergraduates and DIIT degree to officers of Indian Navy. Although the Department does not offer any major undergraduate degree but it offers basic courses in Mechanics (e.g., Mechanics, Materials science, Solid Mechanics, Fluid Mechanics etc.) which are taken by undergraduates from various departments of the institute. The undergraduate teaching constitutes a bulk of our teaching effort. With the joining of several new faculties from diverse areas of Mechanics, the Department is also taking initiative to offer several elective courses at PG level. The Department also aims to start a new M.Tech. program in Materials Science & Engineering.

1.1 List of degree programmes offered and enrolment

Undergraduate: None

The department offers Minor area in "**Computational Mechanics**" to undergraduates.

Post graduate:

Year	M.Tech (Engineering Mechanics)	M.Tech (Design)	MS(R)	DIIT (Navy)	PhD
2012-13	23	22	0	22	4
2011-12	15	22	1	23	7
2010-11	20	19	0	19	10
2009-10	20	19	0	17	6
2008-09	21	13	0	17	11
Total	**99**	**95**	**1**	**98**	**38**

1.2 Consistency of curricula with academic vision of the department

In line with the academic vision of the department, the department offers several advanced fundamental courses in broad areas of Mechanics such as *Theory of Plates and shells, Applied Plasticity, Fracture Mechanics, Engineering Failure Analysis, Advanced Finite Element Method, Computational Fluid Dynamics, Turbulence shear flow, Multiscale modeling of crystalline materials* etc. In order to further broaden our areas as enshrined in our vision document, the Department also aims to start several new courses, e.g., *Turbulence modelling and Computation, Experimental Methods in Fluid Mechanics, Compressible fluid flow, Fluid structure interaction etc.*

Our Department also has a small group in the area of Materials Science & Engineering. Since, IIT Delhi is the only IIT among old IITs which does not offer a postgraduate program in Materials Science & Engineering, our department resolved in its vision to start a new M. Tech. program in Materials Science & Engineering.

1.3 Quality of programmes

(a) Periodicity of curriculum review:

Normally, the curriculum is revised once in every ten years. Recently, a sub-committee was formed by the Department to review PG curriculum, which has submitted its recommendations (see the attached – Annexure 1). The recommendations of the sub-committee will be discussed in DFB.

Recently, UG curriculum review has been completed. The following are the changes pertaining to courses offered by the department:

- Engineering Mechanics is now core for all B.Tech programs.
- One introductory course on Material Science is now compulsory program linked elective. Material Science course offered by Applied Mechanics Department is being taken by Mechanical, Chemical, Bio-Chemical and Textile Engineering departments.
- Solid Mechanics, Fluid Mechanics and associated laboratories is being taken by Civil, Mechanical and Textile Engineering departments.
- Experimental methods is core for Textile Engineering department.

(b) Mechanism of review at UG and PG level:

Typically, the curriculum review is initiated by the Institute which directs various departments to review their curriculum. The department then forms its sub-committee at department level. The recommendations of the sub-committee is discussed in Departmental faculty board and then sent to Institute. The Board of Academic Programs (BAP) having representative from all departments then discusses recommendations of all departments. Once, the BAP approves the review, it is then sent to the senate for approval. Currently, UG curriculum review is underway. Once this is approved by Senate, PG curriculum review of the Institute is likely to follow.

(c) Coursework for PG and PhD programme:

PG program:

Diploma in Naval Construction:	49 credits (all core)
M. Tech. in Engineering Mechanics:	60 credits (45 – core, 9 – PE, 6 - OC)
M. Tech. in Design Engineering:	60 credits (45 – core, 9 – PE, 6 - OC)
M.S (Research) :	20 (Course) +40 (Project) credits

PhD Program:

As per Institute rule, a student joining with Masters degree is required to complete 6 credits while a student joining with B.Tech. degree is required to complete 20 credits of courses before taking up PhD Comprehensive examination. PhD students are also supposed to take an English language course for improving their writing and communication skills. In addition to these courses, the Student Research Committee can recommend additional courses depending on the requirement of the student and the chosen research topic.

(d) Pre-PhD courses offered in last 5 years

The department has offered several pre-PhD courses which are basically 800 level courses. These are as follows:

1. AML851: Fracture Mechanics
2. AML805: Advanced Finite Element Methods
3. AML871: Product Reliability and Maintenance
4. AML811: Advanced Computational fluid Dynamics
5. AML883: Properties and Selection of Engineering Materials
6. AML831: Theory of Plates and Shells
7. AML833: Applied Plasticity
8. AML852: Engineering Failure Analysis and Prevention

9. AML835: Mechanics of Composite Materials
10. AML812: Turbulent Shear Flows
11. AML840: Advances in Solid Mechanics

(e) New advanced Masters/Pre-PhD courses introduced in last 5 years

1. AML736: Multiscale modeling of crystalline materials
2. AML740: Mechanics of biological cell

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

Ph.D. students are allowed to take PG courses and similarly M.Tech. students can also register for pre-PhD courses as program elective (PE). The 700-level courses offered at PG level are also open to UG students. Typically, undergraduate level courses are not open to graduate students though.

(g) Seminar series (weekly/regular) held during last one year

The department plans to start a weekly seminar series soon. Typically, we have lots of faculty candidates giving seminar in our department. Apart from these faculty candidates, list of other seminar speakers who presented in our department during the last one year is as follows:

Date	Speaker	Title
12/2/2014	Mr. Swapnil Praveen University of Virginia, USA	Flow and odorant transport dynamics of chemical sensing in aquatic animals
11/2/2014	Dr. Gaurav Singh Imperial College London	Discrete and continuum studies of some fundamental issues in brittle fracture mechanics
10/01/2014	Prof. Peter Childs Imperial College London	Brainstorming on Design Curriculum
07/01/2014	Prof. Romesh C. Batra Virginia Polytechnic Institute and State University, USA	Finite Deformations of Curved Sandwich Panels during Entry into Water
17/12/2013	Dr. Ashivni Shekhawat UC Berkeley, USA	What has fracture got to do with magnets and liquid-vapor critical point?
2/12/2013	Dr.Satyesh Das Los Alamos National Lab	Predictive modeling of materials from 1st principles
26/9/2013 to 28/9/2013	Dr. P C Jain Head of Structures Division, DRDL Hyderabad	Better Designs using FEA
15/7/2013	Mr. Nehul Gullaiya IIT Bombay	MEMS Design and Instrumentation
6/6/2013	Prof. S. Girimaji Texas A&M University, USA	Partially averaged Navier-Stokes method for turbulence simulations: theoretical

		foundations and some practical examples
8/1/2013	Dr. Chandraveer Singh University of Toronto	Atomistic modeling of materials for aerospace and energy applications

(h) Placement details through campus placement only (2012-2013 batch)

Prog Type	Prog name	No of graduating students	No. of core companies that recruited	No of students selected in core companies	No. of non-core companies that recruited	No of students placed in non-core companies	No of students not placed through campus placement
M.Tech	Engineering Mechanics	23	8	10	0	0	13
M.Tech	Design Engineering	22	8	12	0	0	10

For detailed placement data, please check "Research & Development – Environment" section.

(i) Relevance of UG and PG programmes to recruiters, potential and on-campus recruiters: Data not available.

Detailed survey as per the table sought has not been done. However, the Department plans to carry out such surveys from next academic year which could be very beneficial to students.

(j) Benchmarking of curriculum:

	Stanford (Mechanical, Aerospace)	**Cornell (Theoretical & Applied Mechanics)**	**IIT Kanpur (Mechanical)**	**IIT Madras (Applied Mechanics)**	**IIT Delhi**
Math requirement in Masters/ PhD courses	Yes	Yes	Yes	No	No
PhD course work requirement	90 credits (M.Tech) 135 credits (B.Tech)	4 courses+ one minor degree (3 courses) in other discipline	4 courses (M. Techs) 10 courses (B.Tech)	12 credits (M.Tech.) 24 credits (B.Tech.)	6 credits (M.Tech) 20 credits (B.Tech)
PhD requirement of publishing paper	No	No	No	No	No
PhD teaching requirement	Yes	Yes (2 semesters)	No	No	No
Inter-disciplinary/breadth requirement for PhD	Yes (course work reqd)	Yes – one minor degree required	--	No	No

Annexure - 1
Recommendations of Graduate Program review committee

A Committee was formed by the Dept. Head for rationalization of M.Tech program and opening a new M.Tech program in Materials Science. The committee consisted of following members:

Prof. Puneet Mahajan, Prof. Sanjeev Sanghi, Prof. Rajesh Prasad, Dr. Badri Prasad Patel, Dr. Maloy Singha, Dr. Balaji Srinivasan, Dr. Ajeet Kumar, Captain P. Kulkarni

This committee met several times in the summer of 2013 and made the following recommendations unanimously:

1. Following fundamental courses should be made common to both Engineering Mechanics and Design program. This will help in getting rid of duplicate courses and will provide more time to faculties to float and teach new courses catering to emerging areas of research.
   - Solid Mechanics (3-0-0)
   - Fluid Mechanics (3-0-0)
   - Materials Science (3-0-2)

2. Changes are proposed in the course structure of M.Tech - Engineering Mechanics. The key change is introduction of a new course "**Engineering Math and Computation**" instead of "**Applied Computational Method**" to enhance mathematical/analytical skills of students.
   1st Sem: Solid Mech. (3-0-0), Fluid Mech. (3-0-0), Engg. Math and Comp. (3-1-2), Exp. Methods - Solids and Fluids (2-0-4)
   2nd Sem: Dynamics (3-1-0), FEM (3-0-2), Materials science (3-0-2), PE1, PE2/OE1
   3rd Sem: OE1/PE2, PE3, OE2, M.Tech Project
   4th Sem: M.Tech Project

3. Changes are proposed in M.Tech - Design program. Key changes are introduction of programming component in Decision Theory and Design Optimization and a single Product Design course instead of two.
   1st Sem: Solid Mechanics (3-0-0), Fluid Mechanics(3-0-0), Decision theory & Design Optimization (3-0-2), Computer Aided Design (3-0-2)
   2nd Sem: Materials Science (3-0-2), Design Methods (3-0-0), Feasibility study (1-0-2), Product Design (1-0-4), PE1, PE2/OE1
   3rd Sem: OE1/PE2, PE3, OE2, Project
   4th Sem: Project

4. The committee agreed with the proposal to start new M.Tech program in Materials Science. The list of core courses to be taught in this program is as follows:
   a. Solid Mechanics (3-0-0)
   b. Mechanical behaviour of Materials (Rajesh Prasad, Anamika Prasad, Jayant Jain) (3-0-2)
   c. Computational methods in materials science (Ajeet Kumar) (3-0-2)
   d. Selection and properties of engineering materials (R. Prasad, J. Jain, A. Agarwal) (3-0-0)
   e. Materials characterization (Rajesh Prasad, Jayant Jain) (3-0-2)
   f. Solid state phase transformations (Rajesh Prasad, Jayant Jain) (3-0-0)
   g. Fundamentals of Materials Processing (Rajesh Prasad, J. Jain, Arvind Agarwal) (3-0-2)

h. Materials Thermodynamics (Arvind Agarwal) (3-0-0)

The list of courses under program electives is as follows:

a. Recent advances in materials characterization (a generic course)
b. Texture in materials (Jayant Jain)
c. Bio-materials (Sitikantha Roy, Anamika Prasad)
d. Nano-materials (Arvind Agarwal, Ajeet Kumar)
e. Advanced fracture mechanics (Jayant Jain, Vikrant Tiwari)
f. High strain rate behaviour of materials (Jayant Jain, Vikrant Tiwari)
g. FE methods (Anamika Prasad, Ajeet Kumar, Punnet Mahajan, B. P. Patel, M.K.Singha)
h. Surface Coating and Technology/Surface Engineering (Arvind Agarwal)
i. Composite Materials (Puneet Mahajan, Arvind Agarwal)
j. MEL 778: Design and Metallurgy of welded joints
k. ITL 717: Corrosion and its control
l. MEC 780: Casting technology
m. EEL 787: Welding and allied processes
n. PTL 711: Engineering plastics and speciality polymers
o. MEC 791: Composite material and processing
p. Special Topics in Materials Science and Engineering

5. Following changes are proposed in the list of program electives of Engineering Mechanics and Design Program. Few new courses have been added and are highlighted in bold.
   - **Engineering Mechanics:**
     Advanced Computational Fluid Dynamics, **Turbulence modeling and computation**, **Experimental Methods in Fluid Mechanics**, **Compressible fluid flow, Fluid structure interaction**, Theory of Plates and Shells, Applied Plasticity, Mechanics of composite materials, Fracture mechanics, **Cell mechanics, Multiscale modelling of crystalline materials,** Independent study
   - **Design:**
     Bio-inspired Design would be added to the current list of program electives of Design program

6. A PhD student (with Masters Degree) should take at least 4 courses before his/her comprehensive exam. Of these 4 courses, 2 of them could be taken as AUDIT.

TEACHING ENVIRONMENT

2

Executive Summary: Teaching Environment

The Applied Mechanics Department has a long and proud history of providing an exceptional learning environment. The department caters to fundamental courses at the Undergraduate level and has two M.Tech programs: "*Engineering Mechanics*" and "*Design Engineering*". Apart from this the department also has a DIIT program for Naval officers. The department has several laboratories – both experimental and computational -- associated with its courses.

A simple and powerful measure of the popularity and quality of our courses has been the number of teaching excellence awards that our faculty and courses have received over the years. Over the last 4 years since a formal teaching excellence award has been initiated by the Institute, we have won 7 awards. This reflects that just in the last 4 years, one-third of our faculty members have already received awards for the excellence of their teaching. This ratio is probably the highest in the Institute and reflects our commitment to teaching.

Our department offers some very important courses that form the foundation of many engineering programs: *Engineering Mechanics*, *Materials Science*, *Solid mechanics*, *Fluid Mechanics*, *Finite Element Method* to name a few.

To complement our teaching, we have also been engaging in a process of complete overhaul and up-gradation of our laboratory facilities over the last year. The detailed data may be seen in Section 2.6

2.1 Student Teacher ratio separately and total for UG, PG, PhD (based on gross number and on class size basis)

a. Based on gross numbers

(*Defined as the ratio of the Total number of unique students taking our classes in a semester to the number of faculty present in the department)*

The department has 22 faculty members (average) during the last five years (2009-2013). The department is teaching different courses to 750 UG students, 100 M.Tech students and 35 PhD students in every semester. On this basis our student-teacher ratios are

UG	M.Tech.	Ph.D.	Total
34	4.5	1.5	40

b. Based on class size

(Defined as the ratio of the average of the Total number of students taking a class to the number of faculty teaching that class)

Table 2.1.1 Student to teacher average across lecture courses

	2008	2009	2010	2011	2012
UG	81	94	100	119	103
PG	24	25	27	30	30

2.2 Number of students graduated each year

Table 2.2.1 Students graduated per year in last five years

Year	M. Tech (Engg. Mech.)	M. Tech (Design)	MS(R)	DIIT	PhD
2013	23	22	0	22	4
2012	15	22	1	23	7
2011	20	19	0	19	10
2010	20	19	0	17	6
2009	21	13	0	17	11
Total	**99**	**95**	**1**	**98**	**38**

2.3 Student- TA (or student-hours/TA) ratio

The student-TA ration varies across courses in the department. Typically, we have 20 students / TA / lab course.

2.4 Number of Skilled Technical Staff

The department has five skilled technical staff. There is severe shortage of manpower in teaching laboratories as the number of undergraduate students have increased manifold in recently.

2.5 Gross Laboratory Space: Breakup of lab space for core UG/PG teaching

We have laboratories that are used for UG teaching, PG teaching and research. There is also overlap among teaching and research labs. The respective areas are

Teaching lab space (UG) : 2048 square ft.
Teaching lab space (PG) : 7486 square ft.
Overlapping Research Labs with Teaching Labs **:** 8586 square ft.

2.6 Laboratory modernization performed in the last 5 years (i) UG core, (ii) PG (core), and (iii) elective courses (attach data before and after modernization)

(i) UG Laboratories:

Before Renovation	After Renovation
Material Science Laboratory (AML 120)	
IIT-D was one of the pioneers in introducing lab components in the Introductory Materials Science Course. It is still one the very few institutes to have this feature. The current lab has seen gradual upgradation and improvement over the years. Now, under the new curriculum of IIT, it has been granted a new space and funding under which it is undergoing a major renovation.	• Materials for crystallographic models • Materials for models of defects • Mounting press • Polishing wheel/Grinding machine • Material Selection & design software • Optical microscopes • Tensile tester • Rolling mill • Furnace • Hardness tester • X-ray diffractometer • Materials for customized set up • In-house set up.
Experimental Methods (AML 130)	
Experimental setups initially developed are being modernized with new location of the lab.	*Proposed Equipments*: • Dynamic strain indicators • High speed data acquisition systems • Digital oscilloscope • Accelerometers • Piezzo sensors • Table top wind tunnel set up
Fluid Mechanics Lab	
• Pilot Plant Test Loops for slurry transportation with instrumentation • Open channel flumes with instrumentation (3 Nos) • Close loop water testing facility consisting of underground sump • Overhead tank and pipe loop system	• Antan Paar's Rheogonometer / viscometer • Flow visualization apparatus • Impact of jet • Bernoulli's theorem apparatus

(ii) PG Laboratories:

Before Renovation	After Renovation
CFD Lab-was setup in 2010.	
-	• Computers for data acquisition and computational facility (10 Nos) • Workstations for computational facility • 96 node/344 core cluster for high computational facility

	• Installation of a precision air-conditioner for the cluster.
Computational Lab	
Lower configuration computers.	• Lab with 15 Xeon workstations • Separate spaces for Masters and PhD students
Design Optimization Lab	
Lower configuration computers.	• Lab with 10 Xeon workstations
Stress Analysis Lab	
• Photoelastic bench • Moire fringe equipment • Digital strain meters • Super data loggers • Stress freezing ovens • 50T Instron machine • 10 T and 100 T hydraulically operated universal testing machine	**Additions** • 3 Channel Strain Indicator • Laser Displacement Sensor • 32-Channel Setup for Vibration Measurements and Experimental Model Analysis of Structures • Lamb-Wave based damage detection setup with Pitch-Catch Piezo electric sensing and actuation: 64-Channel Setup with a maximum actuation potential of 130V (peak to peak) and 1MHz frequency
Mechanical Behavior Lab	
Some of the equipments were non functional.	Various machineries like rolling mill, wire drawing machine, Steel and Aluminum melting furnaces have been made operational.

Material Characterization Lab	
This is a new lab which is created last year by adding new equipment like SEM, EDS to existing equipment like OES. A new lab space is now being created to house all these equipment in an organized fashion and also add further new facilities.	*Equipment*: • Foundry Master Optical Emission Spectroscope (OES) • Bruker Energy Dispersive Spectroscope (EDS) with table top scanning electron microscope • Zeiss Optical Microscopes • Hitachi Scanning Electron Microscope (SEM) • Sample preparation facilities for optical and scanning microscopy. *Usage*: in microstructure design, microstructure manipulation, alloy design, mechanical behavior of materials, friction stir welding, bio-materials characterization and characterization of functionally graded materials.

Strength of Material Lab	
Basis testing facilities like: • Universal testing machine • Drop hammer Impact test setup • Torsion testing facility • Hardness and Impact testing machine • 10 T and 25 T computerized universal machine (Zwick) • 50T Instron machine • 10 T and 100 T hydraulically operated universal testing machines	• Uniaxial Testing Machine: *Features*: 5 KN load frame, Bio testing facility with non-contact video extensometer, Temperature control bio-chamber, extension torsion module. • Instron Impact Tester: *Features*: Drop weight hammer, maximum drop weight 14.7 kg *Usage*: for testing composites and helmets • 2 High Speed Cameras: *Features*: 750,000 frames per second, photon SA2 • 3-D DIC Software • Atomic Force Microscope (AFM): *Features***:** Nano-mechanical testing capability with various modes like contact, non-contact, tapping etc. *Usage*: (a) For nano-scale topography, (b) nano mechanical probing of soft materials • Nano Indentor: *Features***:** ASMEC nano indentor with maximum 200 nano N load facility combined with AFM, lateral scratch module. *Usage*: Nano indentation of hard and soft materials. • Soft Sample preparation facility: *Features***:** Incubator, Bio-hood, -20^0C freezer, centrifuge • Micro pipet aspiration facility: *Features***:** Motorized microscope with micro manipulator and pressure transducer *Usage*: Mechanical stiffness and viscoelasticity of biological cells.
Impact Mechanics Lab	
Experiments initially developed are being modernized.	• High impact characterization facility, both under dynamic tension and compression. • Projectile impact facility
Gas Dynamics Lab	
• 5 wind tunnels of different sizes in the range of 0.3mx0.3m to 1.6mx1.6m closed (circuit type complete with instrumentation)	• 3D PIV facility with Tomographic and micro PIV attachments • High speed CCD cameras (SR 50k mega speed, 2 Nos)

• Hotwire anemometer set up (5 Nos) • Betz micro-manometers (10 Nos) • Scanivalve multi-channel with pressure transducers (2 Nos) • Variable speed drives for wind tunnel • FFT analyzer • Computer interface • Environmental wind tunnel (2.0m x2.0m, low speed) with instrumentation for pollution dispersion studies	• 6 ports 532 nm diode laser (1 No) • Laser Doppler Anemometry (3D) with PDA for flow and particle velocity measurements • Air cooled pulsed laser (250 mJ)

2.7 Course file for each course for the last five years

Available with instructor of the course

2.8 Study Materials prepared course wise

AML 100:

- Engineering mechanics (Textbook) prepared by Prof. P. C. Dumir and Prof. Veeravalli.
- Beer, F. P., Johnston, E. R., Mazurek, D. F., Cornwell, P. J., and **Sanghi S.** Vector Mechanics for Engineers, Statics|Dynamics, McGraw Hill, Tenth Edition, 2013.
- Beer, F. P., Johnston, E.R., DeWolf, J. T., Mazurek, D. F. and **Sanghi S.** Mechanics of Materials, McGraw Hill, Sixth edition, 2012 (Global edition adoption author).

AML120:

Materials Science: Course slides prepared and made available on aml120.wikidot.com.

AML 811/812:

- **Dewan A**, 2011, Tackling Turbulent Flows in Engineering, p. 124, Springer, Germany (This book was one of the top 50% most downloaded eBooks in the relevant Springer eBook collection in 2012).
- **Sanghi, S.**, Gupta, V. and Gupta, S.K., Teacher's Manual for Gupta and Gupta: Fluid Mechanics and its Applications, New Age International Publishers, New Delhi, Second edition, 2010.

2.9 Research and Innovation in teaching and learning processes

While our faculty members have been engaging in different experiments in pedagogy, there has been no formal pedagogical research in the department.

2.10 Number of students who have spent at least a semester at another university/institute

3 over the last 5 years

2.11 Number of students from overseas universities who have taken classes, done project works or internship in the department

U.G : 5 (have taken classes)
P.G : 2 (1 intern, 1 PhD student) in the last 5 years.

2.12 Course feedback

Since 2010, the detailed feedback for each course is available online. The data before that is available with the Head of the department.

Our faculty members have consistently received exceptional feedback for their teaching over the years. Our courses at both the U.G and P.G levels are very popular for the value they provide and for their rigor.

Apart from alumni feedback which we have received from B.Tech students who took our courses, a very simple measure for the quality of our teaching has been the teaching awards that our faculty members have received ever since the "**Excellence in Teaching**" awards were formally instated. These awards are based on the course feedback in each course. In the 4 years since the awards have been started, at least one faculty member in our department has received the award each year and one-third of our faculty members have won the award over just the last 4 years

The number of faculty members receiving the award each year since the award was formally started has been listed below

Year	2010 -11	2011 -12	2012 -13	2013 -14
No. of Awards	1	3	1	2

The courses for which the above awards have been given with the number of students also show the range of subjects and the varied class sizes over which our excellence in teaching persists

1. AML 110 : Mechanics (300 students)
2. AML 120 : Material Science (300 students)
3. AML 160 : Fluid Mechanics (150 students)
4. AML 360 : Engineering Fluid Mechanics (20 students)
5. AML 702 : Applied Computational Methods (25 students)
6. AML 705 : Finite Element Methods (75 students)
7. AML 812 : Turbulent Shear Flows (20 students)

The ratio of award winning faculty to the number of faculty members is probably the highest in the institute, reflecting the department's commitment to excellence in teaching. Apart from this, the experienced faculty members in our department have also been regular recognized by alumni through the "*Honour the Mentor*" program.

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

UG : NA
PG : Series of lectures by Mr. Yunus Patel on industrial Design.

2.14 Industry exposure to students- Course related visits to factories, sites, industry exhibitions, field trips etc.

The Product Design and Feasibility Study courses have all the students regularly visiting the field and industries. These are typically unsupervised visits and students do this as part of the design challenge to get the full experience of developing a product and performing market study.

RESEARCH

3

Introduction and Executive Summary: Research

The department of Applied Mechanics has a healthy and synergistic mix of faculty from a variety of disciplines such as Aeronautical & Aerospace Engineering, Civil Engineering, Mechanical Engineering and Materials Science and Metallurgy.

The faculty members of the department engage in a blend of fundamental and applied research. The broad areas of research in which they have been active are *Biomechanics, Fluid Mechanics & Heat Transfer, Materials Science and Solid Mechanics*. Research impetus in the area of Biomechanics has been boosted with our recent faculty recruitments. Some research has also been undertaken in Ship Design, Renewable Energy and Engineering Design Methodology.

In keeping with the vision of the department the following thrust areas have been identified for the next five to ten years.

1) Bio-mechanics and soft materials
2) Engineering and Scientific Computing
3) Multi-functional Materials and Structures.
4) Structure, Processing and Mechanical Behaviour of Advanced Materials
5) Turbulent Convection, Dispersion and other Transport Processes.

The department appreciates that there are two approaches to research; one with a focus on fundamental problems of long term interest and larger gestation period; and the other with a focus on current and applied problems. For the long term health of the department and the institute, it is essential that both approaches are nurtured. Faculty members may then choose one or the other or even both. With this in mind, we plan to conduct brainstorming sessions/workshops to develop qualitative and quantitative metrics to assess and monitor our progress. These will be presented in the next review exercise. For the present, we will be following the format specified by the Institute with comments highlighting the areas where we feel more thought is required.

The quantitative data in brief: (All data are presented for the past 5 years)

i.	Total number of M Tech & Masters students graduated:	**195**	
ii.	Total number of DIIT students graduated:	**98**	
iii.	Total number of Ph.D. students enrolled/graduated:	**66/38**	
iv.	Total number of journal papers published:	**247**	
v.	Total number of sponsored projects undertaken:	**30**	(**Rs. 16.40 crore**)
vi.	Total number of consultancy projects undertaken:	**256**	(**Rs. 6.55 crore**)

Details on the above are provided in the sections that follow.

3.1 Doctoral and Masters Students Supervised

Table 01 summarizes the number of PhD and M Tech students supported by the department over the last five years. The detailed tables (Table 0-7 to Table 0-9) highlighting the research areas of currently enrolled PhD students and their advisors presents a detailed picture of the varied fields of work and the interdisciplinary nature of ongoing research in the department.

Table 3-1: Summary of PhD students and M Tech Students currently enrolled*

(See Table 0-7 to Table 0-9) for topic of PhD research highlighting diverse areas of research)

Type of Assistantship	**PhD**	**M Tech**
Institute assistantship	28	(2013-2015): 36 (2012-2014): 44
Sponsored projects/consultancies	4	-
Other sources	34	6
Total	66	86

3.2 No. of PhD enrolled and graduated per faculty for last 5 years

Table 3-2 summarizes number of PhD students enrolled and graduated in the period 2009 to 2013. Also see Table under Section 2.2

Table 3-2: Details of PhD students enrolled (2009-2013)

Year	PhD students enrolled on Institute Assistantship	PhD students graduated
2013	8	4
2012	11	7
2011	4	10
2010	5	6
2009	6	11
Total	**34**	**38**

3.3 Area of Research

As highlighted earlier, our department faculty works in diverse areas which fall under the broad category of solid mechanics, fluid mechanics, materials science, and naval construction. Individual area of research of each faculty (in alphabetical order by last name) is listed below.

Table 3-3: Research expertise of faculty

ARVIND AGARWAL (University of Tennessee, USA)	Carbon Nanotube, Nanotube Reinforced Nanocomposites and Coatings, Thermal Spray Techniques, Surface Engineering, Bioceramic Coatings, Nanomechanics and Nanotribology, Processing of Bulk Nanostructured Materials, Near Net Shape Processing and Rapid Prototyping, Laser Materials Processing and Synthesis, Bulk Metallic Glassy Coatings
SUHAIL AHMAD (IITDelhi)	Off-shore Structures, Structural Dynamics, Computational Solid Mechanics , Risk and Reliability, Stochastic Composite Behavior, Low velocity and ballistic Impact
MURALI R CHOLEMARI (IISC Bangalore)	Turbulent Flows, Optical Flow Measurement, Applied Fluid Mechanics.
ANUPAM DEWAN (IISC Bangalore)	Computational Fluid Dynamics & Heat Transfer, Modeling of Engineering Turbulent Flows, *Renewal energy, Heat Transfer Enhancement*.
SRIRAM HEGDE (IIT Delhi)	System Programming, Finite Element Analysis, FE Mesh Generation, CAD and CAM, Heat Transfer, Hydrodynamic Stability.
JAYANT JAIN (Univ. of British Columbia, Canada)	Mechanical behaviour of materials, alloy design, microstructure-property relationship, microstructure manipulation, characterization of materials, phase transformations, texture and anisotropy of materials, thermo-mechanical processing, crystal plasticity simulations, *Processing and properties Hybrid materials, corrosion behavior of materials , high temperature of materials*
SANTOSH KAPURIA (IIT Delhi)	Smart Piezolaminated Composite and Sandwich Structures, Thermo-Mechanical Response of Functionally Graded Structures, Boundary Layer Stresses in Anisotropic Laminates, Lamb-Wave Based Structural Health Monitoring, Active Vibration Control, Computational Mechanics, Smart Controllable Pitch Propeller using SMA, Biomechanics
AJEET KUMAR (Cornell, USA)	*Nonlinear elasticity theory of Rods*, Plates and Shells, Stability and Bifurcation, Crystal elasticity, *Computational materials science*; Mechanics of helical nano-structures (carbon nanotubes, DNA, bio-molecules, etc.), Multi-objective optimization, *Atomistic modelling of materials, Nano mechanic, Mechanics of Adhesion*
PUNEET MAHAJAN (Montana State, USA)	Finite Element Methods, Composites and Low Velocity Impact Behaviour, Snow Mechanics, *Composite mechanics, Helmet Impact, Impact of composites, Simulation of Glass moulding*
BADRI P PATEL (MNIT Allahabad)	Nonlinear Static/Dynamic Analysis of Shells, FEM, Composite Structures, Functionally Graded Structures, Smart Structures, Bimodular Composite Structures, *Continuum Damage Mechanics, Non linear dynamics of beam, plates and shells, Multi-Scale Modelling of Nano-Structures*

ANAMIKA PRASAD (MIT, USA)	Cardiovascular Biomechanics, Medical Image Processing & Patient Specific Analysis, Analysis of medical devices, mechanics and failure of biological tissue, Mechanics and micro-mechanism of deformation of engineering materials, Nano-mechanical testing (nanoindentation, nano-scratch tests.
RAJESH PRASAD (Cambridge, UK)	Physical Metallurgy, Elastic Effects in Phase Transformations, Amorphous and Metastable Phases, Structure of Solid-Solid Interfaces, Thin Films.
PRADYUMNA S (IIT Kharagpur)	Functionally Graded Materials, Structural Dynamics, Stability, Composite Structures, Smart Structures, Plates and Shells, *Mesh Free Methods, Layer-wise Theory of sandwich structure*
SANJEEV SANGHI (City Univ., USA)	Numerical and Analytical Studies of Turbulent Flows, Chaos and Dynamical Systems, Computational Fluid Dynamics, FEM, Educational Software
D K SEHGAL (IIT, Delhi)	Numerical and Experimental Stress Analysis, Finite Element Methods in Solid Mechanics, Optimum Shape Design
S N SINGH (IIT Delhi)	Fluid Mechanics, Internal Flows, Computational Fluid Dynamics, Two-phase Flows, Flow Instrumentation
M K SINGHA (IIT Kharagpur)	Nonlinear Finite Element analysis, Nonlinear Dynamics of composite structures, Impact Mechanics, High Strain Rate Behaviour of Materials
BALAJI SRINIVASAN (Stanford, USA)	Computational and Theoretical Fluid Mechanics, Numerical Analysis, Turbulent Flows, Interfacial Flows, *Jet impingement heat transfer, Large Eddy Simulation*
SITIKANTHA ROY (Utah State, USA)	Mechanics of biological growth, Constitutive modelling of cell material, Mechanics of drug delivery, polymer coating etc, Biomedical Energy Harvesting.
Sawan Suman (Texas A&M, USA)	Compressible turbulence: Theory and Modelling, Hypersonic Flows, Turbulence-Chemistry Interactions, Partially-Averaged Navier-Stokes (PANS) Method, Boltzmann Equation-based Solvers
VIKRANT TIWARI (South Carolina, USA)	Digital Image Correlation, Impact Mechanics, Failure Analysis, Dynamic Fracture Mechanics, Product and system design, Fuel Cells
SV VEERAVALLI (Cornell)	Experimental Investigation of Turbulent Flows, Pollutant Dispersion, Stability Theory, Design Methodology of Dams

Table 0-4: Expertise of Naval faculty at AM

CAPT. PR KULKARNI ***MSc(Naval Arch.UCL, UK), PhD(IIT/D)***	Ship hydrodynamics, ship dynamics, ship aerodynamics, ship structures, CFD
CDR. R. VIJAYAKUMAR PhD (IIT, Delhi)	Computational Fluid Dynamics, Ship Hydrodynamics, Warship Design
LT CDR ISHAQ S MAKKAR M Tech(IIT Kgp), DIIT (IITD)	Submarine Design, Computational Fluid Dynamics (CFD), Underwater Technology.
LT CDR B. PRAVEEN ***M Tech(IIT Kgp), DIIT(IITD)***	Naval Architecture, Hydrodynamics.

3.4 New Areas of Research

The thrust areas that the department would like to focus on in the next five years have been presented in the Introduction to this section. Each group in turn deliberated on their specific goals for the next five to ten years. These are presented below.

3.4.1 Design Engineering

The group will try to induct at least two new faculty members who will undertake research in design methodology and tools, introduce courses in architecture design, product evaluation, complexity analysis etc., and act as a core of the group. The existing members will take up research projects leading to products, e.g. in biomedical devices, improvised helmets, structural health monitoring hardware and software etc.

3.4.2 Fluid Mechanics:

With the successful completion of a FIST (2008 to 2013) project the group is well equipped with the latest diagnostic tools (PIV, micro PIV, LDV and HWA) and a 96-node cluster for computational work. We are also currently undertaking renovation and enhancement of the 2m x 2m environmental Wind Tunnel. Armed with these the group hopes to address a wide variety of problems related to turbulent convection, turbulent dispersion, drag reduction, compressible turbulence, multi-phase flows, slurry transport, fluid-structure interaction and hydrodynamic stability theory.

In keeping with the spirit of the overall vision of the department of Applied Mechanics the Fluids Group is very keen to explore applied problems with more direct relevance to society and the country. One of the projects which we wish to undertake in the immediate future is a comprehensive study of wind turbine farms with a view to optimising their performance and understanding possible long-term environmental impacts.

Some of the capabilities/facilities we plan to develop in the next five years are:

1. A low noise water-tunnel facility for flow visualization and optical diagnostics.
2. Lagrangian measurements (PTV).
3. A pilot Vertical Axis Wind turbine Farm.
4. Novel modelling strategies for Compressible Turbulence
5. In-house specialized codes for external aerodynamics

3.4.3 Materials Science:

Based on the research expertise of current faculty at AM@IITD, emerging global research areas of energy and needs of growing Indian industry, following broad research thrusts will be emphasized at IITD.

1. Structure, properties and processing of advanced materials: Multi-scale microstructure design and engineering of structural materials and alloys for improved mechanical properties.
2. Advanced nano-composites and functional coatings
3. In-situ characterization of materials at multiple length scale
   Computational Applications in Materials Science and Engineering

3.4.4 Solid Mechanics:

Traditionally the group has been strong in computational and theoretical mechanics. Computational tools such as Finite Element (FE) have been used extensively in modelling mechanical behaviour and dynamic response of composites and other structures. New theories in plates and shells for analysing composites, thermal buckling, damage mechanics, micromechanics, solid-fluid interaction, structures for deep off-shore oil and gas exploration, low and high velocity impact of materials, system safety and reliability assessment are some areas where the group continues to contribute in a major way. Lately, the group is diversifying into areas such bio-mechanics and multi-scale modelling. Understanding mechanics of cell and designing medical implants are the areas in which department intends to take a lead. The group will be vigorously involved in continuum modelling of nanostructures (CNTs, DNA, graphene sheet, magnesium alloys etc.) and their composites using multi-scale methods. The group has access to high speed computational platforms, computational packages in FE, image processing, molecular dynamics and solid-fluid interaction software.

The group has been actively interacting with number of defence and research laboratories in the country. Many research scholars working in these laboratories are pursuing their graduate studies in the department working on problems of national interest under the guidance of faculty. The experimental facilities in the group are high speed camera and DIC, AFM, impact tester.

Some of the capabilities/facilities we plan to improve / develop in the next five years are:

1. Bi-axial, Fatigue and high temperature material testing facility
2. Hopkinson pressure bar, shock tube and High velocity gun
3. Structural health monitoring and vibrations laboratory
4. Biomechanics laboratory
5. Fabrication and testing of armour grade composites
6. Multi-scale computational models for analyzing nano-composites and composites.

3.4.5 Naval Construction Wing:

The future work in research will be directed in the following areas:

(a) Develop the concept design and prototype of an autonomous underwater Glider.

(b) Develop new experimental facilities in areas of hydrodynamics in the new IIT Delhi campus, to further strengthen the capabilities of Applied Mechanics Department.

(c) Undertake research in the following areas:-
   (i) Ship-Aerodynamics Studies for safe Helicopter-Ship interaction.
   (ii) CFD studies of ship hull forms for optimization of hydro-dynamically induced vibrations & noise.

(d) Facilitate enhanced Industry Academia interaction between design organizations of Indian Navy and IIT Delhi.

(e) Increase collaboration with institutions in India, working in the area of applied research for underwater gliders/AUVs, CFD in hydrodynamic parameters evaluation, materials for marine structures) such as IIT Kharagpur, IIT Madras, NIRDESH, NRB, NSTL, NMRL, NPOL etc

(f) Come out with the following publications:
   (i) NCW submarine design procedure.
   (ii) NCW ship design data book.

3.4.6 Publication

The publication of individual faculty members in the last 5-years (2009-2013) as well as total publications during their career is summarized in

Table 0-5.

Table 3-5: Summary of publication per faculty for the period 2009-2013

No	Faculty	Position	Total (last 5 years)		Total (all years)	
			Journals	**Conference**	**Journals**	**Conference**
1	Arvind Agarwal[1]	Professor	94	56	162	141
2	Suhail Ahmad	Professor	11	36	54	111
3	M R Cholemari	Asst. Professor	2	2	5	5
4	Anupam Dewan	Professor	23	9	49	39
5	S Hegde	Sr. System Prog	1	4	12	11
6	Santosh Kapuria	Professor	34	27	102	46
7	Puneet Mahajan	Professor	18	12	47	40
8	B P Patel	Assoc. Professor	22	26	94	67
9	Rajesh Prasad	Professor	4	14	17	38
10	Sanjeev Sanghi	Professor	10	9	30	56
11	DK Sehgal	Prof. Emeritus	10	10	42	63
12	P K Sen	Prof. Emeritus	14	9	58	60
13	S N Singh	Professor	29	28	146	161
14	Maloy K Singha	Assoc. Professor	18	24	34	32
15	Balaji Srinivasan	Asst. Professor	4	6	6	8
16	S V Veeravalli	Professor	2	4	23	44
Recently (2009-2013) joined faculty members of the Department (In order of joining):						
17	Pradyumna S	Asst. Professor	12	5	13	16
18	Vikrant Tiwari	Asst. Professor	5	5	10	15
18	Sitikantha Roy	Asst. Professor	4	2	12	9
19	Sawan Suman	Asst. Professor	9	8	9	12
20	Jayant Jain	Asst. Professor	6	6	12	8
20	Ajeet Kumar	Asst. Professor	8	5	9	5
22	Anamika Prasad	Asst. Professor	3	11	4	14
Recently retired faculty members continuing / associate with the department						
24	R K Pandey		10	10		
25	N K Gupta		22		123	
26	V Seshadri		18	25		
27	R K Mittal		5	5		
28	Y Nath		22	26		
TOTAL			**251***	**258**	**876**	**849**

*Total publication in journal by the department (22 faculty members) in last five years is 247. The total count excludes the common papers (10: PKS+SNS, 18: VS + SNS, 03: AD+BS, 01: PM+SA, 01: AD+SS, 04: MKS + NKG, 10: RKP + DKS, 22: BPP + YN, 5: PM + RKM).

*Number of publications in SCI journals (from SCOPUS) is **224**

[1] Joined in 2014 and hence excluded from total count

3.4.7 Best Papers in last 5 years

We present the best three papers published by each faculty member in the last five years.

S. Ahmad:

- Mohammed J., Ahmad S., Saiful Islam A. B. M., Mohd. Jumaat Zamin, and Kurian V. J. 2013,Non-linear dynamic analysis of coupled spar platform, *Journal of Civil Engineering and Management*, Volume 19, Issue 4.
- Saiful Islam A.B.M., Mohammed J., Ahmad S, Mohd Jumaat Zamin and Kurian V. J. 2013, Structural behaviour of fully coupled spar–mooring system under extreme wave loading, December 2013, *Journal of Civil Engineering and Management,* 19, pp. S69-S77.
- Islam Nazrul, Zaheer Moonis, and Ahmad Suhail, 2009, Double-hinged Articulated Tower Interaction with Wind and Waves, *Journal of Wind Engineering and Industrial Aerodynamics,* Vol 97, pp 287-97.

M. R. Cholemari:

- Cholemari M R and Arakeri J H, 2009, Axially homogeneous, zero mean flow buoyancy-driven turbulence in a vertical pipe, *J. Fluid Mech*. 621, 69-102.

A. Dewan:

- Kumar R., and Dewan A., 2014, Computation of turbulent thermal plumes: Recent Advances and Challenges. *Heat Transfer Engg.* 35 (4), pp. 367-383.
- Dutta R., Srinivasan B. and Dewan A., 2013, LES of Turbulent Slot Impinging Jet to Predict Fluid Flow and Heat Transfer. *Numerical Heat Transfer: Part A Applications,* 64, pp. 759-776.
- Dewan A., Dutta R., and Srinivasan B., 2012, Recent Trends in Computation of Turbulent Jet Impingement Heat Transfer*, Heat Transfer Engineering,* 33 (4–5) , pp. 447–460.

S. Kapuria:

- Kapuria S, Kumari P, 2013, Extended Kantorovich method for coupled piezoelasticity solution of piezolaminated plates showing edge effect. *Proc Royal Society A: Math, Physical and Engg. Sciences*469: 20120565, pp. 1-19.
- Kapuria, S, Yasin MY, 2010, Active vibration suppression of multi-layered plates integrated with piezoelectric fiber reinforced composites using an efficient finite element model. *Journal of Sound and Vibration, 329*, pp 3247-3265.
- S. Kapuria, J. K. Nath, 2009, Efficient laminate theory for prediction of transverse shear stresses in piezoelectric composite plates, American Institute of Aeronautics and Astronautics (*AIAA) Journal*, 47(12), pp 3022-3030.

P. Mahajan:

- Sharma R, Mahajan P and Mittal RK, 2012, Fiber bundle push-out test and image-based finite element simulation for 3D carbon/carbon composites. *Carbon* 50, pp 2717-25.
- Pinnoji PK, Mahajan P, Bourdet N, Deck C and Willinger R, 2010,Impact dynamics of metal foam shells for motorcycle helmets: Experiments and numerical modeling. *International Journal of Impact Engineering* 37(3), pp 274-84.
- Mahajan P, Kalakuntla R and Chandel C, 2010, Numerical simulation of failure in a layered thin snowpack under skier load. *Annals of Glaciology,* 51 (54), 169- 75.

B. P. Patel:

- Gupta AK, Patel BP and Nath Y, 2012, Continuum damage mechanics approach to composite laminated shallow cylindrical/conical panels under static loading. *Composite Structures* 94 (8), pp. 1703-1717.
- Khan B, Patel BP and Nath Y, 2012, Frequency response of bimodular cross-ply laminated cylindrical panels. *Journal of Sound and Vibration,* 327, pp. 55-69.
- Ibrahim SM, Patel BP and Nath Y, 2010, Nonlinear Periodic Response of Composite Curved Beam Subjected to Symmetric and Antisymmetric Mode Excitation. *ASME Journal of Computational and Nonlinear Dynamics,* 5 (2) 021009, pp. 1-11.

S. Sanghi:

- Deshpande, V., Sanghi, S. and Eshpuniyani, B., 2011, Computational Study of Supersonic Flow Over a Flat Plate with Protrusion*, Journal of Aerospace Science andTechnologies*63 (4), pp.266-276.
- Anwer, S. F., Hasan, N., Sanghi, S. and Mukherjee, S., 2009, Computation of unsteady flows with moving boundaries using body fitted curvilinear moving grids, *Computers & Structures,* 87 (11-12) pp. 691-700.
- Qamar, A. and Sanghi, S., 2009, Steady supersonic flow-field predictions using proper orthogonal decomposition technique, *Computers & Fluids*, 38 (6) pp. 1218-1231.

D K Sehgal:

- Pathak KK and Sehgal DK, 2010, Gradientless Shape Optimization using Artificial Neural Networks", Journal of Structural and Multidisciplinary Optimization, 41 (5), pp 699-709.
- Reddy K H, Partheepan G, Pandey R K and D.K.Sehgal D K, 2011, Use of Miniature Specimen Test and Finite Element Method for Evaluation of Yield Strength and Fracture Toughness in Metallic Alloys, ASTM Journal of Testing and Evaluation, 39 (1).

P K Sen:

- Padma Vasudevan, Mamta Tandon, P.K. Sen and S.N. Singh (2013), "Floating wetlands: Comparison with horizontal flow constructed wetland", Int. J. Environmental Sciences. Vol. 1 (2), 159-171
- Vasudevan, P., Sen, P.K., Singh, S.N., Singh, P., Davies, P. and Dey, P.K. (2013). Trigeneration Using Solar and Biomass Energy for Sustainable Development. International Journal of Energy Sector Management, Vol. 7, No. 3, pp. 309-320.

S. N. Singh:

- Patel VK, Singh SN and Seshadri V, 2013, Effect of Blockage and Location on Mixing of Swirling Coaxial Jets in a Non-expanding Circular Confinement, *Int. Journal of Turbo & Jet Engines.*
- Pradhan AK, Das D, Chattopadhyay R and Singh SN, 2012, Effect of 3D fibre orientation on transverse permeability and filtration efficiency of fibrous filter media, *Physics of Fluids*
- Das D, Pradhan AK, Chattopadhyay R and Singh SN, 2012, Composite Nonwovens, *Textile Progress*, Vol. 44, No. 1, 1–84

M. K. Singha:

- Prakash T, Singha MK and Ganapathi M, 2012, A finite element study on the large amplitude flexural vibration of characteristics of FGM plates under aerodynamic load, *International Journal of Non-linear Mechanics*, 47 (5), pp-439-47.
- Singha MK and Daripa R, 2009, Nonlinear vibration and dynamic stability analysis of composite plates, *Journal of Sound and Vibration,*328, pp-541-554,

B. Srinivasan:

- Srinivasan B, Jameson A, Krishnamoorthy S, 2012, An upwinded state approximate Riemann solver*, International Journal for Numerical Methods in Fluids,* Vol 70, pp 578-602.

S.V. Veeravalli:

- Gopinath K and Veeravalli S V, 2011, Auto-regulative Capability of Pot/Pitcher Irrigation, *NISCAIR-CSIR, India.,* Vol. 70(08).
- Yelmule M. M., Kale S. R. and Veeravalli S. V., 2009 Aerodynamics of a bus with open windows, *Intl. J. of Vehicle design*, Vol. 16, No. 4, pp.459–88.

S. Pradyumna:

- Pradyumna S and Gupta A, 2011, Nonlinear dynamic stability of laminated composite shells integrated with piezoelectric layers in thermal environment, *Acta Mechanica,* 218, pp. 295-308.
- Pradyumna S and Bandyopadhyay JN, 2011, Dynamic instability behavior of laminated hypar and conoid shells using a higher-order shear deformation theory, *Thin-Walled Structures,* 49, pp. 77-84.

V. Tiwari:

- Tiwari V, Sutton MA, Mcneill SR, Xu S, Deng X, Fourney WL, Bretall D, 2009, Application of 3D image correlation for transient plate deformation measurements during blast loading. *Int. J of Impact Eng.,*36: 862-74.

S. Roy:

- Roy S and Qi H J, 2010, A computational biomimetic study of cell crawling, Biomech Model Mechanobiol, 9: 573–581.
- Roy S and Qi H J, 2008, Micromechanical model for elasticity of the cell cytoskeleton, Physical Review, E 77, 061916.

Sawan Suman:

- Suman S and Girimaji SS, 2011, Dynamical model for velocity-gradient evolution in compressible turbulence, *Journal of Fluid Mechanics*, 683, pp. 289-319.
- Suman S and Girimaji SS, 2009, Homogenized Euler equation: a model for compressible velocity gradient dynamics, *Journal of Fluid Mechanics,* 620, pp. 177-194.

J. Jain:

- Jain J, Cizek P, Poole W J, Barnett M R, 2013, Precipitate characteristics and their effect on the prismatic-slip-dominated deformation behaviour of an Mg–6 Zn alloy. *Acta Materialia 61*, pp. 4091-4102.
- Jain J, Poole W J, Sinclair C W, 2012, The deformation behavior of the magnesium alloy AZ80 at 77 and 293 K. *Materials Science and Engineering* A, 547, pp. 128–137.
- Jain J, Poole W J, Sinclair C W, Gharghouri M A, 2010, Reducing the tension-compression yield asymmetry in a Mg-8Al-0.5Zn alloy via precipitation. *Scripta Materialia*, 62: 301.

Ajeet Kumar:

- Kumar Ajeet, Mukherjee Subrata, Jeffrey T. Paci, Chandraseker Karthick, George C. Schatz. 201, A rod model for three dimensional deformations of single-walled carbon nanotubes. *International Journal of Solids & Structures,*48 2849-58.
- Kumar Ajeet, Mukherjee S, 2011, A Geometrically exact rod model including in-plane cross-sectional deformation, *ASME Journal of Applied Mechanics*, 78, 011010.
- Ajeet Kumar, Alex Vladimirsky, 2010, An efficient method for multiobjective optimal control and optimal control subject to integral constraints, *Journal of Computational Mathematics,* 28, pp-517-551.

Anamika Prasad:

- Prasad A, Xiao N, Gong XY, Zarins CK, Figueroa CA, 2012. A Computational Framework for Investigating the Positional Stability of Abdominal Endografts, *Biomechanics in Modeling and Mechanobiology*, Nov 2012
- Prasad A, To LK, Gorreparti ML, Zarins CK, Figueroa CA (2011). Computational Analysis of Stresses Acting on Inter-Modular Junctions in Thoracic Aortic Endografts*. Journal of Endovascular Therapy*, Vol. 18, No. 4, pp. 559-568.
- Prasad A, Dao M, Suresh S (2009). Steady-State Frictional Sliding Contact on Surfaces of Plastically Graded Materials. *Acta Materialia*, Volume 57, Issue 2, pp. 511-524.

3.8 A Model for Qualitative Assessment

As mentioned in the introduction to this section, the department is keen to nurture both fundamental and applied research. One very important issue that needs attention is the assessment of research contribution across these two categories, especially qualitative assessment.

A research assessment committee was set up by IIT Delhi in the wake of the Golden Jubilee Workshop on Taking Research at IIT Delhi to New Heights. One of the recommendations of the committee was that papers be graded as per the matrix shown below (faculty members can choose to be graded on either the Academic Significance scale or the Social Impact scale). The exercise would consist of two stages; self-assessment by the individual faculty member, followed by assessment by an expert committee set up by the department. **The recommendations of this Golden Jubilee committee are still to be debated across the Institute and accepted and hence what is being presented here is one possible model for the exercise of qualitative assessment.**

Category	Originality	Academic Significance	Social impact and relevance
5	Theoretical/numerical work that addresses a problem that has remained open for a long time OR Experimental work relating to the discovery of a new phenomenon.	Has been widely adopted by the academic community, with other scientists and engineers further building on the fundamental thesis of the published work.	Has solved a major, previously unsolved problem of national importance thus making major positive impact on the quality of life of a very large number of people
4	Competent original solution of an important problem OR a valiant attempt at a tough open problem OR an archival experiment.	Has been chosen by the academic community as the method of choice for solving the given class of problems.	Has solved a previously unsolved problem of national importance, thus making positive impact on the quality of life of a number of people
3	Extending a known method (theory/ computation/ experiment) to a new class of problems.	Has emerged as a popular method for solving the given class of problems.	Has created an improved solution for a major problem of national importance
2	Routine advanced research. Competent, (gap-filling) up-to-date work but not of great significance or lasting value.	Has been used by other researchers as well.	Has created an improved solution for a problem of national importance
1	Very mediocre work (addressing irrelevant questions) OR Technically flawed.	No evidence of anyone else finding use for the proposed approach.	Beneficiaries of the created product/ approach unclear.

Such an exercise, though time-consuming, would be absolutely essential to help us assess the intervention made by our research in a particular discipline and therefore the contribution of the department's research as a whole. We hope to carry out such an exercise before the next review.

3.9 Funding

The details of various projects and sponsors are given in Table 3-10 to Table 3-12.

- Table 0-10 gives details of research projects sponsored by external agencies. The total number in this category is **30** with an aggregate funding of **Rs. 16.40 crore**.
-
- Table 0-11 gives details of research projects sponsored from internal IIT Delhi sources. The total number in this category is **17** with an aggregate funding of **Rs. 54.9lakh**.
-

- Table 0-12 details of industrial consulting projects. The total number in this category is **256** with an aggregate funding of **Rs.6.55crore**.

3.10 Large Interdisciplinary projects undertaken

As can be seen from

Table 0-10 which list all externally sponsored research projects, several of these projects are interdisciplinary with PI/CO-PI team varying across departments at IIT and outside. Top 5 interdisciplinary research project (in terms of funding) are listed below.

NO	Project Title	Sponsor	Total Funds	PI/Co-PI	Start Date	End Date
1	Bio-energy: Technology and Business Solutions for the UK and India	DST (INT)	68,270,000	SN SINGH, PK SEN (Co-PI), KK PANT (Co-PI), R SHANKAR (Co-PI), SN NAIK (Co-PI), VK VIJAY (Co-PI)	2009	2014
2	Developing Virtual and Physical Teaching Models for Mathematics Laboratory	SCERT Haryana	5,988,000	S HEGDE (PI), A Tripathi (Co-PI), MR Ravi (Co-PI), NB Bolia (Co-PI), R Prasad (Co-PI), B Srinivasan	2013	2015
3	Development of an Associate Node for Computational Fluid Dynamics at IIT Delhi	AERO (DEFENSE)	4,207,000	SN SINGH, Ratan Mohan (Co-PI), MR Ravi (Co-PI), B Srinivasav (Co-PI), S Sanghi (Co-PI), CV Ramakrishnan (Co-PI), V Sehsadri (Co-PI)	2009	2013
4	Integrated Technology System for Phytoremediation of Domestic Wastewater with Floating Reed Beds: R&D and Pilot Testing	RGIDWM	3,207,840	SN SINGH(PI), PK Sen (Co-PI), S Hegde (Co-PI), S Sharma (Co-PI)	2013	2015
5	Development of Indigenous Membrane Bioreactor (MBR) using Submerged Flyash membranes and its Application for Municipal Wastewater Treatment	DST	2,849,610	SV VEERAVALLI, MR CHOLEMARI(Co-PI), TR SREEKRISHNAN (Co-PI)	2009	2013

3.11 Improving Quality of PhD and M. Tech Programs

The following specific plans were formulated for improving the quality of our M. Tech and Ph.D. programs.

1. To align with the changes at international level, it is aimed to re-design the course structure of our M. Tech. programmes in Engineering Mechanics and Design. Several post-graduate level advanced courses catering to emerging areas of research will be developed.

2. A set of assignments in basic areas (solids, fluids and computational mechanics) will be put up on the web for incoming M. Tech. and Ph.D. students. The students will be asked to submit these assignments at the time of joining. This will make the students aware of the level expected of them at the time of joining.

3. The department timetable will be designed to accommodate a weekly seminar. This will give our graduate students exposure to quality research within the country and abroad. This will also allow graduate students to interact among themselves as well as with the faculty body serve the aim of inculcating good academic culture in our students.

4. The department timetable will be designed to accommodate a weekly seminar. This will give our graduate students exposure to quality research within the country and abroad. This will also allow graduate students to interact among themselves as well as with the faculty body and serve the aim of inculcating good academic culture in our students.

   Design Engineering Programme: This program has been consistently attracting good students, and is one of the most popular M. Tech. programs of the Institute among the students as well as industries. However, product design is becoming increasingly interdisciplinary, often requiring the knowledge of electronics, instrumentation and signal processing etc. in addition to solid mechanics, fluid mechanics and materials science. Besides, a new Design and Innovation Centre is coming up in the institute with the mandate of supporting projects leading to development of new products. Our program must take full advantage of this upcoming facility, and in fact strengthen it. With this view, a restructuring of the Design program will be carried out within the following guidelines:

   a) Introduce a course on electronics/electromechanical systems as a core course of the program.
   b) Allow (and encourage) the students to undertake projects from the upcoming Design and Innovation Centre, which will be compulsorily joint projects bringing in at least two students of different backgrounds.
   c) Allow the students to undertake projects from other departments if it is product related.
   d) Invite design engineers from industry as visiting professors to give lectures on design.

   Materials Science Group: To train new generation of engineers and researchers in Materials Science, we would like to introduce initially an M Tech Program in Materials Science and Engineering. This initiative will be eventually extended to offer BTech Program. This should be given a very high priority as IIT-D is the only one among older IIT'S not having such programs.

3.12 Methodology for identifying obsolesce in research areas and identifying new areas of research

While formulating the Vision for the next five years a very intense brain-storming exercise was carried out over several months. The process involved many sessions in groups of four to five and several sessions in which the entire faculty body was involved. This helped us identify the overall research goals of the department and therefore the thrust areas that needed to be fostered. The list presented in the introduction is one of the outcomes of this process. We wish to undertake this exercise periodically (every three to five years) in order to identify relevant new areas of research and simultaneously weed out obsolescent areas.

3.13 Annexure(Tables)

Table 3-6: Various Funding sources and their Acronyms

AERO (DEFENCE)	Aeronautics R&D Board (Ministry of Defence)
DEFENSE	Ministry of Defence
DRDO (DEFENCE)	Dept of Research and Development (Ministry of Defence)
DST	Department of Science and Technology, Govt. of India
DST (INT)	International Division, Dept. of Science & Technology.
NRB (DEFENCE)	Naval Research Board, Ministry of Defence
SERB	Scientific and Research Board (DST)
RGIDWM	Rajiv Gandhi National Drinking Water Mission
UKIERI	UK-India Education & Res. Initiative

Table 3-7: Details of PhD students enrolled on Institute Assistantship

No	Student	Assistantship	Topic/Area of Research	Supervisor	Year of Reg.
1	Raushan Singh	Institute	Mechanics of Adhesion	A Kumar	2013
2	Sakshi Chauhan	Institute	Biomechanics of Bone	A Prasad	2013
3	Shanta Mohapatra	Institute	Deformation & recrystallization behaviour of magnesium alloys,	J Jain	2013
4	Anuz Zindal	Institute	Effect of Yttrium addition on deformation behaviour of magnesium alloys	J Jain and R Prasad	2013
5	Adnan Ahmad	Institute	Modeling Delaminations in Smart Piezolaminated Structures	S Kapuria	2013
6	Pritanshu Ranjan	Institute	Computation of Turbulent Convective Heat Transfer	A Dewan	2012
7	Sandeep Singh	Institute	Multi-Scale Nonlinear Analysis of Nano-Structures	BP Patel	2012
8	Gaurav Singh	Institute	Precipitation and its effects on deformation behaviour of AZ61 magnesium alloy	J Jain and R Prasad	2012
9	Amit Kumar	Institute	Experimental & numerical study of structures under impact & shock loading	MK Singha and V Tiwari	2012
10	Gaurav watts	Institute	Nonlinear dynamic analysis of Sandwich shells using meshless methods	MK Singha and S Pradyumna	2012
11	Mohit Gupta	Institute	Micromechanics of Composites	P Mahajan , Bent Sorensen (DTU)	2012
12	Shashank Pandey	Institute	Nonlinear analysis of Sandwich plate and Shells	S Pradyumna	2012
13	Mohd. Danish	Institute	Compressible turbulence theory	S Suman and B Srinivasan	2012

No	Student	Assistantship	Topic/Area of Research	Supervisor	Year of Reg.
14	Shreya Banerjee	Institute	Asymptotic methodology of electromechanical slender structures	S Roy	2012
15	Viswanath Sivappa	Institute	Biomechanics of breast cancer cells	S Roy	2012
16	Danish Iqbal	Institute	High Strain Rate Characterization of metals under Impact and Shock Loading	V Tiwari	2012
17	Emarti Kumari	Institute	Nonlinear Dynamics of Plates and curved Shell Panels	MK Singha	2011
18	Bandaru Aswani Kumar	Institute	Ballistic Performance and Probabilistic Analysis of Composite Structures	S Ahmad	2011
19	Jitendra Kumar Agrahari	Institute	Structural Health Monitoring with Piezoelectrics	S Kapuria	2011
20	Anubhav Rawat	Institute	Transportation characteristics of high concentration coal ash slurries through pipelines	SN Singh and V Seshadri	2011
21	Ajay Sood	Institute	Drag Reduction using modification of large scales of turbulent flows	MR Cholemari and B Srinivasan	2010
22	Shiv Dayal Patel	Institute	Probabilistic Analysis of Composite Materials under Ballistic Impact.	S Ahmad and P Mahajan	2010
23	Ratnesh Kumar	Institute	Friction stir welding	R Prasad	2010
24	Syed Mohammad Yahya	Institute	Numerical Analysis of turbulent channel flow with high temperature gradients	S Sanghi and SF Anwar (AMU)	2010
25	Rabijit Dutta	Institute	Large Eddy Simulation (LES) of Turbulent Jet impingement heat transfer	A Dewan and B Srinivasan	2009
26	Bhagwat Singh	Institute	Ventilation in Helmets	S Sanghi and P Mahajan	2009
27	Rishav Rajoria	Institute	To be decided	S V Veeravalli and S Ahmad	2013
28	Chandrahas Shet	Part time	Effect of free stream turbulence on the turbulent boundary layer	MR Cholemari and SV Veeravalli	2013

Table 3-8: Details of PhD students enrolled on Sponsored Project/Consultancies

No	Student Name	Assistantship	Topic/Area of Research	Supervisor	Year of Reg
1	Prakhar Gupta	DST-Inspire Fellow	Instability and phase transition in materials at micro and nano scales	A Kumar	2013
2	LokeshRagta	DST-Inspire Fellow	High order methods for compressible flows	B Srinivasan	2013
3	GargiJaiswal	Project	Mechanics of nonwovens	M Singha and D Das (Textile)	2013
4	MehnazRasool	DST-Inspire Fellow	A Numerical Investigation on the Aeroelastic Stability Characteristics of Composite Wings with Follower Forces	MK Singha	2012

Table 3-9: Details of PhD students enrolled on other sources/External Organization

No	Student Name	Assistantship	Topic/Area of Research	Supervisor	Year of Reg
1	Pankaj Srivastava	Part time	Experimental & Computational Turbulent Convective Heat Transfer	A Dewan	2013
2	Ibrahim Rahimi	Self financed	Nanomechanics	Ajeet Kumar	2013
3	VishwasraoPatil	Part time (NCERT)	Experimental study of structural vibrations	M Singha and S Hegde	2013

No	Student Name	Assistantship	Topic/Area of Research	Supervisor	Year of Reg
4	Sanjeev Kumar	Part time (DRDO)	To be decided	R Prasad	2013
5	Amit Kumar	Part time	Enriched Finite Element for Wave Propagation	S Kapuria	2013
6	N. Dhanesh	Part time	Multi-Field Multi-term Extended Kantorovich Method for Boundary Layer Stresses, In Progress	S Kapuria and GGS Achary (EIL)	2013
7	Sanjay Kumar	Part time (DTU)	Investigation of crack propagation under dynamic 3 point bend loading	V Tiwari	2013
8	Sudeep Verma	Part time	Modelling and Simulation of Melting and Solidification Processes	A Dewan	2012
9	Pankaj K Sharma	Part time	Design and Analysis of Double Acting Blast Valve	BP Patel	2012
10	Q.M Amir	Part time	Creep Assessment of Stainless Steel	J Jain	2012
11	Harpreet Singh	Part time (Siemens)	Low velocity impact of composites	P Mahajan	2012
12	Phm Salih	Part time (Indian navy)	Reliability assessment of post repair submarine hull structure	S Ahmad	2012
13	B Praveen	Part time	Flow characteristics over helo decks	SN Singh and V Seshadri	2012
14	A.H Khan	QIP	Nonlinear Dynamics of Bi-modular Material Shells	BP Patel	2011
15	V.K. Pandey	Part time	Fatigue and Fracture of Functionally Graded Materials	BP Patel , Guruprasad	2011
16	N. Kumar	Part time	Visco-elastic Analysis of Propellant Grains	BP Patel , S Chandran	2011
17	Praveen Srivastava	Part time (SASE, DRDO)	Microstructure of Snow	P Mahajan	2011
18	Dharmendra K Shrivastava	Part time (L&T)	Weldability & Mechanical Characterization of Super304 H Steel	R Prasad	2011
19	H. N. Das	Part time	Smart Propeller Design for Naval Ships	S kapuria and C Suryanarayana (NSTL, Vizag)	2011
20	VijaiChaurasia	Part time	Modeling of Storm Water	S Sanghi and AK Mittal (CS)	2011
21	Ranjeet Kumar	Part time	Analysis of Polymeric Polycentric Prosthetic Knee Joint	Naresh Bhatnagar (ME)	2011
22	Manander Singh	Part time (Teaching)	Dynamic response and probabilistic analysis of composite riser.	S Ahmad	2010
23	S Koteswara Rao	Part time (Indian navy)	Large deformations and Probabilistic analysis of structures subjected to underwater blast loads	S Ahmad and NK Gupta	2010
24	Rajesh Kumar	Part time	Mathematical Modelling and Computation of Turbulent Plume	A Dewan	2009
25	Ajay Kumar	Part time	Experimental study of nonlinear dynamics of noncircular shells	BP Patel	2009
26	Atul R Bhagat	Part time (ASL, DRDO)	Interfacial behaviour of Carbon-Carbon	P Mahajan	2009
27	Vivek K Patel	Institute		SN Singh and V Seshadri	2009

No	Student Name	Assistantship	Topic/Area of Research	Supervisor	Year of Reg
28	ChamanChandel	Part time (SASE, DRDO)	Mechanics of snow	P Mahajan	2008
29	Prince Sharma	Part time (TBRL, DRDO)	Ballistic impact on composites	P Mahajan	2008
30	Sandip Kumar	Part time	LES study of wall bounded turbulent flows	M Cholemari and S V Veeravalli	2007
31	Kiran Kumar Namala	Part time	Impact of composites	P Mahajan and N Bhatnagar	2007
32	Pranab K Pradhan	Part time (DRDO)	High Speed Impact of Spherical projectiles on thin plates	S Ahmad andNK Gupta	2007
33	S. Nasiruddin	Part time	Experimental study of the effect of rotation in the turbulent flow pipe	S Veeravalli and S Hegde	2007
34	T. Vijay Kumar	Part time	Stability theory applied to fully developed turbulent wakes	S Veeravalli and PK Sen	2007

Table 3-10: Summary of Sponsored Research projects for the period 2009-2013

Total cost of Sponsored Projects: 16.4crore

NO.	Project Title	Sponsor	Total Funds	PI/Co-PI	Start	End
1	Variational Asymptotic Modeling of Shear Actuator Modelling of Helicopter Rotor Blade	AERO (DEFENSE)	1,520,000	Sitikantha Roy	2014	2017
2	Cell Mechanics: Probing the Mechanical Response of Biological Cell	SERB	2,780,000.0	Sitikantha Roy	2013	2015
3	Determination of Material Parameters for Johnson-cook Constitutive and Damage Model for AA 2014 and Pure Iron	DEFENSE	996,000.0	Puneet Mahajan	2014	2015
4	Large Eddy Simulation of Turbulent Slot Jet Impingement Heat Transfer	SERB	1,700,000.0	A Dewan (PI), B Srinivasan (Co-PI)	2013	2016
5	Study of Deformation Behaviour of Precipitate Containing Mg-6AI-1Zn alloy	DST	2,170,000.0	Jayant Jain (PI)	2013	2016
6	Flow Characteristics of Heated Multi-coaxial Jets	DRDO	1,239,000.0	SN Singh(PI), V Seshadri (Co-PI), A Dewan (Co-PI)	2013	2015
7	Developing Virtual and Physical Teaching Models for Mathematics Laboratory	SCERT Haryana	5,988,000.0	S Hegde (PI), A Tripathi (Co-PI), Mr Ravi (Co-PI), Nb Bolia (Co-PI), R Prasad (Co-PI), B Srinivasan	2013	2015
8	Nonlinear Dynamic Stability analysis of Functionally Graded Plates and shells Using an efficient Meshless Method	DST	751,000.0	S. Pradyumna	2013	2016
9	Integrated Technology System for Phytoremediation of Domestic Wastewater with Floating Reed Beds: R&D and Pilot Testing	RGIDWM	3,207,840.0	SN Singh(PI), Pk Sen (Co-PI), S Hegde (Co-PI), S Shama (Co-PI)	2013	2015
10	Natural Anisotropic Materials from Microlevel Composition to Macrolevel Response	UKIERI	1,241,480	P Mahajan (PI)And S Ahmad (Co-PI)	2012	2014
11	Active Vibration Control of Smart Composite Structures with Nonlinear Piezoelectrics	DST	2,900,000.0	S Kapuria (PI), S Pradyumna (Co-PI)	2012	2015
12	Design of Ventilated Helmets	UKIERI	1,664,000.0	S Sanghi, P Mahajan	2012	2014

NO.	Project Title	Sponsor	Total Funds	PI/Co-PI	Start	End
13	Numerical Simulation of Fracture Initiation and propagation in weak layer	DRDO	1,500,000.0	Puneet Mahajan	2012	2014
14	Wave Propagation Analysis for Laminated Composite Structures with Internal Delamination	DST	1,815,000.0	Santosh Kapuria, Namita Nanda	2011	2014
15	Experimental and Numerical Investigations on Aerodynamics of Blended Wing Body (BWB) Tailless Configurations	AERO (DEFENSE)	2,054,000.0	SN Singh (PI), Amit Gupta (Co-PI)	2011	2014
16	Modelling of precipitates in steel alloys	DST	2,410,000.0	P Mahajan (PI), SN Singh(Co-PI), A Gupta (Co-PI)	2010	2013
17	Preparation of Baseline Document on Handling and Transportation of Fly Ash	DST	1,652,400.0	V Seshadri (PI), SN Singh(Co-PI), Vk Agarwal (Co-PI)	2010	2012
18	Development of a Synergistic Computational Tool for Material Modelling, Process Simulation and Optimization of Optical Glass Molding	DST (INT)	7,443,600.0	P Mahajan (PI), MK Singha (Co-PI), R Prasad (Co-PI)	2010	2014
19	Mathematical Modelling of Material and Structures their Deformation and Fracture processes	DST (INT)	705,900.0	S Ahmad (PI), NK Gupta (Co-PI)	2010	2012
20	Development of Indigenous Membrane Bioreactor (MBR) using Submerged Fly ash membranes and its Application for Municipal Wastewater Treatment	DST	2,849,610.0	SV Veeravalli, MR Cholemari(Co-PI), Tr Sreekrishnan (Co-PI)	2009	2013
21	Analysis and Resolution of the Carbunde Phenomenon	DEFENSE	687,600.0	Balaji Srinivasan	2009	2013
22	Bio-energy: Technology and Business Solutions for the UK and India	DST (INT)	68,270,000.0	SN Singh, Pk Sen (Co-PI), Kk Pant (Co-PI), R ShaNKar (Co-PI), Sn Naik (Co-PI), Vk Vijay (Co-PI)	2009	2014
23	Investigation of Novel Drag-Reduction Strategies	DRDO (DEFENSE)	1,534,000.0	MR Cholemari(PI), B Srinivasan (Co-PI)	2009	2013
24	Development of an Associate Node for Computational Fluid Dynamics at IIT Delhi	AERO (DEFENSE)	4,207,000.0	SN Singh, Ratan Mohan (Co-PI), MR Ravi (Co-PI), B Srinivasav (Co-PI), S Sanghi (Co-PI), Cv Ramakrishnan (Co-PI), V Sehsadri (Co-PI)	2009	2013
25	Mechanical Characterization of Advanced Materials under Dynamic Loads	DST (INT)	2,487,600.0	MK Singha (PI), NK Gupta (Co-PI)	2009	2012
26	Analysis of Manoeuvring Hydrodynamics of Underwater Vehicles	NRB (DEFENSE)	1,600,800.0	V Seshadri (PI), SN Singh(Co-PI)	2008	2011
27	Modelling of Technological Processes of Manufacturing Interaction and Fracture of Solids and Composite Structures	DST (INT)	1,603,220.0	NK Gupta (PI), S Kapuria (Co-PI), MK Singha (Co-PI), S Hegde (Co-PI)	2008	2010
28	Development and Installation of Web Portal fro Administration and Monitoring of Mid Day Meal Scheme	DST	1,460,000.0	Sriram Hegde	2008	2010
29	Improvement of S&T Infrastructure in Applied Mechanics Department: Establishment of Advanced Flow Diagnostic Laboratory (FIST)	DST	35,000,000.0	PK Sen	2008	2013

NO.	Project Title	Sponsor	Total Funds	PI/Co-PI	Start	End
30	Modelling and Computation of Three-Dimensional Turbulent Convective Heat Transfer for Design of Energy Efficient Pin Fin Heat Exchanger	DST	1,229,600.0	Anupam Dewan	2008	2010

*For funding sources acronym see Table 0-6

Table 3-11: Summary of projects sponsored by Industrial Research & Development (IRD), IIT Delhi for the period 2009-2013

Total cost of Projects Sponsored by IRD: 54.9 lakhs

No	Project Title	Total Funds	PI/Co-PI	Start Date	End Date
1	Non-perturbative Approximations of the Navier-Stokes Equations.	100,000	BALAJI SRINIVASAN	2009	2010
2	Modelling of Microstructural Evolution in Elastically Stressed, Interfacially Anisotropic Thin Films	100,000	MP GURURAJAN	2009	2010
3	Computational Investigation of Perforated Pin Fin Heat Exchangers	100,000	ANUPAM DEWAN	2010	2011
4	Heat-treatment of Metals and Alloys: Surface Engineering	100,000	SANTOSH S HOSMANI	2010	2012
5	Nonlinear dynamic stabililty of functionally graded panels embedded with piezoelectric layers subjected to periodic in-plane load	100,000	S PRADYUMNA	2010	2012
6	Development of Swirler as a Mixer in Industries (TDP-IAS 2010 (II)	100,000	SN SINGH	2011	2011
7	Plate Washer for Hostels (TDP-IAS 2010 (II)	85,000	SN SINGH	2011	2011
8	Rajat Gupta Chair Professor Project (Prof./dr. santosh Kapuria)	100,0000	SANTOSH KAPURIA	2011	2016
9	Topical Problems in Solids and Fluids	800280	NK GUPTA, SN SINGH	2011	2011
10	In-situ studies of recrystallization behavior of Mg-Al alloy	1,75,0000	JAYANT JAIN		
11	TRIPP Chair Professor project to Prof. Puneet Mahajan	600,000	PUNEET MAHAJAN	2011	2014
12	Multipurpose Wheel Chair	60,000	SN SINGH	2011	2012
13	Mechano-Chemical Modelling of Bacterial Growth	100,000	SITIKANTHA ROY	2011	2013
14	Post Failure Analysis in a Three-Point Bend Test using Digital Image Correlation	100,000	VIKRANT TIWARI	2012	2014
15	Turbulent Velocity Gradient Dynamics: Influence of Compressibility on the Role of Pressure	100,000	SAWAN SUMAN	2012	2014
16	Finite Crystal Elasticity of Rod-like Nanostructures and Crystalline Elastic Rods	100,000	AJEET KUMAR	2012	2014
17	Precipitate Characteristics and their Effect on Deformation Behaviour of Mg-Y alloy	100,000	JAYANT JAIN	2012	2014
18	Computational Methods for Understanding Aortic Stent-graft Stability	100,000	ANAMIKA PRASAD	2013	2014

Table 3-12: Summary of Industrial consulting projects for the period 2009-2013

Total cost of Projects Sponsored by IRD: 6.55 crore**

**Projects less than Rs. 2 lakh have been excluded from the table below but are included in total consulting cost reported.

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
1	Evaluation of CTOD Toughness in Base Metal Weld Joint and HAZ of API Steel and Failure Safety Analysis	Jindal Saw Limited, Mathura (UP)	792,000	BADRI PRASAD PATEL (PI), RK PANDEY (Co-PI)	1/2014	1/2015
2	Vetting of Structural Design for the Residential Buildings(Ph-1)	Northfield Homes, Punjab	350,000	MALOY KUMAR SINGHA(PI)	1/2014	3/2014
3	Structural Design of Project Sushma Infinium, NH-22, Zirakpur	Sushma Buildtech Ltd., Chandigarh	650,000	MALOY KUMAR SINGHA (PI)	12/2013	3/2014
4	Vetting of Structural Design for Project Sushma Chandigarh Grande,NH-22 Zirakpur	Sushma Buildtech Ltd., Chandigarh	500,000	MALOY KUMAR SINGHA(PI)	12/2013	3/2014
5	Wind Tunnel Testing of Aero-elastic Models of the High-rise Chimneys at the Hazira and Dahez Sites	Bygging India Ltd., New Delhi	1,400,000	SV VEERAVALLI(PI), SANJEEV SANGHI(Co-PI),SN SINGH(Co-PI)	12/2013	7/2014
6	Structural Vetting of Project Sushma Crescent, Ambala Road, Zirakpur	Sushma Buildtech Ltd., Chandigarh	250,000	MALOY KUMAR SINGHA(PI)	12/2013	1/2014
7	Design of Studies for Strengthening of Existing 82 mm Thick Sickle Plates at Bifurcation Joint Nos. 1 & 3 of Penstocks of SlBHES Srisailam Dam West	APGENCO, Hyderabad	600,000	BADRI PRASAD PATEL(PI)	11/2013	3/2014
8	Proof Checking of Structural Design and Drawings of Hospital Buildings at Kannauj UP	LKT Engg. Consultants Ltd., New Delhi	360,000	MALOY KUMAR SINGHA	10/2013	11/2013
9	Evaluation of In Situ Performance of Flow Elements on the Basis of Experimentally Measured Values of Coefficients	Micro Precision Products Pvt. Ltd.	500,000	SN SINGH(PI), SANJEEV SANGHI(Co-PI), SV VEERAVALLI(Co-PI)	7/2013	4/2015
10	The CTOD Toughness Determination in Pipeline Mats And Ensuring Safety From Failure Using Fracture Mechanics Approach	Jindal Saw Limited, Mathura (UP)	1,044,000	BADRI PRASAD PATEL(PI), RK PANDEY(Co-PI)	4/2013	2/2014
11	Proof Checking of Bridge Monitoring Reports of Five Bridges Under Eastern Railway (Phase-I)	CINTEC International Limited India, New Delhi	333,334	DK SEHGAL(PI)	4/2013	6/2013
12	Thermal Stress Analysis of Pipe Line From Dyke End Pump House To Ash Water Sump	Technofab Engineering Ltd. New Delhi	200,000	BADRI PRASAD PATEL(PI)	3/2013	4/2013
13	Laboratory Evaluation of the Performance Coefficient of Flow Nozzle Assemblies and Derivation of Working Equations Based on the Data	Fabri-Tek Engineers, Pune	230,000	SN SINGH(PI), V SESHADRI(Co-PI)	3/2013	12/2013

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
14	Evaluation of CTOD Toughness and Analysing Failure Safety in Weld Joints of API Steel	Jindal Saw Limited, Mathura (UP)	540,000	BADRI PRASAD PATEL(PI), RK PANDEY(Co-PI)	3/2013	9/2013
15	Performance Evaluation of Impact Probes	Nevco Engineers Pvt. Ltd., New Delhi	500,000	SN SINGH(PI), SANJEEV SANGHI(Co-PI), SV VEERAVALLI(Co-PI)	2/2013	8/2014
16	3D CFD Analysis of the Flow Through Trash Rack Structure in the Presence of Muck Deposition at SLBHES	Andhra Pradesh Power Generation Corp.Ltd, Hyderabad	900,000	SN SINGH(PI), V SESHADRI(Co-PI)	2/2013	3/2014
17	Performance Evaluation of Flow Elements and Derivation of In-situ Equation based on Working Conditions	M/s. Minco (India) Pvt. Ltd, New Delhi	516,500	SN SINGH(PI), V SESHADRI(Co-PI)	1/2013	3/2014
18	Analyzing Fracture Safety of Weld Joints using CTOD Approach	Man Industries (India) Limited, Kutch, Gujarat	612,000	BADRI PRASAD PATEL(PI), RK PANDEY(Co-PI)	1/2013	1/2014
19	Design, Fabrication and Calibration of Pitot Tube for IDCT Works for Maud, Rihand and Vindhyachal	N.B.B.C. Ltd. New Delhi	1,200,000	SN SINGH(PI), V SESHADRI(Co-PI)	1/2013	12/2013
20	Determination of Rheological Parameters and other Properties of Fly Ash Samples for the Design of HCSD System	ABEL Pump Technology, Mumbai	200,000	SN SINGH(PI), V SESHADRI(Co-PI)	11/2012	5/2013
21	Proof Checking of Structural Design for Composite Office Building at Naya Raipur (CG)	Naya Raipur Development Authority, Chhattisgarh	320,000	MALOY KUMAR SINGHA(PI), S PRADYUMNA(Co-PI)	11/2012	3/2013
22	Review of Structural Design and Drawing of proposed RGL Group Housing at Greater Noida, U.P.	Rajesh Projects (India)Pvt. Ltd, Delhi	300,000	SUHAIL AHMAD(PI)	10/2012	11/2012
23	Analysis of CTOD Toughness based on Fracture Mechanics to Ensure Failure Safety & Welding Process for Pipelines	Jindal Saw Limited, Mathura (UP)	420,000	DK SEHGAL(PI), RK PANDEY(Co-PI)	9/2012	9/2013
24	Microstructural study if Zn-Al coating on ductile case Iron pipes	Jindal Saw Limited, Mathura (UP)	435,000	RAJESH PRASAD JAYANT JAIN	11/2012	3/2013
25	Experimental Evaluation of Flow Coefficient of Flow Nozzle Assemblies and Derivation of In-situ Performance Equation	Engineering Specialities Pvt. Ltd, Kolkata	245,000	SN SINGH(PI), V SESHADRI(Co-PI)	8/2012	3/2013
26	Evaluation of FFS Machine Classification	Dharampal Satyapal Ltd., Noida	1,000,000	SANJEEV SANGHI(PI), SUDIPTO MUKHERJEE	8/2012	10/2012
27	Evaluation & Analysis of CTOD Toughness in Weld Pipe Lines for Integrity Analysis Using Fracture Mechanics Approach	Jindal Saw Limited, Mathura (UP)	422,999	DK SEHGAL(PI), RK PANDEY(Co-PI)	8/2012	4/2013

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
28	Conduct of Tests to Evaluate Discharge Coefficients of Flow Elements and Derivation of Equations for In-situ Performance	Micro Precision Products Pvt. Ltd.,Faridabad	1,500,000	SN SINGH(PI), V SESHADRI(Co-PI)	5/2012	9/2013
29	Experimental Evaluation of Performance and Derivation of In-situ Working Equations of the Flow Elements	Minco (India) Pvt. Ltd., Goa	2,064,429	SN SINGH(PI), V SESHADRI(Co-PI)	5/2012	12/2013
30	Experimental Evaluation of the Performance Characteristics of Flow Elements and Derivation of In-situ Equations based on the Data	M/s. Hydropneumatics Pvt. Ltd., Goa	222,000	SN SINGH(PI), V SESHADRI(Co-PI)	5/2012	12/2012
31	Proof Checking of Structural Design for Forest and Water Resources Department Buildings at Naya Raipur	Naya Raipur Development authority	300,000	MALOY KUMAR SINGHA(PI), S PRADYUMNA(Co-PI)	5/2012	10/2012
32	Investigation on Integrity Analysis of Pipeline Weld /Bend Joints & Process Parameters Development Applying Fracture Mechanics Approach	Jindal Saw Limited, Mathura (UP)	262,105	DK SEHGAL(PI), RK PANDEY(Co-PI)	4/2012	12/2012
33	Determination & Analysis of CTOD Toughness for Welded Pipe Lines Using Fracture Mechanics Technique	Jindal Saw Limited, Kutch, Gujarat	480,000	DK SEHGAL(PI), RK PANDEY(Co-PI)	3/2012	3/2013
34	Determination & Analysis of CTOD Toughness for Welded Pipe Lines using Fracture Mechanics Technique	Jindal Saw Limited, Mathura (UP)	235,199	DK SEHGAL(PI), RK PANDEY(Co-PI)	3/2012	11/2012
35	Calculation of Collapse Pressure, Radial Movement and Strains on the Under Sea pipeline using Finite Element Method .... Collapse Test	Welspun Corp. Ltd., Gujarat	380,000	DK SEHGAL(PI)	1/2012	7/2012
36	Determination & Analysis of CTOD Toughness for Welded Pipelines using Fracture Mechanics	Jindal Saw Limited, Mathura (UP)	240,000	DK SEHGAL(PI), RK PANDEY(Co-PI)	9/2011	6/2012
37	Vetting of Design and Drawings of Max Super Speciality Hospital Building at Bhatinda Punjab	MAX Health Care, New Delhi	500,000	SUHAIL AHMAD	9/2011	1/2012
38	Analyzing Fracture Safety of Weld Joints in API Pipeline using CTOD Approach	Man Industries (India) Limited, Kutch, Gujarat	960,000	RK PANDEY(PI)	9/2011	7/2012
39	Determination and Analysis of CTOD Toughness for Welded Pilelines using Fracture Mechanics Techniques	Jindal Saw Limited, Mathura (UP)	300,000	RK PANDEY(PI)	9/2011	12/2011
40	Stress Analysis and Free Vibration Analysis of the Modified Design of Sickle Plate	Andhra Pradesh Power Generation Corp.Ltd, Hyderabad	950,000	V SESHADRI(PI), SN SINGH(Co-PI), BADRI PRASAD PATEL(Co-PI)	8/2011	2/2012
41	Integrity Analysis of Pipeline Weld Joints & Process Parameters using F.M. Approach	Jindal Saw Limited, Mathura (UP)	510,000	RK PANDEY (PI)	7/2011	6/2012

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
42	Calibration of Averaging Pitot Tubes	IA Flow Elements Private Limited, Chennai	200,000	SANJEEV SANGHI (PI)	5/2011	7/2011
43	Evaluation of CTOD Toughness for API 5L Gr.X-60 PSL2 (Sour Service)	Man Industries India Ltd., Gujarat	288,000	RK PANDEY (PI)	5/2011	11/2011
44	Determination of In-situ Equation of Flow Elements based on Experimentally Verified Accuracy in Comparison to Relevant Code	M/s. Minco (India) Pvt. Ltd, New Delhi	3,332,428	V SESHADRI (PI)SN SINGH(Co-PI)	5/2011	2/2013
45	Performance Evaluation of Flow Elements used in Power Plants and Fertilizer Industries by Deriving In-situ Equation based on Experimental--Coefficient	Micro Precision Products Pvt. Ltd.,Faridabad	3,000,000	SN SINGH(PI) V SESHADRI (Co-PI)	5/2011	11/2012
46	Analysis of Pipeline Weld Joints & Process Parameter Development Using CTOD Approach	Jindal Saw Limited, Mathura (UP)	240,000	RK PANDEY (PI)	4/2011	10/2011
47	Evaluation of Tensile & Fatigue Characteristics of Parallel Threaded Mechanical Splices / Couplers	C.P.W.D. New Delhi	220,000	RK PANDEY (PI)	4/2011	9/2011
48	Performance Evaluation of Impact Probes used for Measurement of Air Velocity and Sampling of Particles	Nevco Engineers Pvt. Ltd., New Delhi	300,000	SN SINGH(PI) V SESHADRI (Co-PI)	4/2011	12/2012
49	Wind Tunnel Testing of Aero-Elastic Model of the Chimney at Annupur TPP.	LancoInfratech Ltd.	400,000	SV VEERAVALLI (PI)	4/2011	12/2011
50	Wind Tunnel Testing of Aero-Elastic Model of the 275 m High Chimney	Bygging India Ltd., New Delhi	425,000	SV VEERAVALLI	3/2011	9/2011
51	Derivation of In-Situ Equation for Flow Elements after Verification of the Discharge Coefficient Experimentally	M/s. Minco (India) Pvt. Ltd, New Delhi	1,563,919	SN SINGH(PI) V SESHADRI (Co-PI)	1/2011	5/2012
52	Evaluation of CTOD Toughness in X-65 PSL-2 Pipe Materials	Man Industries (India) Limited, Kutch, Gujarat	288,000	RK PANDEY (PI)	12/2010	12/2011
53	Rectification of Corrective Measures for Reinforcement of ROB Girders at Bikaner	Rajasthan Urban Development Project, Jaipur	300,000	SUHAIL AHMAD (PI) AK NAGPAL (Co-PI)	12/2010	3/2012
54	Wind Tunnel Study for 2x660 MW RCC Chimney of Vidharbha Thermal Power Project at Mandhwa	LancoInfratech Ltd.,(EPC Div.) Gurgaon	375,000	SN SINGH(PI)SV VEERAVALLI (Co-PI)	11/2010	10/2011
55	Wind Tunnel Study for 2x660 MW (Unit:1&2) RCC Chimney of Babandh Thermal Power Project at Dhenkanal	LancoInfratech Ltd.,(EPC Div.) Gurgaon	375,000	SN SINGH(PI)SV VEERAVALLI (Co-PI)	11/2010	11/2011
56	Experimental Evaluation of Performance of Flow meters for their Accuracy and Determination of In-situ Equations	M/s. Minco (India) Pvt. Ltd, New Delhi	1,525,000	V SESHADRI (PI)SN SINGH(Co-PI)	10/2010	3/2012
57	Static Tensile, Cyclic Tension and Cyclic Compression Tests of Threaded Couplers for Joining Reinforcement Bars	Shakti Commodities Pvt. Ltd. New Delhi	210,000	YOGENDRA NATH (PI) BP PATEL (Co-PI)	9/2010	10/2010

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
58	Integrity Analysis of Pipeline Weld Joints using CTOD Approach	Jindal Saw Limited, Mathura (UP)	240,000	RK PANDEY (PI)	8/2010	8/2011
59	Report on Classification of FFS Machines	DharampalSatya pal Ltd., Noida	500,000	SANJEEV SANGHI (PI) SUDIPTO MUKHERJEE (Co-PI)	8/2010	10/2010
60	Determination of In-situ Equation of Flow Elements based on Verified Accuracy and Provide help in setting up Flow Lab in the Premises	Micro Precision Products Pvt. Ltd.,Faridabad	1,550,000	V SESHADRI (PI)SN SINGH(Co-PI)	8/2010	2/2012
61	Testing of PU Coated Steel Belt and Analysis of the Traction Systems	Schindler India Pvt. Ltd., Mumbai	375,000	YOGENDRA NATH(PI) SK GUPTA (Co-PI) BP PATEL (CP)	7/2010	9/2010
62	Wind Tunnel Test of Amarkantak Chimney	PMG Amarkantak(EPC Div)LancoInfrate ch.Ltd,Gurgaon	350,000	SN SINGH(PI)SV VEERAVALLI (Co-PI)	6/2010	2/2011
63	Determination of In-situ Equation of Flow Elements on the basis of Verified Discharge Coefficient given in Standard Codes	M/s. Minco (India) Pvt. Ltd, New Delhi	610,500	SN SINGH(PI) V SESHADRI (Co-PI)	6/2010	10/2011
64	Experimental Determination of Discharge Coefficient to establish Accuracy and Determination of In-situ Equation	Micro Precision Products Pvt. Ltd.,Faridabad	450,000	SN SINGH(PI) V SESHADRI (Co-PI)	4/2010	10/2011
65	Evaluation of Accuracy and Derivation of In-situ Equations of Micro Bars	Micro Precision Products Pvt. Ltd.,Faridabad	200,000	V SESHADRI (PI)SN SINGH(Co-PI)	4/2010	6/2011
66	Derivation of In-situ Equation using Working Conditions after Establishing Discharge Coefficient as per ISO5167(2003)	Minco (India) Pvt. Ltd., Goa	359,002	SN SINGH(PI) V SESHADRI (Co-PI)	4/2010	2/2011
67	Development of a Procedure for Post Processing J Integral Data for Viscous Parameters of Material	Apollo Tyres Limited, Vadodara,Gujara t	500,000	BADRI PRASAD PATEL (PI) YOGENDRA NATH (Co-PI)	3/2010	5/2010
68	Determination of Accuracy of Discharge Coefficient using Primary Methods and then Evaluate the In-situ Equation	M/s. Minco (India) Pvt. Ltd, New Delhi	1,120,000	SN SINGH(PI) V SESHADRI (Co-PI)	2/2010	5/2011
69	Performance Evaluation of Flow Elements used in Thermal Power Plant	Eureka Industrial Equipments Pvt. Ltd., Pune	220,000	SN SINGH(PI) V SESHADRI (Co-PI)	12/2009	3/2010
70	Derivation of In-situ Equation using given Working Conditions and Verification of Discharge Coefficient	Micro Precision Products Pvt. Ltd.,Faridabad	500,000	V SESHADRI (PI)SN SINGH(Co-PI)	12/2009	4/2011
71	Development of Verification Methodology and Technical Support & Supervision of Computerized Draw of Allotment of Plots	Yamuna Express Way Indl. Dev. Authority,Gr. Noida	1,000,000	SANJEEV SANGHI (PI) PK GUPTA(Co-PI) K NARAYANAN(Co-PI)	11/2009	6/2010

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
72	Evaluation of CTOD Toughness in Weld Joints of API Steel and Insurance of Failure Safety Using Fracture Mechanics Approach	Jindal Saw Limited, Mathura (UP)	240,000	RK PANDEY (PI)	9/2009	6/2010
73	Performance Evaluation of Flow Elements and Derivation of In-situ Equation	Minco (India) Pvt. Ltd., Goa	421,502	SN SINGH(PI) V SESHADRI (Co-PI)	9/2009	3/2011
74	Physical Analysis, Rheology & Pilot Plant Loop Tests on Coal Ash Samples for Korba Project	M/s. B.S.B.K. Engineers Pvt. Ltd., Noida	600,000	V SESHADRI (PI)SN SINGH(Co-PI)	9/2009	3/2011
75	Surge Analysis for 900 NB Pipeline at NTPC Dadri and 1000 NB Line at NTPC Jhajjar	Unitech Machines Limited, Gurgaon	350,000	SN SINGH(PI) V SESHADRI (Co-PI)	8/2009	5/2010
76	Performance Evaluation of Flow Elements and Derivation of In-Situ Equation	Minco (India) Pvt. Ltd., Goa	299,001	V SESHADRI (PI)SN SINGH(Co-PI)	7/2009	3/2011
77	Determination of In-situ Performance of Flow Metering Devices based on the Measured Values of Discharge Coefficients in the Laboratory	Micro Precision Products Pvt. Ltd.,Faridabad	500,000	SN SINGH(PI) V SESHADRI (Co-PI)	7/2009	7/2010
78	Experimental Evaluation of Discharge Coefficients and Derivations of In-Situ Equations of Flow Elements at Working Conditions	Minco (India) Pvt. Ltd., Goa	226,000	V SESHADRI (PI)SN SINGH(Co-PI)	6/2009	6/2010
79	Testing and Evaluation of Welded Structural Component	Reliance Infrastructure Ltd., Noida	600,377	BADRI PRASAD PATEL (PI) YOGENDRA NATH (Co-PI) SK GUPTA (Co-PI)	6/2009	8/2009
80	Checking / Vetting of Detailed Hydraulic / Process Design and Drawings of 30 mld STP based on MBBR Technologies at Loni, Ghaziabad	Yamuna Pollution Control Unit-1,UP JalNigam,Gzb	299,265	AK RAGHAVA	6/2009	7/2009
81	Finite Element Analysis of Large Diameter Miter Bends of Reactor-Regenerator Piping for Guru Gobind Singh Refinery Project at Bhatinda	G.R. Engineers Pvt. Ltd.,New Delhi	407,798	SANTOSH KAPURIA (PI)	6/2009	9/2009
82	Evaluation of Accuracy of Discharge Coefficient Experimentally and than Derive the In-situ Equations of Flow Elements	Micro Precision Products Pvt. Ltd.,Faridabad	500,000	SN SINGH(PI) V SESHADRI (Co-PI)	4/2009	7/2010
83	Wind Tunnel Testing of an Aero-Elastic Model of the 275 M High Chimney of Kothagudem TPS, Hyderabad	BGR Energy Systems Ltd.	220,000	MURALI RAMAN CHOLEMARI (PI)SV VEERAVALLI (Co-PI)	3/2009	1/2010
84	Evaluation of CTOD Toughness and Field Weldability Test	Jindal Saw Limited, Mathura (UP)	300,000	RK PANDEY	3/2009	5/2010
85	Determination of Fracture Resistance of Weld Pipes for Application in Carrying Oil & Gases	Jindal Saw Limited, Mathura (UP)	480,000	RK PANDEY	2/2009	2/2010

No	Project Title	Sponsor	Total Funds	PI/Co-PI Name	Start Date	End Date
86	Derivation of In-situ Equation after Verifying the Accuracy of Discharge Coefficient Experimentally using Primary Method of Flow Rate Measurement	Micro Precision Products Pvt. Ltd.,Faridabad	500,000	V SESHADRI (PI)SN SINGH(Co-PI)	1/2009	7/2010
87	Performance Evaluation of Bends & Pipe Joints of API Steel for Gas Pipe Line Applications	Jindal Saw Limited, Mathura (UP)	420,000	RK PANDEY (PI)	1/2009	1/2010
88	Detailed C.F.D. & Stress Analysis for the Penstock Bifurcation at Srisailam Left Bank Hydro Electric Scheme	Andhra Pradesh Power Generation Corp. Ltd, Hyderabad	1,400,000	SN SINGH(PI) BP PATEL (Co-PI) YOGENDRA NATH (Co-PI) V SESHADRI (Co-PI)	1/2009	3/2010
89	Investigation of Causes of Failure of Crane at Commonwealth Games Village, New Delhi	M/s. Ahluwalia Contracts (India) Ltd,New Delhi	200,000	YOGENDRA NATH (PI) SN SINHA (Co-PI)	1/2009	2/2009
90	Derivation of In-situ Equation of Flow Elements after Verifying the Accuracy of Discharge Co-efficient Experimentally using Primary Methods	M/s. Minco (India) Pvt. Ltd. Goa	230,000	SN SINGH(PI) V SESHADRI (Co-PI)	1/2009	7/2009
91	Stochastic Analysis of Composite Structures	General Electric (I)Tech. Centre Pvt. Ltd, Bangalore	551,798	SUHAIL AHMAD(PI) P. MAHAJAN (Co-PI)	1/2009	7/2010
92	Determination of Solid Properties and Conduct Rheological Tests to Determine the Relative Viscosity of Slurry	Hindustan Zinc Ltd,Bhilwara,Rajasthan	350,000	V SESHADRI (PI)SN SINGH(Co-PI)	1/2009	7/2009
93	Preparation of a Detailed Project Report (DPR) on setting up a National Centre for Hydrogen Energy and Fuel Cell Technologies	Ministry of New and Renewable Energy	889,996	CV RAMAKRISHNAN (PI0	9/2008	3/2010

INNOVATION, DESIGN AND DEVELOPMENT

4

Executive Summary: Innovation Design and Development

The department of Applied Mechanics at IIT Delhi is rigorously involved in high quality teaching, research and industrial consultancy in the fields of Stress Analysis, Computer Aided Engineering, Product Design, Impact Mechanics, Fluid Mechanics, Failure Analysis and Material Science.

The Applied Mechanics department boasts of many specialized laboratories with sophisticated and high precision instruments for the use of research and the consultancy work. The department has a dedicated workshop that helps in fabrication of experimental setups and specimen fabrication.

The department trains high number of PG students in M.Tech (Engineering Mechanics), M.Tech (Design Engineering), DIIT (Naval Construction) and PhD students. Our faculty is also actively working in tandem with the industry, with commendable contribution in the experimental, theoretical, finite element, CFD, failure analysis and residual life estimation. The department is actively working towards providing opportunities to both graduate and post graduate students for new designs and innovations in order to provide a fruitful environment for growth. Importance is given to the problems specifically relating to the current technical need of our country. The following section provides the details of our contribution in the past few years.

4.1 Number of student who have been founded for innovating: 10

4.2 Technology developed

1. Development of compressed air based sudden energy release mechanism (V. Tiwari)
2. Quantitative non-contact measurement of metal plates deformation undergoing projectile impact (V. Tiwari)
3. Design of largest diameter Miter Bend of Reactor Regenerator Piping for Guru Gobind Singh Refinery, Bhatinda. (S. Kapuria)
4. Development of software for residual life assessment (R. K. Pandey and D.K. Sehgal)
5. A novel swirl rotor assembly to be used as a mixer (S.N. Singh)
6. Design of dish washer (S.N. Singh)
7. Automatic flushing mechanism (S.N. Singh)
8. Hydraulic Jack (S.N. Singh)
9. Footstep Electricity Generator (S.N. Singh)
10. Coconut dehusking machine (S.N. Singh)
11. Bucket washing machine (S.N. Singh)
12. Development of miniature specimen test technique for evaluation of material properties (R.K. Pandey)
13. Software development for Non linear dynamic analysis of marine risers under random loads (Suhail Ahmad)
14. Software developed for Non linear dynamic response of Tension Leg Platforms (Suhail Ahmad)

15. Software developed Dynamic Analysis and Reliability of Mooring lines for Deep water floating systems (Suhail Ahmad)

4.3 Technology transferred

1. Coconut dehusking machine allotted to K&S Partners. (S.N. Singh)
2. Footstep electricity generator allotted to Anand & Anand. (S.N. Singh)
3. Software on residual life estimation transferred to Indian Oil Corporation, Faridabad. (R.K. Pandey & D.K. Sehgal)

4.4 Number of patents filed and patents granted as a fraction of patents filed: 6/7

4.4.1. Patents Granted

1. Coconut dehusking machine (S.N. Singh)
2. Footstep Electricity Generator (S.N. Singh)
3. Hydraulic Jack (S.N. Singh)
4. Bucket Washing Machine (S.N. Singh)
5. Design of Dish Washer for Low Volume Usage (S.N. Singh)
6. A novel swirl rotor assembly to be used as a mixer (S.N. Singh)

4.5 Innovation of products, process, design, etc. in the department

1. Wind Turbine and Water wheels based Cell phone charging stations for rural India (V. Tiwari)
2. Animal power driven battery charging station for rural India (V. Tiwari)
2. Footstep Electricity Generator (S.N. Singh)
3. Hydraulic Jack (S.N. Singh)
4. Bucket Washing Machine (S.N. Singh)
5. Design of Dish Washer for Low Volume Usage (S.N. Singh)

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

1. Departmental Workshop.
2. Impact Mechanics Laboratory.
3. Experimental Methods Laboratory.

4.7 Number of students/teams who have competed in national/international completions and outcome

1. Nitin K Sharma, Best Paper Awarded in International Conference (London). 2012
2. Nitin K Sharma, Best Paper Awarded in International Conference (USA). 2013

Research & Development Environment

5

Executive Summary: R & D Environment

The Department of Applied Mechanics at IIT Delhi is a specialized engineering department involved in research in the broad area of *Mechanics and Materials* with particular emphasis on

- *Theoretical and Computational Mechanics*
- *Fluid Mechanics and Computational Fluid Dynamics*
- *Experimental Stress Analysis*
- *Impact Mechanics*
- *Fracture Mechanics*
- *Materials Engineering*

Our constant mission has been to focus on fundamental understanding that enables building technology leading to innovation and to encourage students in research and development through science-based engineering education. Over the last five decades several specialized laboratories have been developed in the department. For example, the department has specialized laboratories in *Physical Metallurgy, Material Characterization, Experimental Stress analysis, Impact Mechanics, Fluid Mechanics and Gas Dynamics.* Three computational laboratories having workstations and desktop machines along with an extensive array of software for engineering analysis and design has been set up for exclusive use of research students and faculty members of the department. Apart from this, a parallel cluster with 344 cores has also been set up for large computational problems.

Over the last five decades, several research groups in the department have carried out fundamental research in several fields of engineering -- *(a) Composite and Smart Structures, (b) Aerodynamics and Aero-structures, (c) Civil and Offshore structures (d) Defense structures and body armors, (e) Railway-vehicle dynamics, (f) Snow mechanics, Pipeline engineering, (g) Flow instrumentation, diffusers, combustors and Slurry Transportation (h) Wind engineering, (i) Heat exchangers and Thermal Engineering, (j) Reliability and Maintenance engineering, (k) Manufacturing Analysis and Energy conservation, (l) Metal forming and Friction Stir-Welding and (m) Computer Aided Analysis and Product Design, to name a few.*

A large number of sponsored research projects funded by Government Departments and private agencies are currently in progress in the department. The faculty members of the department are also involved in several international collaborative and mission projects. The outcomes of industrial and academic research conducted in the department are frequently published in prestigious national and international journals.

In the last few years many new faculty members having specialization in core and emerging areas (*e.g., Nano-mechanics, Surface Engineering, Bio-energy Biomechanics and Biomedical Engineering*) of Mechanics have joined the Department, as a result of which the breadth and scope of research activity has increased significantly. Due to the diverse and capable group of faculty members that constitute it, the department envisions itself as a vibrant and significant contributor in the coming years to a range of problems – from those of a fundamental nature to those that directly impart our nation's needs.

5.1 Number of post-doctoral scholars hired in the department and their duration of stay

1. Sangeeta Khare (2010-Present), Sponsored by DST
2. Namita Nanda (2011-Present), Sponsored by DST
3. M. Yaqoob Yasin (2013-Present), Sponsored by DST
4. Rizwan A.Khan (2009-2010), Sponsored by OIDB*
5. Rupesh Daripa (2009-2010), Sponsored by AR&DB

***** Oil Industry Development Board

5.2 Number of foreign students enrolled

	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013
In Masters	-	-	-	01	-
In PhD	-	01	-	-	-

Number of Indian and foreign faculty / researchers who have spent a sabbatical in the Department

None in the past 5 years have spent full semester in the department. Several faculty members have spent a week or more. They are listed in 5.6 (ii)

Sabbatical taken by faculty and where spent

Prof. Santosh Kapuria	1. Stanford University (2009-2010) 2. T U Darmstadt, Germany (2012)
Prof. Sanjev Sanghi	University of Sussex ,UK (Dec2007-Dec2008)

Number of seminars given by the faculty

Faculty	In Department	In other Departments	At Other Institutions
P.Mahajan	1	3	4
S.Kapuria	0	0	14
A.Dewan	0	0	5
Faculty	**In Department**	**In other Departments**	**At Other Institutions**
A.Kumar	0	1	1
S.Pradyumna	0	0	1
J.Jain	0	0	1
S.Roy	1	1	1
M.K.Singha	0	0	3
M.R.Chlomeri	0	0	1
A.Prasad	0	2	10
D.K.Sehgal	0	0	8
S.Balaji	0	1	4
S.Sanghi	0	0	15

Faculty	In Department	In other Departments	At Other Institutions
R.Prasad	0	0	5
S.Veeravali	0	0	2
R.K Pandey	0	0	16
Suhail Ahmad	7	3	10

Number of faculty / researchers / scholars who have visited the Department

(i) For giving seminars

S.No	Date	Speaker	Affiliation	Title of Seminar
1	13-12-2010	Dr. Yapa D.S. Rajapakse	Naval Research ,USA	Challenges in composites research
2	10-01-2011	Dr. Christos C. Chamis	NASA,USA	Probabilistic Multi-scale Multifunctional Composite Fatigue
3	11-02-2011	Dr. Durai Prabhakar	DTU, Denmark	Thermoplastic composites for wind turbine blades
4	07-11-2011	Dr. Pankaj	School of Engineering, University of Edinburgh	Tomography and Bone Modelling
5	27-01-2012	Prof. Ezio Cadona	University of Applied Sciences of Southern Switzerland	High Strain Rate Behavior of Materials
6	10-2012	Shibayan Roy	Department of Materials, Chemnitz Technical University Germany	Texture evolution in Metals & Alloys
7	3-01-2013	Prof. Peter Childs	Imperial College, London	Design challenges for tomorrow – the Airbus experience
8	08-01-2013	Chandraveer Singh	University of Toronto, Canada	Atomistic Modelling of Material for aerospace and energy application
9	06-06-2013	Prof. Sharad Girimaji	Texas A &M	Partially Averaged Navier-Stokes Equations
10	26-9-2013	Dr.P.C Jain	DRDL, Hyderabad	Better Designs using FEA
11	02-12-2013	Dr. Satyesh Yadav	Los Alamos National Lab, USA	Predictive Modelling of Materials by first principle method
12	17 -12-2013	Ashivni Shekhawa	UC Berkeley	What has fracture got to do with magnets and the liquid-vapor critical point?

S.No	Date	Speaker	Affiliation	Title of Seminar
13	07-01-2014	Prof.R.C.Batra	Virginia Polytechnic Institute and State University, Blacksburg	Finite deformations of curved sandwich panels during entry into water
14	11-02-2014	Gaurav Singh	Imperial College London	Discrete and continuum studies of some fundamental issues in brittle fracture mechanics
15	12 -02-2014	Swapnil Pravin	University of Virginia	Tracking the scent: Flow and odorant transport dynamics of chemical sensing in aquatic animals
16	15-07-2013	Mr. Nehul Gullaiya	IIT Bombay	MEMS Design and Instrumentation

(ii) For spending at least a week in the department

1. Levetin Alexender , Ishlinsky Institute for Problems in Mechanics ,Russia
2. Kazak Kiril, Ishlinsky Institute for Problems in Mechanics, Russia
3. Parshin Dmitry, Ishlinsky Institute for Problems in Mechanics, Russia
4. Dr. Pankaj Pankaj, School of Engineering, University of Edinburgh
5. Prof. Peter Childs, Imperial College, London
6. Prof. Sharat Girimaji, Texas A&M University

Adequacy of research infrastructure: - Attached in Annexure 5.1

Adequacy of technical staff-existing numbers and competency areas; competency areas in which there is a shortage

There is a strong requirement for additional technical manpower in the department. The reasons are as follows:

- Few laboratories (e.g., Impact Mechanics and Computational Laboratories) have no technical manpower at present.
- Most of the existing technical staff members have been promoted from lower cadres without undergoing the requisite up-gradation in their technical skills and knowledge
- There is severe shortage of manpower in teaching laboratories as the number of undergraduate students have increased manifold in recently.
- Few of the competent technical staff members are going to retire in near future.
- The department is evolving with addition of new faculty and increased research activities in frontier area of applied mechanics as detailed in Appendix 5.1. This has resulted in new laboratory development (both for teaching and research) with advanced equipments. Hence, skilled technical manpower is required for maintenance and efficient use of equipments.

Laboratory	Existing (Technical + Non-Technical)	Extra Technical Cadre Staff required
Dept. Office	0 + 2 = 2	**1**
Strength of Materials Lab	2 + 1 = 3	**2**
Stress Analysis Lab.	1 + 0 = 1	**1**
Gas Dynamics Lab.	3 + 1 = 4	**2**
M.T.S. Lab.	1 + 0 = 1	**1**
Impact Mech. Lab	0	**1**
Design Optimization	1 + 0 = 1	**0**
Computation Lab.	0	**1**
Materials Sc. Lab. I	1 + 0 = 1	**2**
Fluid Mech.Lab.	0 + 1 = 1	**2**
Experimental Methods	1 + 0 = 1	**2**
Dept. Workshop	2 + 1 = 3	**2**
Dept. Stores	0 + 1 = 1	**1**
Materials Sc. Lab II	0 + 1 = 1	**2**

Work space available for PG students, project staff and post-doctoral scholars

There is **no dedicated workspace available in the department** for PG students, project staff and post-doctoral scholars. The research students are using the **laboratory space** and **faculty offices** as their workspace. Physical space occupied by the department summarized here, whereas, the details are provided in Annexure 5.1

Purely Research Laboratories	18319 sq.ft
Teaching Laboratories (UG)	7486 sq ft
Teaching Laboratories (PG)	2048 sq.ft
Overlapping Research Labs with Teaching Labs	8586 sq.ft
Total Laboratory Space	**36439 sq ft**
PG Student	Share the research Laboratories and faculty offices
Project Staff	
Post-doctoral Scholars	

Number of National Conference/Workshops/Seminars attended by PhD students

Total number: 47

Number of International Conference/workshops/seminars attended by PhD students

Total number: 63

Number of M.Tech students who have continued to PhD.

In the same department	**12**
In other departments of IITD	**1**
In India	**6**
Abroad	**6**

Number of projects with co-guide from industry

Industry	Number of projects	IIT Delhi Faculty
IOCL	Ph.D : 1 M.Tech : 8	D K Sehgal
EIL, New Delhi	Ph.D : 1	S Kapuria
NSTL, Vizag	Ph.D : 1	S Kapuria
IOCL Faridabad, India	Ph.D : 1	J Jain
AIIMS	M.Tech : 2	R K Pandey
DRDO	Ph.D : 1	Suhail Ahmad
Mahindra Satyam, Bangalore	Ph.D : 1	M K Singha

Number of students who have spent time in industry as part of thesis /project work

No. of students	Industry	Duration of project(months)	IIT Delhi Faculty
8	IOCL	6	D K Sehgal and R K Pandey
1	Siemens	8	R.K.Pandey

Self-assessment reports of the Department (if any)

No such reports available. Our vision documents over the years have some qualitative self-assessment

Placement of M.Tech and PhD graduates in technical careers

Attached in Annexure 5.2

Interdisciplinary Work

Faculty	Joint thesis guidance by faculty across groups within Department or across Departments / Centers	Proposals submitted and funded: PI, CO-PI and their group/department affiliations
Santosh Kapuria	Sudip Paul, "*Semi-Active Control of Structures using Smart Materials*", 2009 (PhD Thesis), with Prof. T. K Datta, Department of Civil Engineering, IIT Delhi Kunal Bhatt, "*Blast Protective Structure and Shock Vibration Control*" Ongoing M Tech Thesis, with Dr. V. Matsagar, Department of Civil Engineering, IIT Delhi	
Suhail Ahmad	Rishav, "Aero dynamic response and Probabilistic behavior of tall slender structures", Ongoing PhD thesis with Prof. S. Veeravalli.	Development of Light weight ballistic materials system for Body, Vehicle and Structural Armors, PI: Prof. Naresh Bhatnagar, Mechanical Engineering Department, IIT Delhi.

Faculty	Joint thesis guidance by faculty across groups within Department or across Departments / Centers	Proposals submitted and funded: PI, CO-PI and their group/department affiliations
Murali R Choolemari		Development of indigenous membrane bio reactor using submerged fly ash membranes and its application for municipal wastewater treatment with Department of Bio Technology IIT Delhi and TERI) DST
Sitikanta Roy	G. C. Bagal, "*Biomechanical Study of Tissue Engineered Intervertibral Disc*", 2012, (M.Tech Thesis), with Dr. Sourabh Ghosh, Department of Textile Engineering, IIT Delhi M. Valliapan, "*Modeling of Curved electromechanical actuator*", M.Tech Thesis with Dr. Dineshkumar Harursampath, Department of Aerospace Engineering ,Indian Institue of Science (IISc), Bangalore. Aakash Gupta, "*Mechanics of cerebrospinal fluid dynamics in structural disease like Hydrocephalus in Brain*", M.Tech Thesis, with Prof. Sanjeev Sanghi, Fluids Group, Applied Mechanics	
Sanjeev Sanghi	V. V. Deshpande, "*Study of supersonic flow past a moving protuberance*", 2012 (Ph.D Thesis) with Dr. B. Eshpuniyani, Department of Aerospace Engineering, IIT Kanpur. Syed Mohd. Yahya, "*Numerical Analysis of turbulent channel flow with high temperature gradients*", Ongoing Ph.D Thesis with Dr. S. F. Anwer, Department of Mechanical Engineering Aligarh Muslim University (AMU), Aligarh Vijai Kumar Chaurasia, "*Modelling of Storm Water* " ,Ongoing Ph.D Thesis with Prof. A. K. Mittal, Department of Civil Engineering, IIT Delhi	Transportation Research, Volvo Research Foundation, Sweden, PI: Prof. Dinesh Mohan, Department of Civil Engineering, IIT Delhi
Anamika Prasad	M. Marieswaran, "*Cardiovascular Device*", Ongoing M .Tech Thesis, with Prof. Anand Sneh , Centre for Biomedical Engineering, IIT Delhi Pooja Bhatti, "*Bioabsorbable Coronary Stents*" Ongoing Ph.D Thesis with Dr. Naresh Bhatnagar, Department of Mechanical Engineering, IIT Delhi Dr Manoj Kumar, *"Role of Extracorporeal Irradiation in Malignant Bone Tumor",* ongoing Ph.D thesis with Dr. S. Rasthogi et al., Department of Orthopedics, All India Institute of Medical Sciences (AIIMS), Delhi	

Faculty	Joint thesis guidance by faculty across groups within Department or across Departments / Centers	Proposals submitted and funded: PI, CO-PI and their group/department affiliations
D K Sehgal	V. Chitttibabu, *"Experimental and Numerical Studies on Mechanical Behavior of Bovine Cortical Bone using Rectangular Miniature Specimens",* 2010 (Ph.D Thesis) with Prof. R.K Pandey, Materials Group, Applied Mechanics C. Kanan, *"Characterization of Mechanical Behavior of Cr-Mo Steels using Miniature Specimen testing approach",* 2010 (Ph.D Thesis) with Prof. R.K Pandey, Materials Group, Applied Mechanics T.C Gupta, *"Non-linear Dynamics of Rotor Systems and Chaos" ,* 2010 (Ph.D Thesis) with Prof. Kshitiz Gupta, Department of Mechanical Engineering, IIT Delhi Nitin Kumar Sharma, *"Determination of Mechanical Properties of Human Bones using Miniature Specimen and FEM " ,* 2012 (Ph.D Thesis) with Prof. R.K. Pandey, Materials Group, Applied Mechanics S.P Singh, *"Characterization of Mechanical Behavior of Cr-Mo Steels at High Temperature using Miniature Specimen Testing Technique" ,* 2013 (Ph.D Thesis) with Dr. Sova Bhattacharya ,Indian Oil Corporation Limited	
Puneet Mahajan	Mohammad Hossein Alaei, "Particle Size Effect From Micro To Nano On The Thermal And Mechanical Properties Of Polymer Composites", *2013 (Ph.D Thesis)* with Dr. N. Bhatnagar, Department of Mechanical Engineering, IIT Delhi Kunwar Laiq Ahmad Khan, *"Synthesis and Mechanical Behavior of Aluminum Foam",*2011,(Ph.D thesis) with Dr. Rajesh Prasad, Materials Group, Applied Mechanics G.V.Rao, *"Finite Element Analysis of Machining of uni-directional composites",* 2008 (Ph.D Thesis) with Dr. N.Bhatnagar, Department of Mechanical Engineering, IIT Delhi	Transportation Research, Volvo Research Foundation, Sweden, PI: Prof. Dinesh Mohan, Department of Civil Engineering, IIT Delhi

Faculty	Joint thesis guidance by faculty across groups within Department or across Departments / Centers	Proposals submitted and funded: PI, CO-PI and their group/department affiliations
S N Singh	Arun Kumar Pradhan,, "*Studies on Multi constituent Non Woven Air Filter Media*", 2013 (Ph.D Thesis) with Dr. Dipayan Das, Department of Textile Engineering, IIT Delhi	Experimental and Numerical Investigation on Aerodynamics of Blended wing body Tailless configuration, AR&DB with Dr. Amit Gupta, Department of Mechanical Engineering, IIT Delhi Bio-energy: Technology and Business Solutions for the UK and India with Centre for Rural Development and Technology, IIT Delhi
M K Singha	Gargi Jaiswal, "*Mechanics of Nonwovens*", Ongoing Ph.D Thesis with Dr. D Das, Department of Textile Technology, IIT Delhi P. K. Sahu, "*Mechanical Characterization of Coir Fiber Reinforced Composite*", 2013, (M.Tech Thesis) with Dr. D. Das, Department of Textile Technology, IIT Delhi.	*An Experimental and Numerical Study on the Mechanics of Nonwovens*, Council of Scientific and Industrial Research, with Dr. D Das, Department of Textile Technology, IIT Delhi.
Anupam Dewan	Rahul R. Angal, "*Computational Study of Hydrogen Dispersion Hazards*", 2011 (M.Tech Thesis) with Dr. K. Subramanian, Centre for Energy Studies, IIT Delhi	
P K Sen		Bio-energy: Technology and Business Solutions for the UK and India with Centre for Rural Development and Technology, IIT Delhi

Annexure : 5.1

Adequacy of Research Infrastructure in the Department of Applied Mechanics

Present space with the Department

The total area currently occupied by the department and its breakup under the main heads is presented in the Table below.

Category	Presently occupied space (sq.ft)
Faculty Rooms	5718
Research labs 7486 (UG Teaching) + 2048 (PG Teaching) + 18319 (research) + 8586 (Overlapping of research and Teaching Labs)	36440
Other (office, store, NCW etc.)	4337
Total Area of Applied Mechanics Department	**46,495**

Key drives for additional space required by the department

The department of applied mechanics has undergone several changes in the last few years. Several faculty members (Prof. N K Gupta, Prof S K Gupta, Prof R K Mittal, Prof C V Ramakrishna, Prof V Seshdri, Prof P K Sen, Prof D K Sehgal) has retired, while several new faculty members (Prof. Arvind Agarwal, Dr. Jayant Jain, Dr. Ajeet Kumar, Dr. Anamika Prasad, Dr. Sitikantha Roy and Dr. Vikrant Tiwari) have joined the department in the last three years. The thrust of the department is evolving with the addition of research expertise of new faculty members and increased research activities of the department in the frontier areas of applied mechanics together with the increase of research students. Hence, there is a severe crisis of space within the department, which may be attributed to ***Increased Research activities with setup of new Laboratories.*** The department is preparing to setup the following laboratories :

- Biomechanics and soft materials
- Processing and Mechanical characterization of advanced materials
- Multifunctional Structures Lab
- A low noise water-tunnel facility for flow visualization and optical diagnostics.
- Gas Dynamic Lab for Turbulent Convection, Dispersion and other Transport Processes
- Gas Dynamic Lab for Turbulent Convection, Dispersion and other Transport Processes

Projected space requirement and its justification

The projected space needs of the department are presented in the table below, along with justification for the same

Category	Purpose	Requirement in sq.ft
GD Lab IV	Research	4064
Material Science	Teaching/Res	1500
Soft Material characterization lab	Research	1200
Multifunctional Structures Lab		2000
Impact and Ballistic Lab	Research	2000
Research Scholars Room	Research	2400
Naval Construction wing (NCW)		2800
Faculty office space	5 No.s	900
Total		**16864**

The breakup of total area occupied by the department

A. Laboratory Space					
Name of the Laboratory	Type	Location	dim1	dim2	Area (sft)
Fluid Mechanics	Research	III 133 Gr Flr	192	32	6144
Fluid Mechanics	UG	First Floor	168	32	3870
Strength of Materials	UG+PG+Res	IV 136	110.5	29.5	2876
Physical Metallurgy	PG+Res	MS 207/C-15-16	32	24	768
Materials Science UG Lab	UG	MS 207/C-6-7	36	24	864
Material Characterization Lab	PG+Res	207/A2	38	30	1140
Mechanical Behaviour Lab	Research	MS 207/C-17-18	32	32	1024
Gas Dynamics I,	Research	IV 154			4394
Gas Dynamics II	Research	IV 255			4064
Gas Dynamics III	UG	III mech			1528
Stress Analysis	UG+Res	IV 249,	80	16	1512
Experimental Methods Lab	UG+PG	IV 347	64	20	1280
Impact Mechanics	Research	IV 153	47.5	29	1378
Computational Lab.	UG+PG+Res	IV 245			1200
Product Design and Fabrication Lab	PG+Res	IV 133			2064
M.T.S.	Research	IV 137A			516
Design Optimization Lab.	UG+PG	IV 353			824
C.F.D.	PG+Res	III 232			994
Total Laboratory Space					**36439**
Departmental Stores		IV 151	19	13	247
Department Office		IV 236, 240	43	32.5	1398
Departmental Library		IV 236	18.5	18.5	342
Naval Construction Wing (NCW)	Training/Res	IV 2nd Floor			2350
Total (Office + Library + Store + NCW)					**4337**

Faculty Offices: 5718 square ft.

Balaji Srinivasan	IV 344	15	12	180
Gupta N. K.	IV 134	16	12	192
Hegde S.	IV 346	15	12	180
Kapuria S.	IV 233	15.5	12	186
Mahajan Puneet	IV 250	15	12	180
Mittal R. K.	IV 234	15	12	180
S Roy	IV-243	14	12	168
Rajesh Prasad	III-233	15	12	180
Anamika Prasad	III-234	15	12	180
Arvind Agarwal	III-235	15	12	180
J Jain	III-236	15	12	180
A. Dewan	III-237	15	12	180
Ajit Kumar	IV-342C	15	12	180
M R Cholemari	IV248	15	12	180
Pandey R. K.	MS 207/C-11	14	10	140
Patel B. P.	IV 246	15	12	180
Pradyumna S	IV 247	15	12	180
Sanghi S.	IV 241	15	12	180
Sehgal D. K.	IV 135	15	12	180
Sen P. K.	IV 340	15	12	180
Seshadri V.	IV 232B	19	12	228
Singh S. N	IV 232A	19	12	228
Suhail Ahmad	IV 252	16	12	192
Singha M. K.	IV 251	15	12	180
Veeravalli S. V.	IV 255	15	12	180
Vikrant Tiwari	IV 256	15	12	180
Sawan Suman	IV 342B	16	11	176
Guest faculty Room	IV 338	10	12	120
Research Associate	IV 341	10	12	120
Naval Construction Wing				
Capt P. R. Kulkarni	IV 354			162
Lt Cdr S. K. Rao	IV 357			162
Cdr Vijay Kumar	IV 356			162
Lt Cdr B. Praveen	IV 352			162
Total				**5718**

ANNEXURE: 5.2

Review of the Department Placement of M.Tech and Ph.D Graduates in Technical Careers (based on the data provided by the Training and Placement Cell in IITD

Program Details	Year and No. of graduating students	Nature of job for first 2-3 years after graduation	Nature of job 5 yrs. after graduation	% of graduates in technical lines of work	% graduates starting in technical line who are now a manager or administrator
Ph.D		Immediately after graduation, different Ph.D students of the Department have joined the following types of job: • Teaching in Engineering Colleges, NIT, IIT • Scientist in DRDO Laboratories • Postdoctoral research • Industrial job The details are listed here.	**Same**	**90% (approx)**	**10% (approx)**
	2009	Dr. Nidur Singh - ANSYS Pune Dr. M.Venkat Rao - Laboratory for nuclear Materials, Paul Scherrer Institute, Switzerland Dr. P. Praveen Kumar - Scientist, DRDO Hyderabad Dr. Parminder Singh- Additional Director, DRDO Dr. Saibal Sen- Indian Navy Dr. R. S. Tarnacha- Head,Department of Aerospace Engineering., Manav Rachna International University, Faridabad Dr. R. VijayKumar- Faculty, NCW, Applied Mechanics Department., IIT Delhi Dr. Anurag Mudgal- Associate Professor, Department of Mechancial Engineering, Pandit Deendyal Upadhyay Petroleum University, Ghandhinagar Dr. Rizwan A. Khan - Assistant Professor, NIT Jalandhar Dr. K. Gurumurthi - Deputy Manager, EIL			
	2010	Dr. Sunil Chandel - Assistant Professor, DIAT, PUNE Dr. Amit Ray- Indian Navy Dr. K. Khan- Assistant Professor, Department of Mechanical Engineering, NIT Durgapur Dr. S. M. Ibrahim- Assistant Research Professor, Department of Civil Engineering, King Saud University, Saudi Arabia			

Program Details	Year and No. of graduating students	Nature of job for first 2-3 years after graduation	Nature of job 5 yrs. after graduation	% of graduates in technical lines of work	% graduates starting in technical line who are now a manager or administrator
		Dr. Vikas Kumar Satyam - Mazagaon Dock, Mumbai Shailendra V Gade- Scientist, DRDO Dr. Rupesh Daripa- Crompton Greaves Limited, Mumbai Dr. Chitti Babu - Associate Professor, GMR institute Srikakulam (AP)			
	2011	Dr. K. L. A. Khan- Professor & Head, Department of Mechanical Engineering, Krishna Institute of Technology, Ghaziabad Dr. Sudip Paul- Senior Manager, Structures Department, Engineers Indian Limited, New Delhi Dr. K. Gopinath- Professor, Dept. of Mechanical Engineering, SDM College of Engineering and Technology, Dharwad. Dr. T. Prakash- Mahindra Satyam, Bangalore Dr. C. Kannan- Manager Indian Oil Corporation			
	2012	Dr. M. Z .K. Yusufzai- Assistant Professor, Department of Mechanical Engineering, IIT BHU Dr. S. Giribaskar- Research Associate, University of Strathclyde, UK Dr. Poonam Kumari- Assistant Professor, Department of Mechanical Engineering, IIT Guwahati Dr. J. K. Nath- Associate Professor, Department of Mechanical Engineering., Siksha O Anusandhan University, Bhubneswar Dr. G. Joshi- Assistant Professor, Defence Institute of Advanced Technology, Pune Dr. T. C. Gupta- Associate Professor, NIT Jaipur			
	2013	Dr. Rajneesh Sharma - Postdoctoral Scholar, University of Manchester. Dr. M. Yaqoob Yasin- Project Scientist, Dept. of Applied Mechanics, IIT Delhi Dr. A.K. Gupta- Scientist, ISRO Satellite Centre, Bangalore Dr. Nilamber Kumar Singh- Assistant Professor, NIT Patna			
M.Tech in Design Engineering	**2009-2010**	Srihari Prasad Gorti - Jyoti Ltd. Madan Lal- National Engineering Industries Ltd. Koduri Srikrishna - Hero Honda Vijay - National Engineering Industries Ltd. Sutar Sunil Suresh - Daimler India Commercial			

Program Details	Year and No. of graduating students	Nature of job for first 2-3 years after graduation	Nature of job 5 yrs. after graduation	% of graduates in technical lines of work	% graduates starting in technical line who are now a manager or administrator
		Vehicles Pvt. Ltd. Chandra Shekhar Thakur- ANSYS-Fluent India Private Ltd. Chandrabhan Prajapati- Integral University Rajesh Kumar Dwivedi - Mahindra & Mahindra Ltd. Karan Oberoi - Tata Motors Girjesh Shukla - Jyoti Ltd. Nivesh Pandya - Ispat Industries Ltd Aniruddh Pratap Singh - Mahindra & Mahindra Ltd.			
	2010-2011	Prashant Vipul- Mercedes-Benz Research and Development India Private Ltd Rajesh Kumar Shukla - Integral University Manish Jindal- Eaton Technologies Pvt. Ltd. Sreenadh K- Cummins India Bablukumar Jha- Integral University Madukar S- Daimler India Commercial Vehicles Pvt. Ltd. Ashwini N - Eaton Technologies Pvt. Ltd. Jitendra Kumar- Tata Motors Ashwin Chandar N C- Eaton Technologies Pvt. Ltd. Gopal Singh- Hero Honda Prabal Singh- Mahindra & Mahindra Ltd. Siddhant Garg- Eaton Technologies Pvt. Ltd. Abhinav Dhar- TCE Consulting Engineers Ltd Patil Sunil Jagannath- Kirloskar Pneumatic Company Ltd., Pune Dhakate Rohan Madhukar- Mahindra & Mahindra Ltd.			
	2011-2012	V S N Ranjit Kumar G - Isgec Heavy Engineering Ltd. Mayank Patni- ANSYS India Vinay Yadav- Tata Motors Manjulata Bhatti- Mewar University Garima Chauhan- Mahindra & Mahindra Ltd., AFS Ltd. Vinayak Macchindra Trigune - Mahindra & Mahindra Ltd. , AFS Ltd. S Naidu Velagala- TVS Motor Dheerendra Kumar Dewangan - Hero Motorcorp Ltd. Thorat Rajesh Ashok- Renault Nissan Technology & Business Centre India Pvt. Ltd.			

Program Details	Year and No. of graduating students	Nature of job for first 2-3 years after graduation	Nature of job 5 yrs. after graduation	% of graduates in technical lines of work	% graduates starting in technical line who are now a manager or administrator
		Ajay Kumar Behera- Senior India Pvt.Ltd K.Srikesh- Hero Motorcorp Ltd. Vikas Kumar Mishra- Oceaneering International Services Limited Gunjit Kumar- Mahindra & Mahindra Ltd.,AFS Ltd. Sanjeev Shreekant Sharma- Atlas Copco (India) Ltd. Munendra Kumar-Oceaneering International Services Limited Jituranjan Nayak -Mercedes-Benz Research and Development India Private Limited Sajilal-S- Renault Nissan Technology & Business Centre India Pvt. Ltd. Meenakshi- Mahindra & Mahindra Ltd.,AFS Ltd. Pankaj Kumar- GLA University , Mathura R.Karthik- Mercedes-Benz Research and Development India Private Limited Chalukya N Chincholi- Robert Bosch Engineering India			
	2012-2013	Mahavir Singh-W.S.Atkins India Pvt Ltd Anjan Kumar-Subros Ltd Swati Sharma-Tata Motors Jaskaran Singh-Hero Motorcorp Ltd Satish Kumar Panda-Hero Motorcorp Ltd Rajasekhar Reddy Martala-W.S.Atkins India Pvt Ltd Arun Baby-Titan Industries Ltd Vishwanath Yakkala- Subros Ltd Deshmukh Shrinath Shivajirao -Isgec Heavy Engineering Ltd Vishvendra Pratap Singh-Oceaneering International Services Ltd Swangikar Pradeep Vinayak Jayshree -Tata Motors Satyendra Singh Yadav-GE India Technology Center			
M.Tech in Engineering Mechanics	**2009-2010**	K.Soma Shekar-ANSYS –Fluent India Pvt. Ltd. Santosh Chandra Gondyala -Tata Motors Kishan P.B -John Deere Amit Kumar - CSIR Labs. Lakhvinder Singh-Ispat Industries Ltd. Pansare Munir Ramjan -Tata Motors Sharad Kumar –CSIR Labs. Kanire Subhash Shantinath -Daimler India Commercial Vehicles Pvt. Ltd. Aditya Pandey -Mahindra & Mahindra			

Program Details	Year and No. of graduating students	Nature of job for first 2-3 years after graduation	Nature of job 5 yrs. after graduation	% of graduates in technical lines of work	% graduates starting in technical line who are now a manager or administrator
	2010-2011	Mohit Kumar -Mercedes-Benz Research and Development India Pvt. Ltd Krishna Teja Trikutam-Eaton Technologies Pvt. Ltd. Sanjay Kumar Dewangan -John Deere Naveen Kumar Sahu- Siemens Power Engineering Pvt. Ltd. Ravi Sagar -Bharat Electronics Ltd. Dhanesh Kumar - Moserbaer Solar Ltd. Angal Rahul Ramesh -Daimler India Commercial Vehicles Pvt. Ltd. Anand Mishra-Cummins India Khumbhar Amol Shripal - Eaton Technologies Pvt. Ltd. Ashish Kumar Mahapatre -Tata Motors Kumar Kartikeya - Eaton Technologies Pvt. Ltd. Gulavani Rohan Arun -Tata Motors Ashish Kumar Choudhary -Mahindra & Mahindra Rishav -Mahindra & Mahindra			
	2011-2012	Sarath T Joseph Vaidyan -Tata Motors Praveen Kumar Banda -Hero Motocorp Ltd Renjith A.R-Atlas Copco India Ltd. More Nikhil Jalindar -Atlas Copco India Ltd. Patil Sandip Balaso -Blue Star Ltd. Vinayak Manoji -TVS Motors Collins J. Mekkat-Tata Motors Vijaindra Kumar Verma- Oceaneering International Services Ltd. Patil Santosh Balasaheb - National Engineering Industries Ltd. Mani K Paul-Tata Motors			
	2012-2013	Neeraj Bhatia–Caterpillar India Pvt. Ltd. Vinit Vijay Deshpande-Hero Motocorp Ltd. Pankaj Gupta -GLA University Saurabh Agarwal-Mercedes-Benz R&D India Pvt. Ltd. S.T Subramanian - Caterpillar India Pvt. Ltd. Biswajit Khara-W.S Atkins India pvt Ltd. Jamsheed P-Power Grid Corporation of India Ltd. Tota Rakesh Kumar -W.S Atkins India pvt Ltd. Paritosh Mishra -Graphic Era University Pendyala Gautam Dev-Senior India Pvt.Ltd			

OUTREACH/ EXTERNAL STAKEHOLDER

6

Executive Summary: Outreach/ External Stakeholder Engagement

The data shows that in last five years, the department has conducted a good number of workshops/courses not only to other IITs, NITs, but also to the industrial sector. Learning research material and seminars are made available in the web and to other institution. The partnership of IIT Delhi- Indian Navy named as NCW (Naval Construction Wing) has resulted in indigenous design of naval platforms and acquisition, construction, repair and modernization of warships and submarines. Our alumni have made a significant contribution in the design of aircraft carrier Vikrant and nuclear submarine Arihant. The faculty members of the department were successful in getting projects in collaboration with different industries and government organizations. Many of the completed projects undertaken have contributed in achieving the national development goals. The faculties were recognized and awarded for their outstanding efforts towards science and technology. They have also been Fellow of academics, etc. Many of them have mentored other institutions in curriculum as well as laboratory development.

6.1 Educational

a) Workshops/short term courses/courses to other IITs, NITs, other institutions

2013	QIP short term course on "UG teaching of Materials Science", IIT Delhi, 11^{th}-17^{th} July 2013.	Dr. J. Jain & Prof. R. Prasad
	QIP/CDC Symposium on "Cardiovascular Bioengineering", 12^{th} Dec 2013.	Dr. A. Prasad & Dr.S.Roy
	Workshop on "Principles and Techniques in X-Ray Diffraction", National Resource Centre in Materials, Department of Materials Engineering, IISc Bangalore, Topics: Basic Crystallography, Stereographic Projection, Point and Space Groups, Quasicrystals, 10^{th}-11^{th} July 2013 .	Prof.R.Prasad
	Workshop on "Principles and Techniques in X-Ray Diffraction" at National Resource Centre in Materials, Dept. Of Materials Engineering, IISc, Bangalore, 10^{th} -11^{th} June 2013.	Prof.R.Prasad
	Workshop on "Characterization of Materials" at Dept. of Metallurgical and Materials Engg. , Visvesvaraya National Institute of Technology (VNIT), Nagpur, 22^{nd} -24^{th} March 2013.	Prof.R.Prasad
	Workshop on "Characterization of Materials, Department of Metallurgical and Materials Engineering, VNIT, Nagpur, Topic: Basic Crystallography, 22^{nd}- 22^{nd} Mar. 2013.	Prof.R.Prasad
	Organizer and principal instructor in a training program in Materials Science, Terminal Ballistics Research Laboratory (TBRL), DRDO, Chandigarh. A five day course on basic concepts of materials science, 16^{th}, 17^{th}, 18^{th}, 25^{th}, 26^{th} Mar. 2013.	Prof.R.Prasad & Dr. J. Jain
	Organized the 3^{rd} Asian Conference on "Mechanics of Functional Materials and Structures", 5^{th}-8^{th} Dec. 2012.	Prof.S.Kapuria Dr. S.

		Pradyumna
2012	Organizer and Principal Instructor for onsite training program on Physical Metallurgy for Maruti-Suzuki Engineers, Training Centre of Maruti-Suzuki, A detailed course on physical metallurgy concepts. Nov.-Dec. 2012.	Prof.R.Prasad
	Indo-Danish Workshop on "Future Composites Technologies for Wind Turbine Blades" at IIT-Delhi, 8th Oct. 2012.	Prof.P.Mahajan & Dr.V.Tiwari
	INSPIRE (Innovation in Science Pursuits for Inspired Research), DST, "Surfaces and Interfaces: Titanic, Artificial Rain and Capillary Rise", 25th May 2012.	Prof.R.Prasad
2011	UGC NRC-M Workshop on NRCM Workshop on X-Ray Diffraction Methods, IISc, Bangalore, Topics: Basic Crystallography, Stereographic projections and Crystallographic Point Groups, 27th Dec. 2011.	Prof.R.Prasad
2011	UGC NRC-M workshop on Structural Characterization Techniques in Materials Science, IISc, Bangalore, Topics: Basic Crystallography, Stereographic projections, 29th June. 2011.	Prof.R.Prasad
2010	Faculty Development Programme on 'Mechanics' at Lovely Professional University, July 2010	Prof. S. Sanghi
	Faculty Development Programme on 'Solid Mechanics' at Lovely Professional University, July 2010	Prof. P.Mahajan
	5th SERC School on Texture & Microstructure, IIT Madras, Topic: Basic Crystallography, 25th Oct. 2010.	Prof.R.Prasad
2009	"Perspective of Welding Technology" NIT, Jallandhar, Topic: "Microstructural Evolution in Steel welds", 30th Dec. 2009.	Prof.R.Prasad
	CSIR Program on Youth for Leadership in Science (CPYLS), IIT, Madras, Topic: "Mechanical Behaviour of Materials", 22nd Dec. 2009.	Prof.R.Prasad
	Faculty Development Programme on 'Solid Mechanics' at Lovely Professional University, July 2009	Prof.P.Mahajan
	Faculty Development Programme on 'Mechanics' at Lovely Professional University, July 2010	Prof. S. Sanghi
	Workshop on "Microstructural Engineering", National Resource Centre for Materials, IISc, Bangalore, Topic: "Microstructure Evolution in Welding", 25th May 2009.	Prof.R.Prasad

b) Learning research material, science and technology made available on the website

2012	Slides and materials for AML120 course available at website : aml120.wikidot.com	Prof.R.Prasad
2013	Mechanics video lecture made available to IIT students at http://10.220.108.35/Etsc/videoprogrammes/courseinfo.php?id=am01	Prof. S.Sanghi

c) Courses taught via NKN, developed for NPTEL:

Ongoing	QEEE Course on 'Mechanics' on Jan-Mar. 2014	Prof.S.Sanghi

d) Books monographs, study material made available to other institutions

2013	Developing study material on solid mechanics for undergraduate teaching for a private company IREO. This is a consultancy project through FITT.	Prof. P.Mahajan

e) Experiments developed and made available to other institutions : NIL

f) Seminars live/via NKN, web to other institutions in India/abroad

2013	"Finite crystal elasticity of nano and continuum rods", University of California, Merced, USA, Nov. 2013.	Dr.A.Kumar
	"Effect of precipitate characteristics on prismatic slip dominated deformation behavior of Mg-6Zn alloy", 'Microstructure Diffraction 2013', IIT Bombay, 19^{th} -20^{th} April 2013.	Dr. J. Jain
	"Computational-based methods for Cardiovascular diseases: Application to Endovascular Aneurysm repair", Department of Mechanical & Materials Engineering at Florida International University, Miami, USA, June 2013.	Dr. A.Prasad

g) Reach out to schools, NCERT, KVs, etc. (e.g. K-12 programmes)

2014	Concept based teaching on 'Mechanics' at K.V. at IIT-Delhi, 3rd Jan.2014	Prof.S.Sanghi
2013	Talk titled "New Frontiers in Biomechanics and Medical Imaging" to high-school students during Popular Lecture Series at National Science Center, New Delhi.	Dr. A. Prasad
	Concept based teaching of 'Mechanics' for class XII, D.P.S. Society, Aug. 2013	Prof.S.Sanghi
2012	Concept based teaching of 'Mechanics' for class XII, D.P.S. Society, July 2012	Prof.S.Sanghi
2011	Gave talks for school students at DST Inspire program (IIT-Delhi) and CSIR-CPYLS program (IMMT-BBSR).	Prof.R.Prasad

h) Mentoring of other institutions, e.g. new IITs, NITs, universities, etc. Including faculty mentoring, curriculum development, laboratory development

2013	An observer in 'Pravartana'2013': TEQIP Workshop on Applied Mechanics at IIT Kanpur, Oct. 2013.	Prof.S.V.Veera valli
	"QIP", Summer Research Fellow, mentored two faculties from other universities like AMITY, etc., May-July 2013.	Dr. J. Jain
	An observer: "TEQIP conclave of Educators On quality of delivered academics in Mechanical Sciences", at IIT Kanpur, Dec. 2012.	Prof.S.V.Veera valli

2012	Visited MNIT, Bhopal to attend research degree committee meeting, 21st Oct. 2012.	Prof. D. K. Sehgal
	Visited MNIT, Allahabad as an expert for faculty selection, 17th Aug. 2012.	Prof. D. K. Sehgal
	Visited WELSPUN, Dahej, Gujrat as an expert for "Conducting Pipe Ring Collapse Test on Under Sea Gas Pipeline", 9th–12th Jan. 2012.	Prof. D. K. Sehgal
	"QIP", Summer Research Fellow, mentored two faculties from other universities.	Prof.P.Mahajan
2013	Helped in Materials Science Curriculum development at NIT-Srinagar.	Prof. R. Prasad

6.2 Industry collaboration

a) No. of students (PhD/masters) directly linked to industry funded projects

One, Funded by L&T.	Prof.R.Prasad
Presently 4 students pursuing PhD are working with DRDO.	Prof.P.Mahajan
One PhD student, IOCL R&D Faridabad.	Dr.J.Jain
Two PhD and eight Masters students, all ten of them from IOCL.	Prof.D.K.Sehgal
One student from SIEMENS	Prof.P.Mahajan

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

One student from Maruti took PG course in Materials, Dec. 2010.	Prof.R.Prasad
Two students took subject AML 705.	Dr.B.P.Patel
Two students.	Prof.S.Ahmad

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

2011	Oil Industry Development Board (OIDB): "Risk & Reliability analysis of Marine Risers", 2011, 6.78 lakhs.	Prof.S.Ahmad
2009	Central Warehousing Corporation, New Delhi: "Design And Study on Cost Effective Construction of Large Span Warehouses of Central Warehousing Corporation", 2009-10, Rs. 1,65,450.	Prof.S.Ahmad
	Central Warehousing Corporation, New Delhi: "Design and Optimization of warehouses for B.C. and Ordinary Soil Conditions of central warehousing corporation", 2009-10, Rs. 1,65,450.	Prof.S.Ahmad
	Central Warehousing Corporation, New Delhi: "Design of Large Span Trusses for Coastal Areas of central warehousing corporation", 2009-10, Rs. 27,575.	Prof.S.Ahmad

d) Continuing education/courses for industry

2014	Courses on Finite Element Method have been organized for trainee Engineers of Maruti Udyog. The courses consisted of about 45 lectures and 6-8 practicals. Courses in year 2013 and 2014.	Prof.P.Mahajan
	A short term course on Materials science: Terminal Ballistic	Dr. J. Jain

2013	Research Laboratory (TBRL), Chandigarh, DRDO Lab, March 2013.	
	Materials Science for TBRL, 2013.	Prof.R.Prasad
2012	Physical Metallurgy for Maruti, Nov. 2012.	Prof.R.Prasad
	A short term course on "Physical Metallurgy for Maruti Engineers", Maruti Suzuki India Ltd., Gurgaon, India, Oct.-Dec. 2012.	Prof.R.Prasad & Dr.J.Jain
2009	Special lectures in, "Finite Element fundamentals- Engineering Design" Industry Sponsored Course, Dassault Systems Solid Works Corp, USA and IIT Delhi, 16th Dec. 2009.	Prof.S.Ahmad
	International Course on Transportation Planning and Road Safety, IIT Delhi, India. Lectures on helmets delivered annually for last 5 years.	Prof.P.Mahajan

e) Faculty secondment to industry: NIL

f) Research projects undertaken with industry as partner

2014	M/S Jindal Saw Ltd: "Evaluation of CTOD Toughness in base metal, weld joint and HAZ of API steels and analyzing for failure safety", Jan.2014. Rs. 8,89,891.	Prof.R.K.Pandey & Dr.B.P.Patel
	"Modeling of Electromechanical Slender Structure", AR&DB, Jan. 2014 – Jan. 2016, Ongoing.	Dr. S. Roy
2013	"Mechanical Probing of Biological Cell", DST, Oct. 2013 - Oct. 2015, Ongoing.	Dr. S. Roy
	M/S Jindal Saw Ltd: "Evaluation of CTOD Toughness in pipe lines to ensure failure safety using Fracture Mechanics analysis", Jun.2013. Rs. 40,449.	Prof.R.K.Pandey & Dr.B.P.Patel
	M/S Jindal Saw Ltd: "CTOD Toughness determination in pipeline materials and ensuring safety from failure using fracture mechanics approach", May2013, Rs 11,73,039.	Prof.R.K.Pandey & Dr.B.P.Patel
	Jindal Saw Limited, Mathura (U.P.): "Evaluation of CTOD toughness and analyzing failure safety in weld joints of API steels", Mar.2013, Rs. 6,06,744.	Prof.R.K.Pandey & Dr.B.P.Patel
	Jindal Saw Limited, Mathura (U.P.): "Integrity analysis of pipe line weld joints using CTOD approach", Jan.2013, Rs. 4,44,946.	Prof.R.K.Pandey & Dr.B.P.Patel
	M/S Man Industries Ltd., Kutch, Gujrat: "Analyzing fracture safety of weld joints using CTOD approach", Jan.2013, Rs. 6,87,643.	Prof.R.K.Pandey & Dr.B.P.Patel
2012	Jindal SAW Ltd.: "Microstructural study of Zn-Al coating on ductile cast iron pipes", Nov. 2012-April 2013.	Dr.J.Jain
	Jindal Saw Limited, Mathura (U.P.): "Analysis of CTOD Toughness to ensure failure safety and welding process for pipe lines", Sept.2012, Rs. 4,71,912.	Prof.R.K.Pandey
	UKIERI, British Council: "Design of Ventilated Helmets", 2012-2014, Rs. 17lacs, Ongoing.	Prof.S.Sanghi
	Jindal Saw Limited, Mathura (U.P.): "Development of weld process	Prof.R.K.Pandey

	parameters for the pipe lines using CTOD based fracture mechanics approach", July2012, Rs. 2,69,664.	
	Jindal Saw Limited, Mathura (U.P.): "Application of fracture mechanics techniques in analyzing fracture toughness of welded pipe lines", Mar.2012, Rs. 2,59,425.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Assessment and analysis for the suitability of track pins under cyclic loading", Mar2012, Rs. 88,240.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness using fracture mechanics approach", Feb.2012, Rs. 1,98,540.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase IV", 2012-2013, Rs. 4.75lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
2012	DS Limited, NOIDA: "Evaluation of FFS Machines Classification", August 2012, Rs. 10lacs.	Prof. S. Sanghi
	IA Flow elements, Chennai: "Analysis and calibration of six inches averaging Pitot tube", March 2012, Rs. 2lacs.	Prof. S. Sanghi
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase I", 2012, Rs. 2.65lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	UK India Education and Research Initiative (UKIERI): "Natural anisotropic materials from micro-level composition to macro-level response", 2012, Rs. 32,44,200.	Prof. S. Ahmad
	Ordinance factory, Muradnagar: "Assessment & Analysis for the suitability of track pins under application involving cyclic loading", 2011-2012, Rs. 0.88lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	"Risk & Reliability analysis of Marine Risers", Oil Industry Development Board (OIDB), 2011.	Prof. S. Ahmad
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics", Dec.2011, Rs. 2,64,720.	Prof.R.K.Pandey
	Ordinance factory, Muradnagar, Mathura (U.P.): "Investigation on fatigue performance on T-20 track pins by 4-point bend test", Sep.2011, Rs. 88,240.	Prof.R.K.Pandey
	M/S Man Industries Limited, Kutch, Gujrat, India: "Analyzing fracture safety of weld joints API Pipeline using CTOD approach", Sep.2011, Rs. 10,58,880	Prof.R.K.Pandey
2011	Ordinance factory, Muradnagar: "Evaluation of performance of track pins under cyclic 4-point bend test to ensure suitability", Sep.2011, Rs. 88,240.	Prof.R.K.Pandey
	M/S Man Industries Limited, Kutch, Gujrat, India: "Analyzing fracture safety of weld joints API Pipeline using CTOD approach", Sep.2011, Rs. 10,58,880	Prof.R.K.Pandey
	Jindal Saw Limited: "Determination and analysis of CTOD Toughness for welded pipelines using Fracture Mechanics Techniques", Sep.2011, Rs. 3,30,900.	Prof.R.K.Pandey

2011	Jindal Saw Limited, Mathura (U.P.): "Integrity analysis of pipeline weld joints and process parameters using FM approach", July.2011, Rs. 5,62,230.	Prof.R.K.Pandey
	Jindal Steel Limited, Kosi kalan: "Integrity analysis of pipeline weld joints and process parameters development using FM approach", June.2011, Rs. 5,50,000.	Prof.R.K.Pandey
	M/S AMW-MGM Forgins Pvt Ltd, Mysore: "4-point Cyclic test and evaluation T-90 track pins", May.2011, Rs. 97,285.	Prof.R.K.Pandey
	CPWD, New Delhi: "Evaluation of tensile and fatigue characteristics of parallel threaded mechanical splices couplers", April.2011, Rs. 2,42,660.	Prof.R.K.Pandey
	M/S Man Industries Limited, Kutch, Gujrat, India: "Evaluation of CTOD Toughness for API 5L Gr X-60 PSL2", May.2011, Rs. 3,17,664.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase II", 2011-2012, Rs. 1.96lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	WELSPUN CORP, Gujrat, India: "Calculation of Collapse Pressure, Radial Movement and Strains on the Under Sea Pipeline Using FEM, DNV Formulation and to Conduct experimentally Pipe Ring Collapse Test" at WELSPUN Gujrat Premises, 2011-2012, Rs. 4.20lacs.	Prof.D.K. Sehgal
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase III", 2011-2012, Rs 2.59lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase IV", 2011-2012, Rs. 5.29lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	AR&DB: "Dynamic response and risk assessment of air craft component", 2011, Rs. 4,78,480.	Prof. S. Ahmad
	Oil Industry Development Board (OIDB), Risk & Reliability analysis of Marine Risers, 2011, Rs. 6.78lacs.	Prof. S. Ahmad
2010	DS Limited, NOIDA: "Report on Classification of FFS Machines", Aug. 2010, Rs. 5lacs.	Prof. S. Sanghi
	M/S Man Industries Limited, Kutch, Gujrat, India: "Evaluation of CTOD Toughness in S-65 PSL-2 Pipe materials", Dec.2010, Rs. 3,17,664.	Prof.R.K.Pandey
	Ordinance factory, Muradnagar: "Development criteria for suitability of track pins under applications of cyclic loading", Dec.2010, Rs. 1,32,360.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Integrity Analysis of pipeline weld joints using CTOD approach", Oct.2010, Rs 2,64,720.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Investigation on integrity analysis of pipe line weld joints and process parameters developments using FM approach", Aug.2010, Rs 5,40,000.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "CTOD Toughness in weld joints of API steel and developments and modifications of process	Prof.R.K.Pandey

	parameters of weld joints", June.2010, Rs 1,80,000.	
	"Vetting Design and Drawings for Construction of Ranney Well at Dulhepur Village, Faridabad", March 2010, Rs. 1.8lacs.	Prof. S. Sanghi
2010	DST – RFBR (Indo-Russian Project): "Mathematical modelling of Material and Structures their deformation and fracture processes", 2010, Rs.14,11,800.	Prof. S. Ahmad
	Project funded by DST and jointly undertaken by IITD and TERI: "Development of Indigenous Membrane Bioreactor (MBR) using Submerged Flash Membranes and its Application for Municipal Wastewater Treatment", 2009-2013.	Prof.S.V.Veeravalli
	Jindal Saw Limited, Mathura (U.P.): "Evaluation of CTOD Toughness in weld joints of API steel and insurance of failure safety using FM approach", Nov.2009, Rs 5,29,440.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination of elastic-plastic toughness in piping joints and bends and evaluation of their suitability for engg. applications", Nov.2009, Rs 8,70,000.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Evaluation of toughness property in weld joints of API steel", May.2009, Rs 99,270.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Microscopic examination of steels for surface studies", Apr.2009, Rs 71,695.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Evaluation of CTOD Toughness and field weldability-test of pipe lines", Mar.2009, Rs 3,37,080.	Prof.R.K.Pandey
2009	Jindal Saw Limited, Mathura (U.P.): "Determination of fracture resistance of weld pipes for application in carrying oil and gases", Feb.2009, Rs 5,39,328.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Performance evaluation of bends and pipe joints of API steel for gas pipe line application", Jan.2009, Rs 4,71,912.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Determination & Analysis of CTOD Toughness for welded Pipelines using Fracture Mechanics Techniques. Phase V", 2012, Rs. 2.94lacs.	Prof.D.K.Sehgal & Prof.R.K.Pandey
	MCD Delhi, India: "Testing of HDPE Corrugated Pipe of size 90mm as per IS: 14930 Phase II, 2009-2010, Rs. 1.32lacs.	Prof.D.K.Sehgal
	MCD Delhi, India: "Testing of Octagonal Pole for Wind Pressure Phase II, 2009-2010, Rs. 1.36lacs.	Prof.D.K.Sehgal
	Sarda Steel, Kanpur, India: "Physical Testing of Steel bars", 2009-2010, Rs. 0.32lacs.	Prof.D.K.Sehgal
	Ghazipur Slaughter House and Rendering Plant", 2009-2010, Rs. 0.67lacs.	Prof.D.K.Sehgal
	MCD, Delhi, India: "Testing of fire Fighting System in the MCD, Delhi, India: "Testing of HDPE Corrugated Pipe of size 90mm as per IS: 14930, 2009-2010, Rs. 1.32lacs.	Prof.D.K.Sehgal
	Central Warehousing Corporation, New Delhi: "Design of Large Span Trusses for Coastal Areas of central warehousing corporation", 2009-2010, Rs. 27,575.	Prof. S. Ahmad

2009	Sarda Steel Kanpur: "Physical and Chemical TESTING OF Steel bars", 2009-2010, Rs.1.32 lakhs. [Prof. D. K. Sehgal]	Prof. D. K. Sehgal
	Central Warehousing Corporation, New Delhi: "Design And Study on Cost Effective Construction of Large Span Warehouses of Central Warehousing Corporation", 2009-10, Rs.1,65,450. [Prof. S. Ahmed]	Prof. S. Ahmad
	Central Warehousing Corporation, New Delhi: "Design and Optimization of warehouses for B.C. and Ordinary Soil Conditions of central warehousing corporation", 2009-10, Rs.1,65,450. [Prof. S. Ahmed]	Prof. S. Ahmad
	Aeronautical Research Development Board at IIT Delhi: "Development of an Associate Node for Computational Fluid Dynamics", 2009-06-03, Rs.42lacs, Ongoing.	Prof. S. Sanghi
	ONGC: "Preliminary study of possible avenues for combustion of low calorific value flue gas", March 2009-2010, Rs.3lacs.	Prof. S. Sanghi
	Yamuna Expressway Industrial Development Authority, NOIDA: "Development of Verification Methodology and Technical Support & Supervision of Computerized Draw of Allotment of Plots", Nov. 2009, Rs.10lacs.	Prof. S. Sanghi
	General Electrical (I) Tech. Centre Pvt. Ltd.: "Stochastic Analysis of Composite Structures", Rs.6.2lacs, 2009.	Prof. S. Ahmad
2008	MCD, Delhi, India: "Checking of Electric Pole for Dimensions, Physical Properties, Galvanization and Welding", 2008-2009, Rs. 0.88lacs.	Prof. D. K. Sehgal
	Ghaziabad Precision Products Pvt Ltd: "Evaluation of fatigue endurance of springs for material substitution", Dec.2008, Rs 77,528.	Prof.R.K.Pandey
	Jindal Saw Limited, Mathura (U.P.): "Fracture Mechanics study of weld joints of API steel piping", Dec.2008, Rs. 5,05,620.	Prof.R.K.Pandey
	Orient Power system, New Delhi: "Toxicity studies relating to Pb-casting in closed metal dies using gravity/pressure", Nov.2008, Rs. 22,472.	Prof.R.K.Pandey
	Motherson Sumi System Ltd, Noida: "Fracture analysis of brass connectors", Nov.2008, Rs. 22,472.	Prof.R.K.Pandey
	Cintec International Ltd, India: "Proof Checking of Bridge Monitoring Report of Eastern Railway", 2008-2010, Rs.2.8lacs.	Prof. D. K. Sehgal
	MCD Delhi, India: "Testing of Octagonal Pole for Wind Pressure", 2008-2009, Rs.0.45lacs.	Prof. D. K. Sehgal
	Cintec International Ltd, India: "Proof Checking of Bridge Monitoring Report of North-East Frontier Railway", 2008-2010, Rs.2.8 lakhs.	Prof. D. K. Sehgal
2008	Naval Research Board: "Large Scale Data Processing and Visualization", 2008-11-04, Rs.40lacs.	Prof. S. Sanghi
	M/s Paharpur Cooling Tower Ltd.: "Design and Calibration of Pitot Rods", Kolkata, 2008, Rs.2.25lacs.	Prof. S. N. Singh
	M/s Jindal Steel and Power Ltd., Raigarh: "Rheo Logical Analysis of	Prof. S. N. Singh

	Ask for HCSD", 2008, Rs.1.75lacs.	

f) Laboratories, equipment, etc. provided by industry for use in UG/PG teaching laboratories and student projects: NIL

6.3 Professional

a) Service as Board, Senate, selection committee member at other IITs, NITs and other universities

2014	Selection of faculty members at IIT-Hyderabad, 2014.	Prof. R. Prasad
2013	Member, National Selection Committee of DAAD PhD and PhD Sandwich Model Scholarships, Nov. 2013.	Prof. S. Kapuria
	Member, National Selection Committee for Fulbright Postdoctoral Research Fellowship, Oct. 2013.	Prof. S. Kapuria
	Member, Selection Committee for CSIR, Oct. 2013.	Prof.R.K.Pandey
	Selection committee member in Krishna Institute of Engineering and Technology, 2013.	Dr. M. K. Singha & Dr.Pradymna.S.
	Member, Selection Committees, NIT Raipur, March 2013; Defense Inst. of Arm. Tech. 2013; MS University of Baroda, 2013.	Prof. S. Kapuria
	Selection Board Dept. of Mechanical Engg., IIT-Hyderabad; DRDO; CSIR, 2013.	Prof. P. Mahajan
2012	Selection of Scientists at NML (CSIR), 2012-2013.	Prof. R. Prasad
2011	Member, National Selection Committee for International Fulbright-Nehru Senior Research Fellowships, Oct. 2011.	Prof. S. Kapuria
	Member, National Review Committee for International Fulbright Science and Technology Award, June 2011.	Prof. S. Kapuria
	Member, Selection Committee for Defence staff, CGO Complex, March 2011.	Prof.R.K.Pandey
2010	Member, National Selection Committee for Fulbright-Nehru Doctoral and Professional Research Fellowships, Sept. 2010.	Prof. S. Kapuria
	Member, Selection Committee for Naval Officers, CGO Complex, July 2010.	Prof.R.K.Pandey
	Member, Selection Committee for DRDO, March 2010.	Prof.R.K.Pandey
2009	Member, Governing Body, Delhi College of Arts and Commerce, Aug. 2009 – Oct. 2010.	Prof. S. Kapuria
	Member, Faculty Selection Committee, Haryana Waqf Board, July 2009.	Prof.R.K.Pandey
	Member, Faculty Selection Committee, Haryana Waqf Board, Meerut, May 2009.	Prof.R.K.Pandey
	Member, Faculty Selection Committee, NIT-Rourkela, May 2009.	Prof.R.K.Pandey
	Member, Fellowship Selection Committee, CSIR, New Delhi, Feb. 2009.	Prof.R.K.Pandey
	Member, Faculty Selection Committee, NIT-Raipur, Jan. 2009.	Prof.R.K.Pandey
	Member, DRDO Selection Committee, Jan. 2009.	Prof.R.K.Pandey
2008	Member, DRDO Scientists Selection Committee, Dec. 2008.	Prof.R.K.Pandey
	Selection committee at IIT-Hyderabad.	Prof.S.V.Veeravalli
	Service as selection committee member at NIT-Jalandar, NIT-Hamirpur, NIT-Allahabad, RGPV-Bhopal, SGT-Gurgaon, IP Univ-Delhi.	Prof. D. K. Sehgal

b) Service as PhD thesis examiner at other institutions

2014	"Experiments on a rolling sphere submerged in an incompressible fluid" submitted by P K Verekar, Dept. of Mech. Engg. IISc Bangalore, supervised by J H Arakeri, Jan.	Prof.S.V.Veeravalli
	MANIT-Bhopal, Feb.	Prof. D. K. Sehgal
	Examiner at N.A.L. Bangalore.	Dr. Pradyumna S.
	PhD Thesis Examiner for IIT Madras.	Dr. M. Singha
2013	IIT-Madras; IIT Roorkee, Nov.	Prof.D.K.Sehgal
	PhD Thesis Examiner for NIT-Rourkela.	Prof.R.K.Pandey
	PhD examiner at IIT-Roorkee	Prof. P. Mahajan
	MS Thesis Examiner for IIT-Madras	Prof. P. Mahajan
	PhD examiner at IISc Banglore	Prof.S.Kapuria
2012	PhD Thesis Examiner at East Point College of Engg & Tech., Bangalore.	Prof.R.K.Pandey
	PhD examiner at IISc Banglore	Prof.S.Kapuria
	PhD Thesis Examiner at IIT-Roorkee, 2012	Dr.B.P. Patel
2011	Examiner at Belgaum University, June.	Prof.R.K.Pandey
	IIT-BHU	Prof. R. Prasad
	"Studies on vortices with density stratifications" submitted by H N Dixit, Engg. Mech. Unit, J N Centre for Advanced Scientific Research, Supervised by R. Govindarajan,	Prof.S.V.Veeravalli
	PhD Thesis Examiner at IIT Kharagpur, Dept. of Metallurgical & Materials Engg., April.	Prof. R. K. Pandey
	PhD examiner at IIT Madras.	Prof.S.Kapuria
	PhD examiner at IIT Bombay.	Prof.S.Kapuria
	MS Thesis Examiner for IIT Madras.	Prof. P. Mahajan
	Examiner at Fakir Mohan University, Balasore, Odisha.	Prof. P. Mahajan
2010	PhD Thesis Examiner at IIT Roorkee, Dept. of Metallurgical & Materials Engg., Dec.	Prof.R.K.Pandey
	Examiner at NIT Surathkal, Dept. of Metallurgical Engg., Nov.	Prof. R. K. Pandey
	PhD examiner at IIT Madras	Prof.S.Kapuria
	PhD Thesis examiner for IIT Madras.	Prof. P. Mahajan
	Thesis examiner at IIT Bombay.	Prof. P. Mahajan
2009	PhD Examiner at IIT Kharagpur.	Prof. R. Prasad
	PhD Thesis Examiner at IIT Roorkee, Dept. of Metallurgical & Materials Engg., Aug.	Prof. R. K. Pandey
	PhD Thesis Examiner at Barktulla Univ-Bhopal.	Prof. D. K. Sehgal
	PhD examiner at IIT Kharagpur	Prof.S.Kapuria
	PhD examiner at NIT Bhopal	Prof.S.Kapuria
	PhD Thesis examiner , NIT-Surathkal, 2009	Dr. B.P. Patel
	PhD Thesis examiner for NIT-Tiruchirapalli, 2009.	Dr. B.P. Patel

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

	Member of committee for selection of Scientist B through Campus	Prof. A. Dewan

2013	Placement at IIT-Indore, Dec. 2013.	
	Project Review Committee, Fly Ash Unit, DST, last 3yrs.	Prof.S.Sanghi
	Member, Review Panel of ARDB (DRDO), 2013.	Prof.S.Sanghi
2012	Member, Peer Review Committee, TBRL, DRDO, 2012	Prof. P. Mahajan
	Member, Research Council, SASE, DRDO, 2012-13	Prof. P. Mahajan
2010	Member, PEER Review Committee, SASE, 2010-11.	Prof. P. Mahajan

d) Technical expert on policy, regulatory, laws, standards committees: NIL

e) Member of Board/Advisory board of public and private sector corporations: NIL

f) Positions (e.g. director, vice chancellor, etc.) held by faculty on lien: NIL

6.4 Contribution to national development goals

a) Projects undertaken

2012	"Development of Light weight ballistic materials system for Body, Vehicle and Structural Armors, Industrial Research and Development", IRD, IIT Delhi, sponsored by Central Govt of India, 3yrs, 2012, Rs. 1 crore.	Prof. S. Ahmad
2010	"Authentication of Aerostat capacity against projectile impact and remaining afloat, XIX Common Wealth Games", Government of India, Delhi, 2010.	Prof. S. Ahmad
	The notable examples of design of frontline warships and submarines are the recent launch of the indigenous aircraft carrier 'Vikrant' and nuclear submarine 'Arihant'. All these projects have been led by the proud alumni of NCW/Applied Mechanics Department/IIT Delhi.	Alumni of the Department

b) Policy inputs-implications, visible impact on society: NIL

c) Entrepreneurship development

Teaching feasibility study to prepare reports for entrepreneurship development.	Prof. D.K. Sehgal

6.5 Alumni Engagement

a) Regular interaction/engagement with alumni and outcomes: NIL

b) Contributions from alumni: NIL

6.6 Recognitions and Awards

a) Awards to Faculty

2014	Erasmus Mundus Fellowship, 2014.	Prof. R. Prasad
	Member, Editorial Board of journal of Thermal Stresses; Guest Editor, Special Issue of ACTA MECHANICA on Mechanics of functional Materials and structures, 2014.	Prof. S. Kapuria
	Teaching Excellence Award, IIT-Delhi, 2014.	Prof. S.V. Veeravalli & Dr. Sawan Suman
2013	Distinguished Alumnus Award- DME-IIT-BHU, 2013.	Prof. R. Prasad
	DST Young Scientist Award. The award includes a research grant of Indian Rs. 21,70,000 for research project titled: "Study of deformation behaviour of precipitate containing Mg-6Al-1Zn alloy".	Dr. J. Jain
	Teaching Excellence Award, IIT-Delhi, 2013.	Dr. Balaji Srinivasan
	Received a DST Fast track for the project Mechanical Probing of biological cell, 2013	Dr. S. Roy
2012	Teaching Excellence Award, IIT-Delhi, 2012.	Prof. R. Prasad Dr. B.P.Patel Dr. Balaj Srinivasan
	Young Faculty Incentive Fellowship, IIT Delhi, 2012.	Dr. J. Jain
	Sapna Larioa Outstanding Biomedical Engineering Award, IIT Delhi.	Dr. S. Roy
2011	Rajat Gupta Chair Professor, 2011.	Prof. S. Kapuria
	Excellence in Teaching Award, I.I.T. Delhi, 2011.	Prof. S. Sanghi
	Young Faculty Incentive Fellowship, IIT Delhi, 2012.	Dr. A. Kumar
2009	Fulbright Senior Research Fellow, 2009.	Prof. S. Kapuria

b) Fellow of academics, INAE, etc

Fellow, Indian National Academy of Engineering (INAE).	Prof. S. Kapuria
Fellow, Institution of Engineers, India.	Prof. A. Dewan
Fellow, Institutions of Engineers, India.	Prof. S. Sanghi
Fellow, Institution of Engineers, India.	Prof. S. N. Singh

GOVERNANCE

7

Executive Summary: Governance

Governance of the Applied Mechanics Department at IIT Delhi is characterized by its efficient and transparent decision making. The Department has various committees to assist the Head of the Department in taking decisions and manage different academic and administrative issues. The Department is proactive in envisaging the present and future requirements of the department, taking appropriate actions and communicating requirements/needs to the institute authorities. The department has a faculty search committee for seeking new applicants as well as actively processing the incoming applications The Department had been able to add 8 new faculty members in the last 5 years. The Department holds its Faculty Board meetings regularly to discuss various academic and administrative related issues and take decisions. The Departmental Research Committee takes decisions on research related issues.

7.1 Governance

(a) Organization structure – The head of the department is responsible for all the administrative activities of the department. The department has several committees that assist the Head in managing the various aspects of the Department. The committees have varying degree of independence and responsibility. These include:

i. **Departmental Faculty Board (DFB)** – Responsible for taking decisions on all academic/administrative matters.
ii. **Professors Committee** – Responsible for shortlisting of faculty applicants, taking faculty related important decisions.
iii. **Departmental Research Committee (DRC)** – Responsible for managing all research related matters of the department as well as those related to PG students.
iv. **Training and Placement Committee** – Responsible for training and placement related matters of the students of the Department.
v. **Faculty Search Committee** – Responsible for seeking and assessing applicants for faculty positions.

(b) Planning documents developed by the department

i. A Vision document was recently prepared by the department and communicated to the Institute administration.
ii. A document on Space Requirement was also prepared recently and forwarded to the relevant Institute authorities.

(c) Records of discussions within the department-internal documents (meetings minutes, position papers, discussion papers, concept papers, etc.)

Minutes of DFB, DRC and professorial committees are circulated amongst the committee members, sent to the appropriate authorities for necessary actions and are archived.

(d) Physical resources-percentage utilization for UG PG core and elective teaching separately, UG and PG student research, Projections for future

i. Presently, on an average faculty members spend 10% of their time teaching core courses, 10% on teaching elective courses, 20% on laboratory or similar courses, 20% on administrative matters, 10% on M Tech project guidance and 30% on PhD research guidance.

ii. In future, as we continue to improve faculty strength, we hope to reduce the faculty load from teaching and administration and increase the focus on PhD research guidance. One possible outcome could be - 10% on teaching core courses, 10% on teaching elective courses, 10% on laboratory or similar courses, 10% on administrative matters, 10% on B Tech/ M Tech project guidance and 50% on PhD research guidance.

iii. With increased faculty strength, we also hope to be more liberal in allowing faculty to take sabbaticals or non-teaching semesters to pursue newer areas of research.

(e) Financial resources-(i) funds provided to the department, (ii) processes of distribution, (iii) funding for focus areas, (iv) funding for UG and PG core teaching laboratories. Outcome of funds utilization. Changes in funding pattern and funds utilization, and effects on departmental strategy

i. Funds are provided to the department under several different heads. These include NPN05 and PLN03. For 2013-14, the amounts received under these funds were 42 lacs (NPN05) and 1.9 crore (PLN03).

ii. The budget for consumables (NPN05) is distributed equitably amongst the faculty depending upon their requirements. For the budget of non-consumables (PLN03), the HOD calls a DFB meeting and requests all faculty to submit their requests for the year. The fund allocation finalized in the DFB is communicated to Planning unit. Once the funds are received from Planning unit, the HOD through DFB decides the priorities of equipment purchases.

iii. Funding requests from faculty for repairs of office and laboratories are routinely made from the faculty to Planning unit via HOD.

iv. Funding requests for UG/PG lab upgradation are made by the respective faculty lab in- charges together with the HOD as per lab requirements.

v. At present, we feel that the support we receive from the Institute meets our expectations.

vi. For future, the department would like to be in a place where majority of the funding comes through sponsored research projects from government agencies and industry. We are already moving towards this. During 2009-13, the total funding that the department faculty received via major sponsored research projects was Rs. 16.4 crore while the total funding received from the Institute from 2009-2013 was Rs.54.9 lakh. The Department has also received Rs. 6.55 crore from different consultancy projects.

(f) Delegation of decision making within department/centre. List the processes and structures for financial and academic management, and the methodology for their review

As mentioned above, the department takes a team based approach towards decision making. The various teams listed above are responsible for the assigned tasks and do most of the groundwork. Final approval of the matter may happen in the respective

committee or a higher level committee or by the HOD depending on the nature of the matter.

7.2 Department management and operations

(a) Organization structure-mandates, flexibility, etc. (Sept. 2013 onwards)

SECRETARY, DEPT. FACULTY BOARD : Dr. B. P. Patel

DEPARTMENTAL RESEARCH COMMITTEE

1. Chairman	:	Prof. Puneet Mahajan
2. Member	:	Prof. Suhail Ahmad
3. Member	:	Prof. Rajesh Prasad
4. Member	:	Dr. B.P. Patel
5. Member	:	Dr. Murali R. Cholemari
6. Member	:	Prof. S. Kapuria
7. Member	:	Prof. S. V. Veeravalli
8. Member	:	Dr. M. K. Singha

GROUP COORDINATORS

1. Solid Mechanics	:	Prof. Puneet Mahajan
2. Fluid Mechanics	:	Prof. S.V. Veeravalli
3. Design Engg.	:	Prof. Santosh Kapuria
4. Materials Science	:	Prof. Rajesh Prasad

PROGRAMME COORDINATORS

1. M.Tech. (Engg. Mech.)	:	Prof. Rajesh Prasad
2. M.Tech. (Design Engg.)	:	Dr. Murli R. Cholemari
3. DIIT (Naval Construction Wing)	:	Dr. B. P. Patel
4. Ph.D.	:	Dr. M. K. Singha

LABORATORY INCHARGES

1. Fluid Mechanics	:	Prof. S. V. Veeravalli
2. Strength of Materials	:	Dr. M. K. Singha
3. Materials Science/Physical Metallurgy	:	Dr. Jayant Jain
4. Gas Dynamics	:	Prof. S. N. Singh
5. Stress Analysis	:	Prof. S. Kapuria
6. Experimental Method & Analysis	:	Dr. V. Tiwari
7. Impact Mechanics	:	Dr. V. Tiwari
8. Computational Lab.	:	Dr. Ajeet Kumar
9. Departmental Workshop	:	Dr. S. Pradyumna
10. Departmental Stores	:	Prof. Suhail Ahmad
11. Departmental Library	:	Dr. Anamika Prasad
12. M.T.S.	:	Dr. B. P. Patel
13. Design Optimization Lab.	:	Dr. S. Hegde
14. C.F.D. Lab. & Parallel Comp. facility	:	Dr. Balaji Srinnivasan Dr. Ajeet Kumar

OTHER ASSIGNMENTS

1. Time Table (Incharge)	:	Dr. S. Pradyumna
2. Computer Liaison Officer/ AMD website	:	Dr. S. Hegde/ Dr. S. Roy
3. Safety Committee	:	Dr. V. Tiwari
4. Training & Placement	:	Dr. Sitikantha Roy
5. Curriculum Development	:	Prof. Sanjeev Sanghi
6. Assistantship Coordinator	:	Dr. M. K. Singha
7. Physical Facilities	:	Dr. S. Hegde/Dr.V.Tiwari

INSTITUTE ASSIGNMENTS

1. Central Library Committee (ACL)	:	Prof. Anupam Dewan
2. B.P.G.S.&R.	:	Prof. Anupam Dewan
3. B.U.G.S.	:	Prof. Santosh Kapuria
4. Computer Users' Committee	:	Prof. Sanjeev Sanghi
5. Academic Interaction Committee	:	Dr. Balaji Srinivasan
6. Alumni Affairs & Intl. Programme	:	Dr. Murali R. Cholemari
7. Vice President, Applied Mech. Society	:	Prof. Anupam Dewan

Flexibility: A faculty can go on sabbatical in which case his/her work is shared by other faculty.

(b) Processes for curriculum planning

Typically, the curriculum review is initiated by the Institute which directs various departments to review their curriculum. The department then forms its sub-committee at department level. The recommendations of the sub-committee are discussed in Departmental faculty board and then are sent to the Institute bodies. The Board of Academic Programs (BAP) having representative from all departments then discusses recommendations of all departments. Once, the BAP approves the review, it is then sent to the senate for discussion and approval. Currently, UG and PG curriculum review is underway.

(c) Processes and methods for teaching resources management

The faculty members manage their own course resources. They also use Institute's online academic management and infrastructure SLA system for giving grades/marks, marking attendance, to get student feedback and get linked to Sakai to share teaching resources with students.

(d) Guest faculty, affiliation for teaching core, elective UG and PG courses

There is seldom any guest faculty who is invited to take courses. Guests in their specified field of specialization are, however, often called for giving seminars, invited talks and to evaluate M. Tech Projects and PhD theses. Faculty members try to highlight the Department and its activities at all available forums. The Department also maintains a highly visible and informative website to attract the prospective faculty aspirants. The procedure to select a faculty member through all the routes remains the same.

(e) Faculty short-listing criteria.
Institute-level short-listing criteria:

Minimum Short-listing Criteria for an Assistant Professor:

- Ph. D with 3 years experience
- 1st class or equivalent grade in all degrees in respective discipline, with a consistently good academic record
- Potential for very good teaching
- Maximum age of 35 years(to be relaxed by 5 years in case of persons with disability), and
- At least 4 publications (of which at least 2 should be in reputed journals)

Minimum Short-listing Criteria for an Associate Professor:

- Ph. D with 8 years experience of which at **least 3 years should** be as an Assistant Professor or equivalent.
- 1st class or equivalent grade in all degrees in respective discipline, with a consistently good academic record.
- Should have demonstrated capability for good teaching.
- At least 10 publications (of which at least 4 should be in reputed journals).
- Should have guided at least one Ph. D student, possibly jointly with other faculty/researcher.
- Completed at least one sponsored R&D or consulting project as PI, or completed two sponsored R&D or consulting project as co-PI.

Minimum Short-listing Criteria for a Professor:

- Ph. D with 10 years experience of which either
  a. at least 3 years should be as an Associate Professor or equivalent, or
  b. at least 8 years should be as an Assistant Professor or equivalent (in cases where the post of Associate Professor or equivalent does not exist), and
- 1st class or equivalent grade in all degrees in respective discipline, with a consistently good academic record.
- Should have demonstrated excellence in good teaching.
- At least 20 publications (of which at least 8 should be in reputed journals).
- Should have guided at least one Ph. D student, or have guided at least two Ph. D students jointly with other faculty/researchers.
- Completed:
  a. one sponsored R&D or consulting project as a PI
  b. one more sponsored R&D or consulting project as PI, or two two sponsored R&D or consulting projects as co-PI
- Engineer/Technologist from industry who may or may not have a Ph.D. Such a person should have made a significant contribution to research, innovation or generation of new knowledge while working in a responsible position in a company with an established reputation and significant revenue. His/her contribution should be adequately documented by the way of awards, designs that are in production, patents, design registrations, and/or publications. The

contribution and position occupied by him/her earlier should be consistent with the academic position for which he/she is being considered.

Additional Criteria for the Department of Applied Mechanics

For Assistant Professor

Basic (Bachelor's/Master's) degree must be in one of the following (or in equivalent specialization)

a. Mechanical Engineering
b. Civil Engineering
c. Aerospace Engineering
d. Metallurgical Engineering/ Materials Science

(f) How collectiveness of the faculty has enhanced academic output and enhanced quality, etc.

The faculties according to their areas of specialization are clubbed in four different groups namely Solid Mechanics, Fluid Mechanics, Material Science and Design Engineering. Faculty members have joint projects/papers within and outside the groups. Also through Inter-departmental discussions, M. Tech. projects, Ph.D. SRC committee formation, the group members interact and help to enhance the quality of research going on in and outside the department. In section 3 (research) part of the document, more information on number of collaborative projects, papers written together in the last 5 years can be found.

(g) Nature, quantum and quality of support from of secretarial staff, stores and inventory management, purchases, ambience, etc.

There are several staff members who help the department. Some of the posts and the implicit nature of work involved are as mentioned below:

Designation	Off./Lab Name
Sr. Assistant	Dept. Office
Attendant	Dept Office
Sr. Lab. Asstt	Strength of Materials Lab
Jr. Lab. Asstt.	Stress Analysis Lab.
Jr. Tech. Supdt.	Gas Dynamics Lab.
Jr. Lab. Assistant	Gas Dynamics Lab.
Jr. Mechanic	Gas Dynamics Lab.
Jr. Lab. Assistant	M.T.S. Lab. and Impact Mech. Lab
Jr. Tech. Supdt.	Design Optimization / Computation Lab.
Jr. Tech. Supdt.	Materials Sc. Lab.
Attendant	Fluid Mech. Lab.
Jr. Tech. Supdt.	Experimental Methods
Jr. Mech.	Strength of Materials Lab
Sr. Mech.	Dept. Workshop
Jr. Mech.	Dept. Workshop
Attendant	Dept. Workshop
Jr. Supdt. (Stores)	Dept. Stores
Attendant	Materials Sc. Lab

7.3 Faculty

(a) Faculty Profile

At present the Department has 21 regular faculties, 4 Emeritus Professors and 1 INSA Professor. There is a mix of 9 Professors, 2 Associate Professors and 9 Assistant Professors among regular faculty members and 4 Adjunct Faculty in Naval Construction Wing. The expertise of faculty can be broadly classified into four areas viz.,(i) Solid Mechanics, (ii) Fluid Mechanics (iii) Material Science and (iv) Design Engineering. As can be seen from the relevant sections of the present document, faculty members actively engage in fundamental as well as applied research. Despite the rich diversity in faculty profile, highlighted in the following section, there still remain some gaps in terms of skills especially in the area of process control.

(b) Diversity in faculty profile by (i) gender, (ii) category, (iii) region, (iv) Ph.D. institution, (v) post-doctorial institutions worked in, (vi) organizations/industry worked in and (vii) employment prior to joining the department. (Mention in numbers)

- Gender : 23 Males and 1 Female
- Category : 24 General
- Ph.D. Institution : 13 from IIT/IISc/NIT and 11 from Abroad
- Post-doctoral institute : 7 Abroad
- Industrial experience : 9
- Prior employment : 12 in Academics, 9 in Industry.
- Naval Officers : Captain-1, Commander-1, Lt. Commander-2

(c) Procedure for faculty searches

Procedure

As per the Statutes of the institute, all faculty posts at the Institute are normally filled through regular advertisement and rolling advertisement at the level of assistant Professor. However, the BOG has the power to decide, on the recommendations of the Director, that a particular post be filled by invitation or by promotion from amongst the members of the staff of the Institute. In all these cases, appointments are made by the BOG on the recommendations of the Selection Committee constituted for the purpose. In the case of appointments to reserved posts, the relevant reservation rules apply. The advertisement is drafted to include the following:

- Designation of the post sought to be filled.
- Area in which recruitment is contemplated.
- Pay scale attached to the post and allowances.
- Minimum qualifications expected of the candidates.
- Additional/desirable qualifications, if any.
- Previous experience required, with the type of experience, duration etc.
- Prescribed age.
- Relaxation of age, qualifications and experience if any.
- Mode of collecting forms of application from the Institute by the intending candidates.
- Last date for receiving requests for application forms from intending candidates.
- Last date for the receipt at the Institute, of filled and completed applications from candidates.

When any post is reserved for candidates belonging to the Scheduled Castes/Scheduled Tribe /OBC, this fact is specifically mentioned in the advertisement. Candidates in the service of Government or Quasi-Government or Govt. aided Institutions including Universities, are expected to send their applications through proper channel or furnish a certificate from the employer that they have no objection to their applications being considered. The advertisement is released in such a way that all the regions of the country are covered. A panel of such newspapers is approved by the Director from time to time. In special cases, the Director may decide that additional coverage be provided by advertising the posts abroad and/or in scientific journals. The Institute also has rolling advertisement for the post of Assistant Professor in its various academic Departments/Centres. Prospective candidates can apply any time throughout the year. Based on the need of the department/Centre concerned, efforts are made to take a decision at the earliest.

The processing of applications is done in accordance with statutes of the institute. Applications received in the Establishment (E-I) Section by the due date prescribed, are registered in a register kept for the purpose and entered in the ACSS System. All the applications received are then forwarded to the Head of the Department for his preliminary scrutiny and advice to the Chairman Selection Committee regarding the candidates who are shortlisted and could be invited for test/interview by the Selection Committee for the post. The applications undergo the shortlisting criteria check. The shortlisted applications are forwarded to Faculty Search Committee (FSC) of the Department. The FSC is a mix of Faculty members who represent different areas of Applied Mechanics of interest to the Department. The FSC critically evaluates the application with respect to the publications/patents/technology development and alignment with the department’s requirement. The recommendations of FSC are conveyed to Professorial Committee (PC) of the Department which then takes a decision on further progress of the applications. Shortlisted candidates are then invited for interaction with the Department. This is preferably in the form of a one-day visit to the Department. FSC coordinates this visit by arranging many one-to-one meetings with the current faculty members and a seminar by the candidate. The seminar is attended by the faculty members. Each member is asked to provide a feed-back about the candidate's suitability for selection to the HOD. Based on these inputs and experience of the one-to-one meetings, FSC prepares a recommendation for the PC. PC thoroughly deliberates on each application and arrives at a recommendation which is conveyed to the Head of Department. The HOD gets the applications discussed by the PC before sending his advice to the Chairman Selection Committee.

In case of Professor, the selection committee consists of

- Director (Chairman).
- One Visitor's nominee (member).
- Two nominees of the Board, one being an expert but other than a member of the Board (members).
- One expert nominated by the Senate other than being a member of the Senate (member).
- In case of Assistant and Associate Professors, the selection committee consists of
- Director (Chairman).

- Two nominees of the Board, one being an expert but other than a member of the Board (members).
- One expert nominated by the Senate other than being a member of the Senate (member).
- Head of the Department (member).
- The Institute may have one member of the Board and one expert from the approved list against two nominees of the Board on the Selection Committees or both the experts as nominees of the Board from the approved list in case local member of the Board is not available. The nominees of the Board are approved by BOG from time to time, normally for a period of two years. *SC/ST/OBC* representative will also be included as a member of the Selection Committee if the post is reserved for *SC/ST/OBC* etc.

The meeting of the Selection Committee is fixed by the Chairman of the Committee. A copy of the advertisement and particulars of all the candidates called for interview are forwarded to each member of the Selection Committee. The Selection Committee interviews the candidates called. It considers the credentials of all the persons who have applied and also considers names if any suggested by members or otherwise brought to its notice. The Selection Committee thereafter makes its recommendations, the names of selected candidates being arranged in the order of merit. The Selection Committee also suggests the starting salary in the grade in each case. The Chairman, BOG looks at the recommendations of the selection committee and takes the final decision. Offers of appointment are issued on approval of the Chairman, BOG. The offer of appointment indicates the salary offered, the rates of allowances, the duration of the appointment and other terms and conditions of service as applicable from time to time, and prescribes the date by which acceptance of offer is to be communicated by the candidate. A candidate who is offered an appointment in the Institute should join within three months, if in India; and within six months, if abroad, from the date of the offer. However, Director may extend the joining time on request, up to six months from candidates in India; and one year for candidates abroad. The candidate is directed to get himself examined for physical fitness by the prescribed Medical authority. On production of a satisfactory certificate of physical fitness, the offer of appointment becomes operative.

(d) Result of faculty searches, number of applicants, shortlisted and offered a position

There has always been a good response to faculty advertisements and rolling advertisements. All shortlisted candidates satisfy the short listing criteria (given in section 7.2). Advertisement wise responses are listed here. Response with respect to post applied for is listed first followed by those with respect to area. Many applicants as well as currently serving faculty members would fall into multiple areas.

MS- Materials ScienceSM- Solid Mechanics FM- Fluid Mechanics

Advt	Post	Applied	Shortlisted	Area of Specialization	Offered	Area of Specialization
08/2013*	Assistant professor	20	1	MS	1	MS
11/2012	Professor	5	3	2- MS, 1- SM	2	MS
11/2012	Associate professor	5	0	-	0	-
05/2012	Assistant professor	18	4**	3- SM, 1- MS	3	2- SM, 1- MS
11/2011	Assistant professor	58	7***	2- MS, 2- SM 3- FM	5	1-MS, 2- SM, 2- FM
03/2011	Professor	3	0	-	0	-
03/2011	Associate professor	3	1	SM	1	SM
03/2011	Assistant professor	1	1	MS	0	-
11/2010	Professor	8	0	-	0	-
11/2010	Associate professor	8	1	SM	0	-
11/2010	Assistant professor	44	6	2- MS, 3- SM 1- FM	2	SM
11/2009	Assistant professor	44	14	5- MS, 7- SM 2- FM	2	1-SM, 1- MS

*****Special drive for OBC/SC/ST, ** 1 Candidate did not join, ***1 withdrew application.

(e) Success in recruitment (data for last five years), and offers that the person had from other IITs/IISc/TIFR

In the last five years we have been able to attract 2 new Professors and 6 new Assistant Professors. Most of them had offers from multiple IITs. In addition, some of existing faculty members also got promoted to higher level.

(f) Faculty lost to other institutions post selection

One, namely Dr. Santosh Hosmani joined College of Engineering, Pune.

(g) Faculty time utilization - in class, in meetings, project management, Ph.D. guidance, Masters Project guidance, UG project guidance

At present, on an average faculty spends 20% of their time teaching core courses, 20% on teaching elective courses, 10% on laboratory or similar courses, 20% on administrative matters, 10% on UG/PG project guidance and 20% on PhD research guidance. In future, as we continue to improve faculty strength, we hope to reduce the faculty load from teaching and administration and increase the focus on PhD research guidance. One possible outcome could be - 10% on teaching core courses, 10% on teaching elective courses, 10% on laboratory or similar courses, 10% on administrative matters, 10% on *UG/PG* project guidance and 50% on PhD research guidance. With increased faculty strength, we also hope to be more liberal in allowing faculty to take sabbaticals or no-teaching semesters for starting/exploring newer areas of research.

(h) Level of harmony among department faculty

At a professional level, there is a very high degree of cooperation among faculty members. This ranges from sharing research scholars, laboratory space, courses and tutorials to working on joint projects and publications. Most of the activities of the department are run through identified groups of faculty members who work harmoniously. There is a coffee-club where faculty members meet to have informal discussions over a cup of coffee/tea.

At a personal level, the faculty members are very close to each other and occasions such as marriages are celebrated with great common joy and gaiety. It is not uncommon for faculty members to share their happiness by inviting other members for get-togethers from time to time. Many Faculty members continue with the departmental bonds by opting for their post-retirement homes in common housing societies.

7.4 Students

(a) Criteria for short-listing and selecting students for admission to Master's and Ph.D programmes in the past 5 years

M.Tech

YEAR	DIRECT (Regular)					
2009-13			OBC	GEN	PH/SC/ST	For part time candidates, same criteria as above was used except that these candidates need not have the valid GATE score. Minimum 2 years of professional experience.
	BE /BTECH /DUAL	% MARKS	**60**	**60**	**55**	
		CGPA	**6.75**	**6.75**	**6.25**	
		GATE	**495**	**550**	**200**	
	Without Written Test	% MARKS	**75**	**75**	**70**	
		CGPA	**8.5**	**8.5**	**7.5**	
		GATE	**650**	**650**	**520**	
	Or IIT B.Tech without GATE score	CGPA	**8**	**8**	**8**	

M.S. (Research)

YEAR	DIRECT (Regular)					INTERVIEW (Regular)			
2009-13			OBC	GEN	PH/SC/ST	OBC	GEN	PH/SC/ST	For part time candidates, same criteria as above are proposed except that these candidates need not have the valid GATE score. Minimum 2 years of professional experience.
	BE /BTECH /DUAL	% MARKS	**60**	**60**	**55**	**60**	**60**	**55**	
		CGPA	**6.75**	**6.75**	**6.25**	**6.75**	**6.75**	**6.25**	
		GATE	**495**	**550**	**200**	**495**	**550**	**200**	
	Without Written	% MARKS	**75**	**75**	**70**	**75**	**75**	**70**	

YEAR	DIRECT (Regular)					INTERVIEW (Regular)			
	Test	CGPA	**8.5**	**8.5**	**7.5**	**8.5**	**8.5**	**7.5**	
		GATE	**900**	**900**	**720**	**900**	**900**	**720**	
	Or IIT B.Tech without GATE score	CGPA	**8**	**8**	**8**	**8**	**8**	**8**	

Ph.D

YEAR	INTERVIEW(REGULAR)					INTERVIEW(PART TIME)
2009-13			OBC	GEN	PH/SC/ST	For part time candidates, in addition, minimum 2 years of professional experience.
	MTECH	%MARKS	**70**	**70**	**60**	
		CGPA	**7.5**	**7.5**	**6.75**	
	MSC	%MARKS				
		CGPA				
		GATE				
		(OR NET, CSIR, UGC)				
	BTECH	%MARKS	**75**	**75**	**70**	
		CGPA	**8.5**	**8.5**	**7.5**	
		GATE				
	IIT BTECH	%MARKS				
		CGPA				

(b) Facilities provided to students and their maintenance/management system

i. Learning:

- Institute and department library for referring books.
- Online resources like e-books, e-journals, standards like ASTM/ISO managed by central library.

ii. Research:

- Computational lab, CFD lab for Ph.D and M.Tech students with individual desktops.
- Individual research laboratories of their own supervisors and that of other faculty members.
- Central Workshop
- Solid Mechanics, Bio Mechanics and MTS laboratories.

iii. Staying:

- Hostel facilities with internet access and married accommodation for married scholars

(c) Mentoring seminars/sessions held for Ph.D students for prospective faculty careers

- The invited lectures delivered by the invited speakers, seminars by prospective faculty candidates are open to all Ph.D students. In fact, all seminars are open for all Ph.D students.

BENCHMARKING

8

Executive Summary: Benchmarking

Unlike the conventional UG degree awarding Engineering Departments, the Department of Applied Mechanics or similar departments have been historically developed in fewer institutions both in India and abroad. For the purpose of benchmarking, we have chosen the other Applied Mechanics Department in the IIT system, i.e. **IIT Madras,** and the very reputed **Department of Engineering Science and Mechanics of Virginia Polytechnic Institute and State University, USA**. The benchmarking is broadly done under three categories: curriculum, teaching and research based on several benchmarking parameters identified under these categories. The information from other institutes is collected from the data available in their websites and other sources from the internet.

The curriculum for UG, PG and PhD programmes is more or less comparable in the IIT system. However, compared to the MS programs of Virginia Tech and other institutes of USA, the credit requirement in our M.Tech program is on the higher side. The main difference is in teaching and research environments. Out of three departments, we have the highest teaching commitments, since we also teach the basic engineering science courses for the entire institute. The technical staff availability is limited at IIT Delhi (only 5 staff, and most of them are promoted from non-technical category and hence are not well trained). On the other hand, Virginia Tech. has highly qualified staff (some with a Ph.D. degree) to handle and maintain some of the equipments.

Even with these constraints, we are doing reasonably well in terms of number of journal publications (SCI journals only considered for comparison) per faculty. The number of journal publications per faculty per year is better for IITD (2.03) than IITM (1.43). It is, however, two-third of the publications of Virginia Tech. (2.96). In terms of average citations per faculty also, IITD with 155 citations is doing much better than IITM with 54 citations, but again Virginia Tech publications have much higher impact with 370 citations per faculty in last five years. With many new faculty members joining over last five years, we are committed to work hard towards not only maintaining our leading position in the country, but also approaching Virginia Tech in terms of both research output and its impact.

The comparison also reveals that, out of the three departments, IITD has the lowest number of graduate students enrolled per faculty (IITD: 3.2, IITM: 3.4, Virginia Tech: 5.1). Clearly, one of the ways of enhancing our research output will be by increasing our Ph.D. intake. For many parameters, reliable data from these two departments could not be obtained. Efforts will be made to get these data in future, continuing with the process of benchmarking.

In conclusion, we are doing better than our counterpart in IITM in terms of teaching, research output and its impact. In the next five years, it will also be our endeavor to consistently improve our position in research globally by creating state-of-the-art research facilities, environment, output and impact.

For benchmarking purposes we have chosen one good institute from India ,i.e. IIT Madras, and one top institute from abroad, i.e. Virginia Polytechnic Institute and State University, USA (QS rank 5). In the following three subsections we compare the performance of Department of Applied Mechanics, IIT Delhi against the other two departments from IIT Madras and Virginia Tech. The benchmarking is broadly categorized into three parts based on comparison of (i) curriculum (ii) teaching, and (iii) research. The comparison is done based on different parameters as listed out in the tables given under these three broad categories.

8.1 Benchmarking of curriculum- for the past 5 years

Benchmarking Parameters	IIT Delhi			IIT Madras (Dept. of Applied Mechanics)			Virginia Polytechnic Institute and State University (ESM Dept.)		
	UG	PG	PhD	UG	PG	PhD	UG	PG	PhD
Total credit requirement	NA	60	6 (M.Tech.) 20 (B.Tech.)	NA	60	12 (M.Tech.) 24 (B.Tech.)	130	30	44-55 (B.Tech.) 23-34 (M.Tech./ M.S.)
Core credits		45			48			18	
Elective credits		15			12			12	
Core credit as % of total credits		75			80			60	
No. of theory courses in core curriculum		7	2 (M.Tech) 6 or 7(B.Tech)			4 (M.Tech) 8 (B.Tech)			
No. and nature of laboratories		3 credits (Eng. Mech) 7 credits (Des. Eng.)			3 credits				
Thesis Requirements		18 credits (Two semesters project)	Total fulfillment		20 credits (Two semesters project)	Total fulfillment			Partial fulfillment
Important differences with peers		Credit requirement for M. Tech programs is on the higher side. At IIT Delhi, currently, a curriculum review of PG programs is underway, which will address this issue.							

8.2 Benchmarking of Teaching Environment (in past 5 years)

Benchmarking Parameters	IIT Delhi			IIT Madras (Dept. of Applied Mechanics)			Virginia Polytechnic Institute and State University (ESM Dept.)		
Number of Faculties	22			24			27		
Whether Department owns UG Program	No			Offers Dual-Degree with B.Tech from other Departments (Aerospace, Civil, Electrical, Naval Arch.)			Yes (BS)		
	UG	**PG**	**PhD**	**UG**	**PG**	**PhD**	**UG**	**PG**	**PhD**
Student-Teacher Ratio	30	4	3.2	No info	4.25	3.8	4.7	0.9	5.1
Number of Students Graduated	---	195 (M.Tech) +98 (DIIT) =293	38		102	No info	143	33	66
Student-T.A. Ratio	20			No info.			No info.		
No. of Skilled Staff	5			5			13		
Gross Lab Space (UG/PG) Teaching and Research (Sq ft.)	7486	2048	18319	No info			No info		

8.3 Benchmarking of Research Environment (in past 5 years)

Benchmarking Parameters			IIT Delhi	IIT Madras (Dept. of Applied Mechanics)	Virginia Polytechnic Institute and State University (ESM Dept.)
No. of Masters & PhD students supported	(i) By institute assistantship	M.Tech	289	no inf.	no inf.
		PhD	28		
	(ii) On sponsored research projects/ consultancies	M.Tech	4	no inf.	37
		PhD	4		137
	(iii) Other sources	PhD	34	no inf.	no inf.
Total	**M.Tech.**		**293**	**102**	**37**
	PhD		**66**	**92**	**137**
No. of PhDs (per faculty in past five years)	(i) Enrolled		**3.2**	**3.8**	**5.1**
	(ii) Graduated		**1.7**	no inf.	**2.4**

Benchmarking Parameters	IIT Delhi	IIT Madras (Dept. of Applied Mechanics)	Virginia Polytechnic Institute and State University (ESM Dept.)
List of Research Area	Active vibration control, Cardiovascular biomechanics, Composite structures, Continuum mechanics, Damage Mechanics,	Active control, Autonomous data acquisition in digital photoelasticity, Ballistic impact simulation, Computational Adaptive System,	Active vibration control, Artificial intelligence, Biomechanics, Bioinspired mathematical modeling, Cardiovascular

Benchmarking Parameters		IIT Delhi	IIT Madras (Dept. of Applied Mechanics)	Virginia Polytechnic Institute and State University (ESM Dept.)
		Digital image correlation, Functionally graded material FGM structures, Fracture mechanics, High strain rate events, Mechanobiology, Nano-Mechanics, Non-linear dynamics, Offshore structures, Piezothermoelasticity, Postbuckling of plates/panels/shells, Smart structures, Snow mechanics, Soft materials, Structural reliability, Alloy design, Crystal plasticity simulations, Computational materials science, Computational fluid dynamics, Heat transfer enhancements, Hypersonic flows, Internal flows, Partially-Averaged Navier-Stokes equations (PANS), Pollutant Dispersion, Turbulence-Chemistry interactions, Turbulent Flows.	Constraint effects in fracture, Image/signal processing of biological structures /Tissues, Modeling and design of structures, Residual stress measurement in glass articles, Smart Structures, Computational fluid dynamics, High Ra Convection , Large eddy simulation , Microscale flows, Thin film flows and interfacial phenomena, Turbulence modeling, Foot pressure measurements in diabetic patients, Quantification of optical nerve disorders.	mechanics, Composite materials, Continuum mechanics, Dynamical systems, Functionally Graded Materials, Mechatronics, Molecular dynamics, Nano mechanics, Non linear dynamics, Probabilistic mechanics, Smart Structures, Aeroelastic phenomena. Climate Change, Computational fluid dynamics, Nuclear Science Aerodynamics, Fluid-structure interactions, Super fluid hydrodynamics, Transonic flows, Turbulence.
Total number of publications	Journal[#] (SCI Journals only)	224	171	400
	Conference	253	72	155

Benchmarking Parameters		IIT Delhi	IIT Madras (Dept. of Applied Mechanics)	Virginia Polytechnic Institute and State University (ESM Dept.)
Publications per faculty: (average per year in past 5 years)	Journal[#] (SCI Journals only)	2.03	1.43	2.96
	Conference	1. 6	0.6	1.15
Publications per PhD student	Journal[#]	2.8	1.9	4.3
	Conference	2.5	0.8	1.8
Total number of citations[#,+]		3405	1295	9990
Average citations per dept: Total citations of all faculty since 2009 (for all papers)/no. of faculty		155	54	370
No of sponsored projects - with details per faculty (Details given in Section 3)		30 (all faculty members) [Rs. 16.40 Cr]	no inf.	no inf.
No of industrial consultancies projects - with details per faculty (Details given in Section 3)		256 (all faculty members) [Rs. 6.55 Cr]	no inf.	no inf.

[#]Data taken from Scopus. [+]Self citations have been excluded.

FEEDBACK SYSTEMS AND RESULTS

9

Executive Summary: Feedback systems and Results

Department of Applied Mechanics encourages all the students and alumni to provide an honest feedback of their performance. The departmental website provides comprehensive information of faculty profile and existing research facilities. However in light of several revamping of lab infrastructure, we are in the process of revamping the website as well to better reflect the current status and opportunities. For teaching and course evaluation our department utilizes the IITD's website. It allows all the students (BTech, MTech and PhD) to evaluate course and its instructor on various parameters, which can be later viewed by faculty members. The feedback of recruiters is managed by Training and Placement cell of the institute. Also, the department has presence on several social and professional networking platforms (Facebook, LinkedIn, Google plus) where students and alumni can provide feedback.

9.1. Departmental Website of The Applied Mechanics

Here(http://am.iitd.ac.in)the contact information of all the faculty members is listed publically. People can utilize this to convey the information directly to the relevant person either through phone or email. Some screenshots of our website are provided below

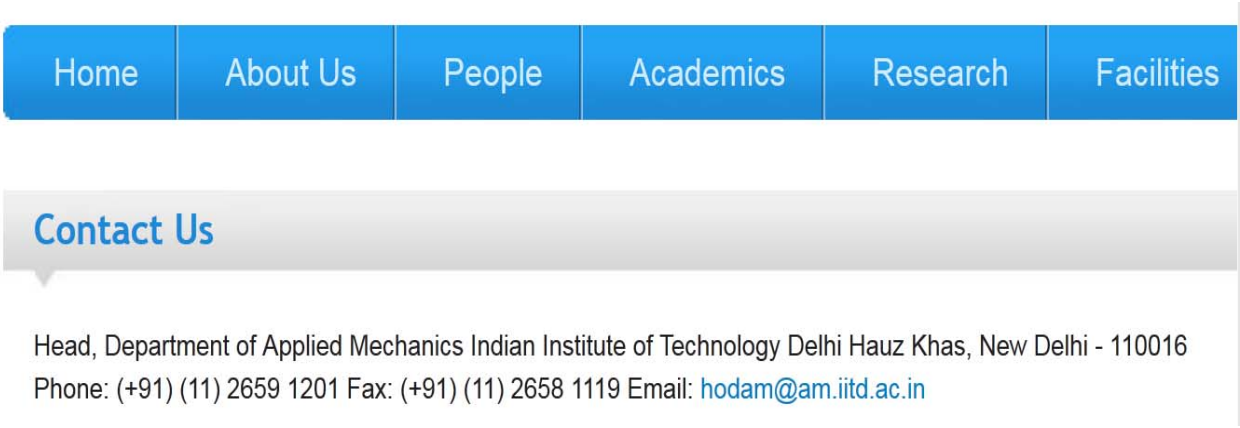


Figure 9.1.2 Contact information of department on Web page

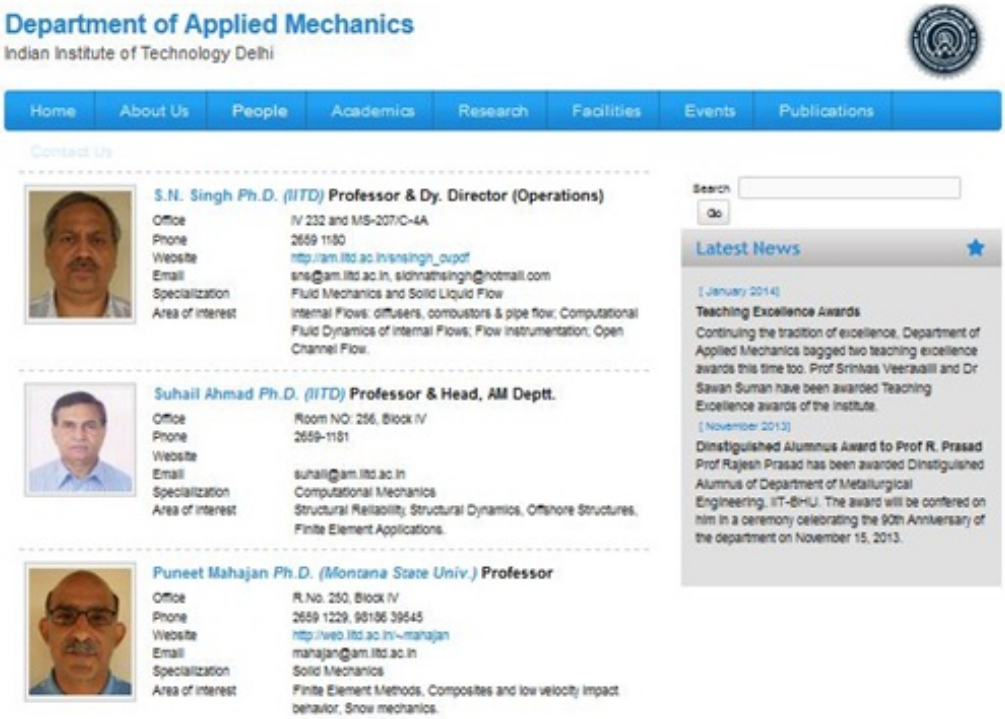


Figure 9.1.3Faculty details on departmental web page

9.2. Social networking website

Due to the increasing popularity of the social networking sites especially among young people, our department also maintains its presence on the Facebook, Google and LinkedIn. This allows our department to connect with the audience on the wider scale. Alumni and retired faculty members are now able to provide their valuable insight and feedback on our performance. The screenshot of our Facebook page is provided below for the convenience.

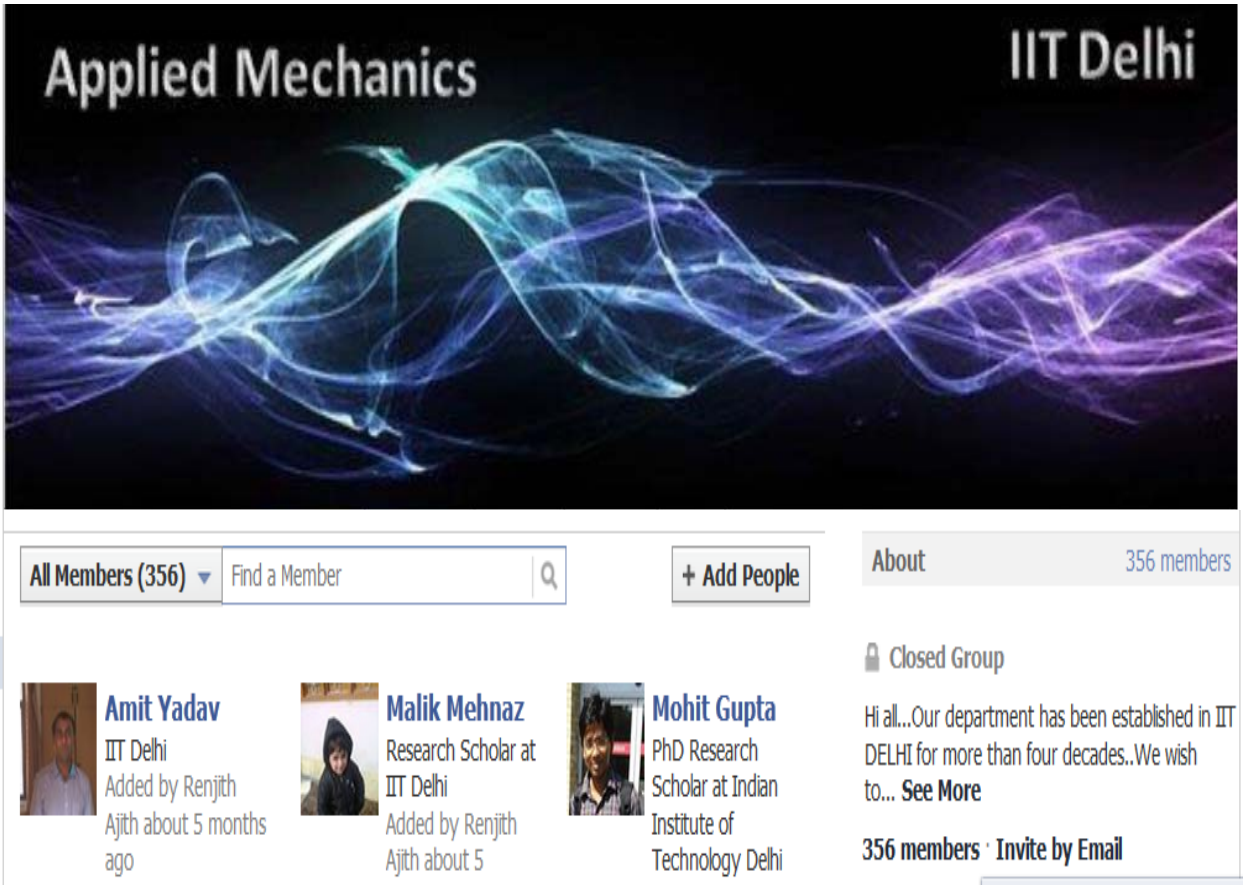


Figure 9.2.1 Screenshot of Facebook page

9.3 Feedback and course evaluation using IITD'S website

For teaching and course evaluation our department utilizes the IITD's website. It allows all the students (B.Tech, M.Tech and Ph.D) to evaluate course and its instructor on various parameters, which can be later viewed by faculty members by logging in on the following web link with their Kerberos ID and password:

https://campus1.iitd.ac.in/hcmprod1/signon.html

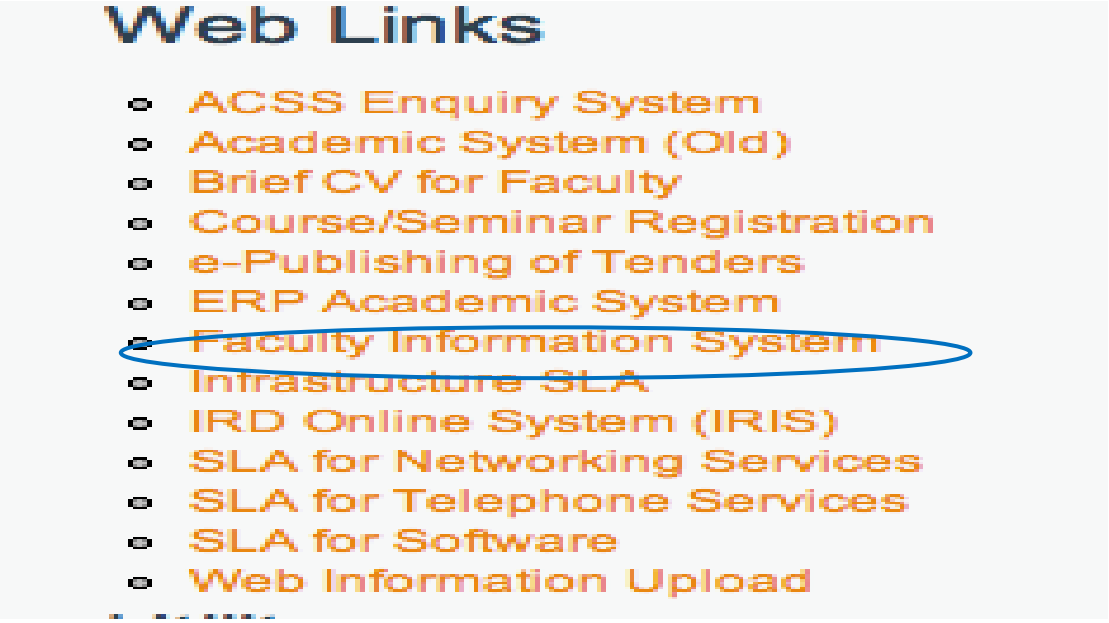


Figure 9.3.1 Web address to faculty information system

Some of the relevant screen captures of the institute feedback system are provided below:

Figure 9.3.2 Faculty center to manage class related activities

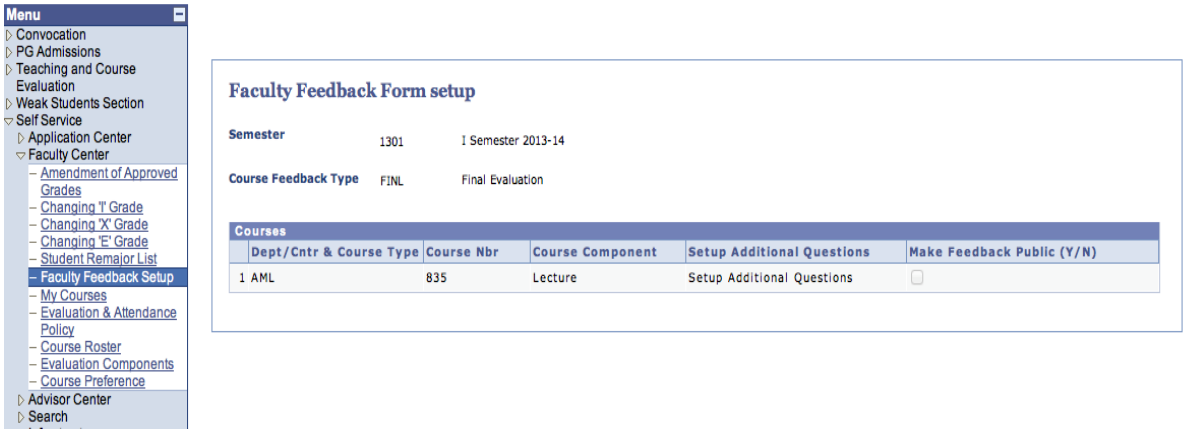
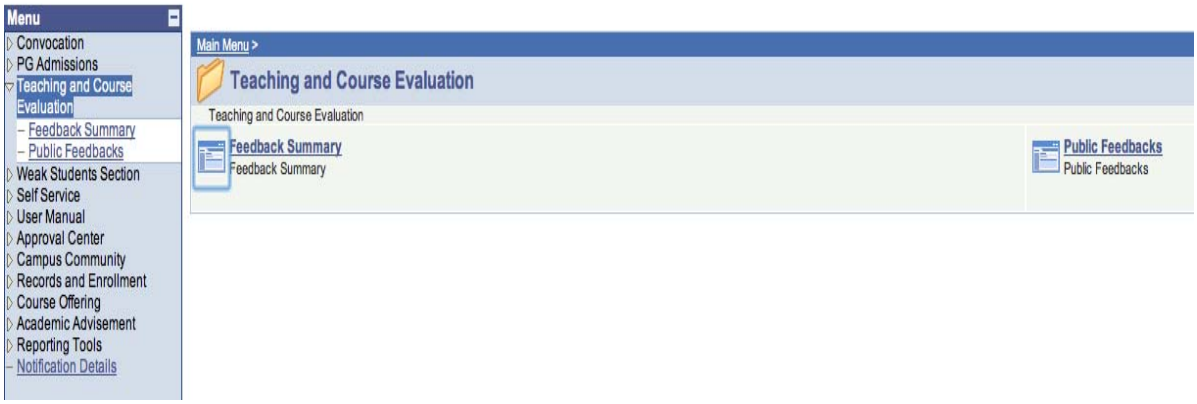


Figure 9.3.3 Screenshot for faculty access of course feedback



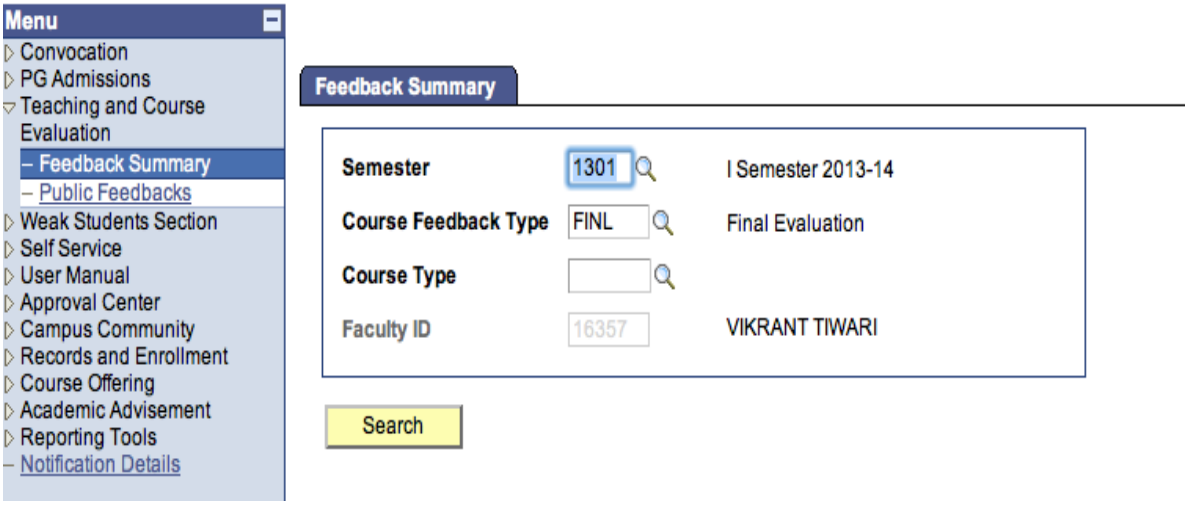


Figure 9.3.4 Teaching and course evaluation for faculty

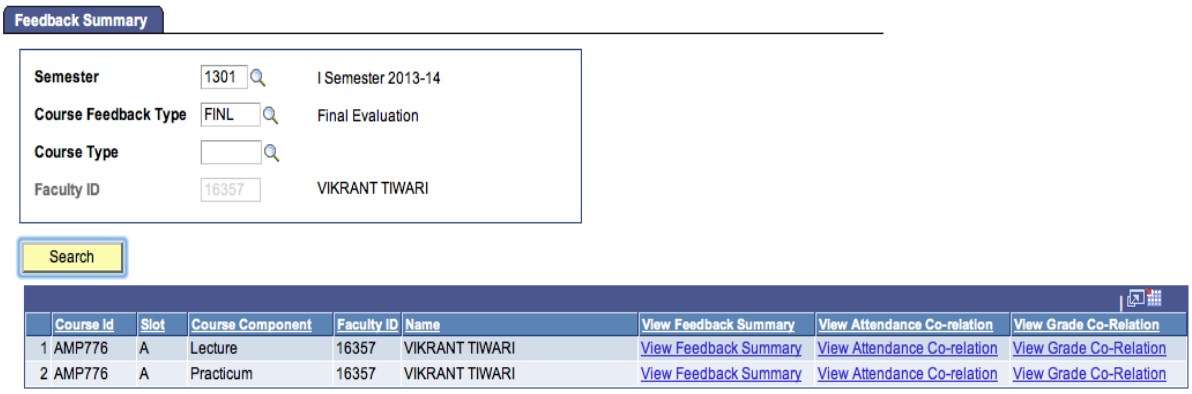


Figure 9.3.5 Option for faculty to access course feedback

Question No: 1

Description: How would you rate the work-load of this course?

Rating / Response	Student Count
Just Right	13
No Opinion	3
Too Heavy	6
Very Little	2

Question No: 2

Description: Were the lectures held regularly?

Rating / Response	Student Count
No	3
No Opinion	5
Yes	16

Question No: 3

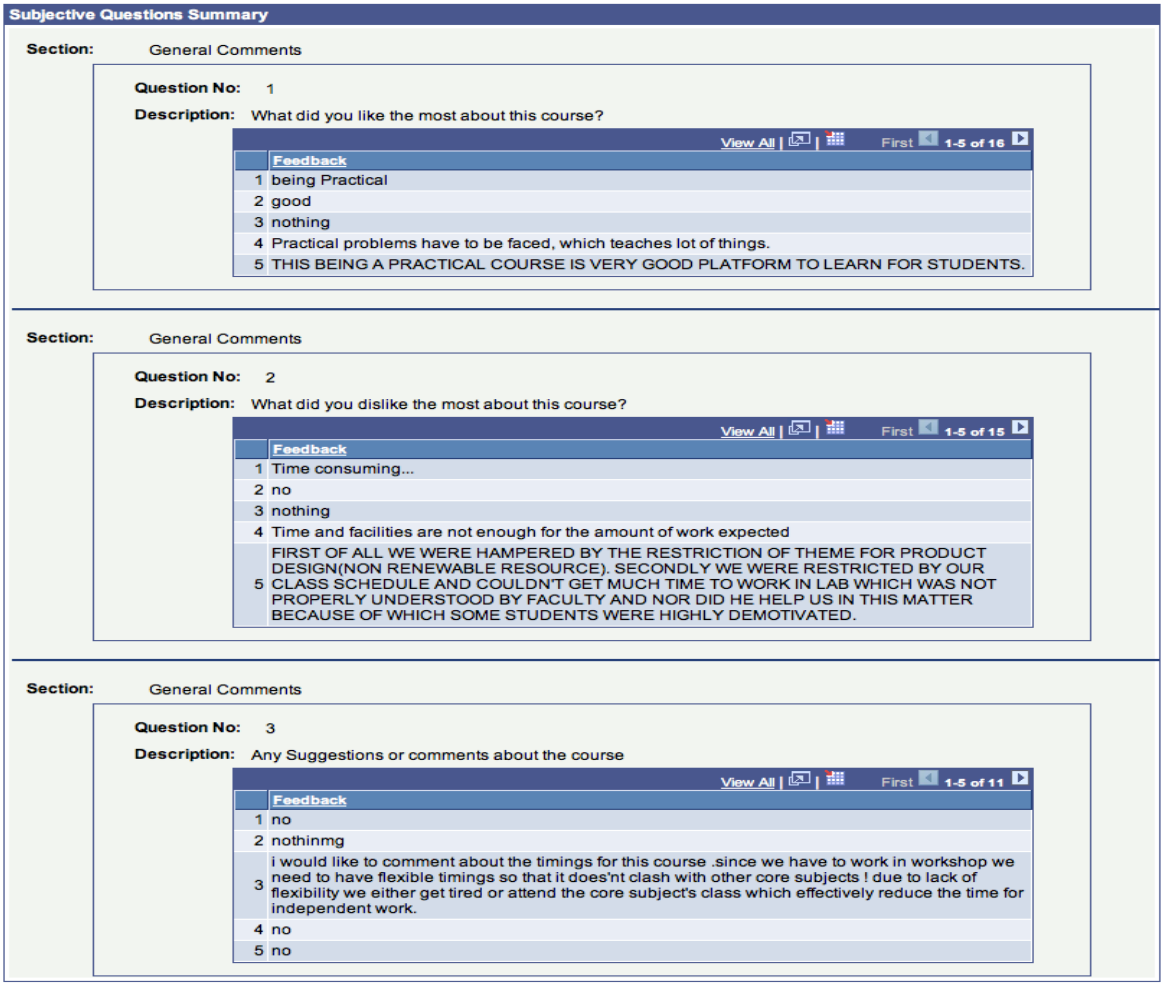
Description: Were the lectures held on time?

Rating / Response	Student Count
No	2
No Opinion	4
Yes	18

Question No: 4

Description: Was the course evaluation policy announced at the beginning of the semester?

Rating / Response	Student Count
No	0
No Opinion	5
Yes	19



Subjective Questions Summary

Section: General Comments

Question No: 1

Description: What did you like the most about this course?

View All | First 1-5 of 16

	Feedback
1	being Practical
2	good
3	nothing
4	Practical problems have to be faced, which teaches lot of things.
5	THIS BEING A PRACTICAL COURSE IS VERY GOOD PLATFORM TO LEARN FOR STUDENTS.

Section: General Comments

Question No: 2

Description: What did you dislike the most about this course?

View All | First 1-5 of 15

	Feedback
1	Time consuming...
2	no
3	nothing
4	Time and facilities are not enough for the amount of work expected
5	FIRST OF ALL WE WERE HAMPERED BY THE RESTRICTION OF THEME FOR PRODUCT DESIGN(NON RENEWABLE RESOURCE). SECONDLY WE WERE RESTRICTED BY OUR CLASS SCHEDULE AND COULDN'T GET MUCH TIME TO WORK IN LAB WHICH WAS NOT PROPERLY UNDERSTOOD BY FACULTY AND NOR DID HE HELP US IN THIS MATTER BECAUSE OF WHICH SOME STUDENTS WERE HIGHLY DEMOTIVATED.

Section: General Comments

Question No: 3

Description: Any Suggestions or comments about the course

View All | First 1-5 of 11

	Feedback
1	no
2	nothinmg
3	i would like to comment about the timings for this course .since we have to work in workshop we need to have flexible timings so that it does'nt clash with other core subjects ! due to lack of flexibility we either get tired or attend the core subject's class which effectively reduce the time for independent work.
4	no
5	no

Figure 9.3.6 Screenshots of feedback summary showing details of feedback forthe students.

9.4 System for feedback from recruiters

- On campus: Training & Placement Cell
- Off campus: None

9.5 Mechanism of obtaining industry feedback & findings

Information feedback through direct communications or Internet, data provided by industry through various channels.

9.6 Alumni feedback mechanism and its outcome: Alumni office, Facebook

9.7 Placement records : Ph. D- 100%, M. Tech- 65%

VISION FOR NEXT 5-10 YEARS

10

Executive Summary: Vision Next 5-10 years

The Department of Applied Mechanics is a unique engineering department involved in teaching, fundamental & applied research and industrial consultancy. The broad areas of research are Fluid Mechanics, Materials Science and Solid Mechanics and to some extent Comprehensive Design. The faculty of the department stem from diverse backgrounds—Aeronautical & Aerospace Engineering, Civil Engineering, Mechanical Engineering and Metallurgy & Materials Science. Given this mix we feel we are strongly positioned to address the challenges.

For the next 5-10 years, in keeping with the overall vision, and in addition to the research areas already being explored by its faculty, the department of Applied Mechanics would like to focus on the following:

i. Directing at least 30% of our research effort towards problems of national interest.

ii. Participating actively in collaborative projects/programmes with other departments within IIT Delhi and researchers from other institutions to facilitate the first aim.

iii. Upgrading and setting up state-of-the-art laboratories in the areas of Bio-Mechanics, Fluid Mechanics, Solid Mechanics and Materials Science.

iv. Vastly strengthening our post-graduate and Ph.D. programmes.

v. Retaining and further strengthening the department's acknowledged excellence and reputation in teaching and fundamental research.

10. Vision for next 5-10 years

10.1 Goals and benchmarking for future in relation to (i) curricula, (ii) research,(iii)outreach, and (iv) Process for regular internal assessment

The Department of Applied Mechanics at IIT Delhi is a specialized engineering department involved in teaching, research and industrial consultancy in the broad areas of Stress Analysis and Mechanical Testing, Computer Aided Analysis and Product Design, Reliability and Maintenance engineering, Offshore Structures, Impact Mechanics, Manufacturing Analysis and Energy conservation, Fluid Mechanics and Pipeline Engineering, Computational Fluid Dynamics and Wind Engineering, Physical Metallurgy and Failure Analysis, Biomechanics.

In line with the academic vision of the department, the department offers several advanced fundamental courses in broad area of Mechanics such as Theory of Plates and shells, Applied Plasticity, Fracture Mechanics, Engineering Failure Analysis, Advanced Finite Element Method,

Computational Fluid Dynamics, Turbulence shear flow in addition to other basis courses.

Two new courses “Multiscale modeling of crystalline materials” and “Cell Mechanics” have recently been started. Several new courses, e.g., Turbulence modeling and Computation, Experimental Methods in Fluid Mechanics, Compressible fluid flow, Fluid structure interaction are in the pipeline.

The Department also aims to start a new M.Tech. Programme in Materials Science. The recommendations of curriculum review of the Department is also given in Section 1 : Curriculum .

Traditionally the **Solids group of the department** has been strong in computational and theoretical mechanics. Computational tools such as Finite Element (FE) have been used extensively in modelling mechanical behaviour and dynamic response of composites and other structures. New theories in plates and shells for analyzing composites, thermal buckling, damage mechanics, micromechanics, solid-fluid interaction, structures for deep off-shore oil and gas exploration, low and high velocity impact of materials, system safety and reliability assessment are some areas where the group continues to contribute in a major way. Lately, the group is diversify into areas such bio-mechanics and multi-scale modelling. Understanding mechanics of cell and designing medical implants are the areas in which department intends to take a lead. The group will be vigorously involved in continuum modelling of nanostructures (CNTs, DNA, graphene sheet, magnesium alloys etc.) and their composites using multi-scale methods. The group has access to high speed computational platforms, computational packages in FE, image processing, molecular dynamics and solid-fluid interaction software.

The Solids group has been active in research in areas, such as impact mechanics, structural mechanics and health monitoring, mechanics of composite materials, offshore structure, snow mechanics and biomechanics. The group has well established experimental and computational facilities to do research in these areas.

With the successful completion of a FIST (2008 to 2013) project the **Fluids Group** is well equipped with the latest diagnostic tools (PIV, micro PIV, LDV and HWA) and a 96-node cluster for computational work. We are also currently undertaking renovation and enhancement of the 2m x 2m environmental Wind Tunnel. Armed with these the group hopes to address a wide variety of problems related to turbulent convection, turbulent dispersion, drag reduction, compressible turbulence, multi-phase flows, slurry transport, fluid-structure interaction and hydrodynamic stability theory.

In keeping with the spirit of the overall vision of the department of Applied Mechanics the Fluids Group is very keen to explore applied problems with more direct relevance to society and the country. One of the projects which we wish to undertake in the immediate future is a comprehensive study of

wind turbine farms with a view to optimizing their performance and understanding possible long-term environmental impacts.

Materials Science and Engineering (MSE) is a multi-disciplinary discipline which enables a large variety of applications. Hence, it provides a myriad number of opportunities for materials scientists and researchers to advance the science and technology. Our vision is to develop Materials Science and Engineering programme at Applied Mechanics Department in a true "multi-disciplinary" manner, integrating the core MSE areas with ongoing solid mechanics, fluid mechanics and design research.

At present, the **Design Group of the Department** draws its strength from members of the Solid Mechanics Group, Fluid Mechanics Group and Materials Science Group, who are involved in teaching of M. Tech. (Design Engineering) Programme courses, the UG course related to design engineering and product related projects. In the next five years, the group aims to reorient its M. Tech programme to make it more interdisciplinary, as well as start research activity in design methods and tools.

Naval Construction Wing of the Department provides a comprehensive education in Naval Architecture with an emphasis on concept design, which prepares Naval Constructor officers of Indian Navy and Indian Coast Guard for their future roles in design, acquisition, construction, repair and modernization of Warships and Submarines. Therefore, the emphasis of research and teaching at NCW is on product design and product life cycle management of a marine vehicle. The vision of NCW is "To become a Centre of Excellence in the country for advanced education and research in the area of Naval Architecture and allied fields, aligned to the strategic needs of Indian Navy".

Thrust Areas

The specific research areas to which the department wishes to give impetus in the next five years (and beyond) are:

1) Bio-mechanics and soft materials
2) Engineering and Scientific Computing
3) Multi-functional Materials and Structures.
4) Structure, Processing and Mechanical Behaviour of Advanced Materials
5) Turbulent Convection, Dispersion and other Transport Processes.

Some of the specific projects for which proposals are being finalized are:

1) Bio-medical devices and equipments
2) Comprehensive Study of Vertical Axis Wind Turbine Farms
3) Light weight materials for transportation
4) Underwater Glider

10.2 Vision of curricula and teaching-learning processes – UG, PG and Ph.D.; innovations proposed:

The Department has well equipped undergraduate and postgraduate teaching cum research laboratories in Computation, CFD, Design Optimization, Experimental Methods, Fluid Mechanics, Gas Dynamics, Impact Mechanics, Materials Science & Physical Metallurgy, MTS, Solid Mechanics, Stress Analysis, and a Workshop.

The Department does not have its own undergraduate programme but is involved in teaching a large number of courses in engineering science and arts to undergraduates from other departments. The Department also has a Minor Area Programme in Computational Mechanics for undergraduates. At the undergraduate level we have an on-going project to develop teaching-aids for classroom and laboratory sessions. We are currently engaged in the development of demonstration videos for teaching laboratory courses.

Postgraduate:- The Department of Applied Mechanics has two postgraduate programmes. (i) M.Tech. (Engineering Mechanics) and (ii) M.Tech. (Design Engineering). In addition, the Department also offers a DIIT programme in Naval Construction, sponsored by Indian Navy.

The Design Engineering Programme of Applied Mechanics is one of the most popular M. Tech. programmes of the Institute among the students as well as industries. However, product design is becoming increasingly interdisciplinary, often requiring the knowledge of electronics, instrumentation and signal processing etc. in addition to solid mechanics, fluid mechanics and materials science. Besides, a new Design and Innovation Centre is coming up in the institute with the mandate of supporting projects leading to development of new products. Our programme must take full advantage of this upcoming facility, and in fact strengthen it. With this view, a restructuring of the Design programme is being carried out.

To train new generation of engineers and researchers in Material Science, we would like to introduce initially an M.Tech. Programme in Materials Science and Engineering. This initiative will be eventually extended to offer B.Tech. Programme. This should be given a very high priority as IIT-D the only one among older IITs not have such programmes.

10.3 & 10.4 Areas identified for improvement in (i) curriculum, (ii) teaching-learning New areas for research and Masters programmes, and industry participation

The department of Applied Mechanics would like to focus on the following:

i. ***Directing at least 30% of our research effort towards problems of national interest :-***

The specific projects in this direction will be finalized after an intense brainstorming exercise (currently near completion). The thrust areas, that the department will focus on for the next five years and beyond, are listed below. It is clear that any large project would require multi-disciplinary effort and this is spelt out in the second objective.

ii. ***Participating actively in collaborative projects/programmes with other departments within IIT Delhi and researchers from other institutions to facilitate the first aim:-***

The department of Applied Mechanics has already initiated effort with the following:

a) Centre for Energy Studies for sustainable energy systems.
b) Naval Construction Wing for several projects of interest to the Navy.
c) Mechanical Engineering, Textile Technology and Polymer Science for the development of light-weight body armours.
d) We will also be actively involved with the inception and activities of the Design and Innovation centre.

iii. ***Upgrading and setting up state-of-the-art laboratories in the areas of Bio-Mechanics, Fluid Mechanics, Solid Mechanics and Materials Science:-***

The aim is to strengthen existing research areas and develop new avenues of basic research, while at the same time providing support for new courses we wish to develop. Some of the efforts currently underway are:

a) Experimental Methods Laboratory (UG) in the new Academic Complex.
b) Materials Science Laboratory (UG) in the new Academic Complex.
c) Bio-Mechanics Laboratory.
d) Environmental Wind Tunnel Facility.
e) Material characterization Laboratory.
f) Multi node parallel computing facility.

iv. ***Vastly strengthening our post-graduate and Ph.D. programmes:-***

In this connection we wish to offer a M. Tech programme in Materials Science in the near future. Once this programme is well established we will actively work towards developing an undergraduate programme in Materials Science.

v. ***Retaining and further strengthening the department's acknowledged excellence and reputation in teaching and fundamental research:-***

Some of the on-going efforts in this regard are:

a) Development of demonstration videos for teaching laboratory courses.
b) Development of virtual laboratory modules to supplement (but not replace) existing experiments.
c) Development and offering of courses to support and promulgate research in new areas.

10.5 Projections for (i) funded projects, (ii) journal publications

For future, the department would like to be in a place where majority of the funding comes through sponsored research projects from government agencies and industry. We are already moving towards this. In 2009-2012, the total funding that the department faculty received via major sponsored research projects was 16.40 crore while the total funding received from the Institute from was 54.9 lakhs.

In last 5 years, the department has published 247 papers in peer reviewed international and national journals and has presented 253 papers in peer reviewed international and national conferences (**see Table 3.5**). With several faculty members recently recruited, the department is expected 25% growth in next 5 years.

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

Ph.D. : 11-12 per year
M.Tech. (Design Engineering): 40 per year
M.Tech. (Engineering Mechanics): 40 per year
(May include new M.Tech program)

10.7 Projected faculty profile, and areas for recruitment

At present, there are 21 faculty members and 3 Emeritus Professor in the Department of Applied Mechanics. It is expected to recruit 8-10 faculty members in next 5 years. The areas for recruitment are:-

- Solid Mechanics
- Fluid Mechanics
- Design Engineering
- Materials Science

10.8 Projections for future benchmarking (for comparison after 5 years)-institutions in India and abroad, and parameters for future comparison : Please refer Section 8 Benchmarking (8.4 &8.5)

10.9 Infrastructure and governance – limiting factors that affect achievement of benchmarks and methods to overcome these

1. More lab space is required
2. More supporting staff is required

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

The Department of Applied Mechanics is actively participating in collaborative projects/programmes with other departments within IIT Delhi and researchers from other institutions to facilitate the first aim.

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The department of Applied Mechanics has already initiated effort with the following:

a) Centre for Energy Studies for sustainable energy systems.
b) Naval Construction Wing for several projects of interest to the Navy.

c) Mechanical Engineering, Textile Technology and Polymer Science for the development of light-weight body armours.
d) We will also be actively involved with the inception and activities of the Design and Innovation centre.

10.11 New initiatives that the department/centre will undertake

Teaching:-

Development of M.Tech. and B.Tech programmes in Materials Science

To train new generation of engineers and researchers in Materials Science, we would like to introduce initially an M.Tech. Programme in Materials Science and Engineering. This initiative will be eventually extended to offer B.Tech. Programme. This should be given a very high priority as IIT-D is the only one among older IIT'S not having such programmes.

Restructuring of M. Tech. (Design Engineering) Programme

This programme has been consistently attracting good students, and is one of the most popular M. Tech. programmes of the Institute among the students as well as industries. However, product design is becoming increasingly interdisciplinary, often requiring the knowledge of electronics, instrumentation and signal processing etc. in addition to solid mechanics, fluid mechanics and materials science. Besides, a new Design and Innovation Centre is coming up in the institute with the mandate of supporting projects leading to development of new products. Our programme must take full advantage of this upcoming facility, and in fact strengthen it. With this view, a restructuring of the Design programme will be carried out within the following guidelines:

a) Introduce a course on electronics/electromechanical systems as a core course of the programme
b) Allow (and encourage) the students to undertake projects from the upcoming Design and Innovation Centre, which will be compulsorily joint projects bringing in at least two students of different backgrounds.
c) Allow the students to undertake projects from other departments if it is product related.
d) Invite design engineers from industry as visiting professors to give lectures on design.

Facilities :- Some of the capabilities/facilities we plan to improve / develop in the next five years are:

6. Bi-axial, Fatigue and high temperature material testing facility
7. Hopkinson pressure bar, shock tube and High velocity gun
8. Structural health monitoring and vibrations laboratory
9. Biomechanics laboratory
10. Fabrication and testing of armour grade composites
11. Multi-scale computational models and experimental facilities for studying nano-composites and composites.
12. A low noise water-tunnel facility for flow visualization and optical diagnostics.
13. Lagrangian measurements (PTV).

14. A pilot Vertical Axis Wind turbine Farm.
15. Novel modelling strategies for Compressible Turbulence
16. In-house specialized codes for external aerodynamics

Research:- Research at the Department of Applied Mechanics at IIT Delhi is focused broadly in the areas of Solid Mechanics, Fluid Mechanics, Materials Science, and Product Design. Over the last five decades specialized laboratories devoted to these areas have been developed to a high degree of sophistication. A computational laboratory having a sufficient number of networked workstations and desktop machines along with an extensive array of software for engineering analysis and design has been set up for exclusive use of P.G. students and faculty of the department. A well equipped workshop helps fabricate specimens and experimental set-up for research projects as well as U.G. experiments.

The department has acquired sophisticated instruments for use in research and consultancy projects. The department conducts courses in engineering science, engineering arts, computational mechanics and CAD for U.G. students. It also runs three post-graduate programmes namely

- M. Tech. (Applied Mechanics)
- M.Tech. (Design Engg.)
- D.I.I.T. (Naval Construction)

10.12 Outreach goals anticipated limitations in the attainment of these

- To strengthen industry-academia interactions
- Development of demonstration video for teaching laboratory courses
- Development and offering of courses to support and promulgate research in new areas
- Actively involved with the inception and activities of the Design and Innovation Centre
- To facilitate enhanced industry Academia interaction between design organizations of Indian Navy and IIT Delhi
- Explore the possibility of opening the programme to civilian students/sponsored students from Shipyards and Industry.
- To increase collaboration with institutions in India, working in the area of applied research for underwater gliders/AUVs, CFD in hydrodynamic parameters evaluation, materials for marine structures such as IIT Kharagpur, IIT Madras, NIRDESH, NRB, NSTL, NMRL, BPOL etc.

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

Two faculty members are assigned the job to go through the feedbacks. They are putting up the issues in the DFB for making necessary changes based on the feedback.

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

- What are the expectations of the Review Committee from the faculty members in order to increase our international ranking

Information in Public Domain

11

Executive Summary: Information in Public Domain

The reports and other documents are categorized into the following main groups and archived and kept in both physical form and on the internal website for easy access and use.

1. Minutes of the meetings
2. Administrative Reports
3. Technical Reports
4. Semester Schedules
5. Agenda Papers
6. Vision documents
7. Annual Reports
8. Information Brochure
9. RTI Queries
10. Forms and formats

11. Information in Public Domain

11.1 Minutes of the meeting

The minutes of the meetings are filed and kept in the departmental office. Also, the archived scanned copies are available for last few years on the internal website of the department.

11.2 All reports archived in the central / departmental libraries

The student theses, project reports and other technical reports are available in department library. The PhD and M.Tech. thesis are available both in central and departmental library in both hard copy and soft copy versions.

11.3 Past vision documents, review documents and standing review committee documents

These documents are available in the department. Some of these are also put on the internal web for easy access by faculty members.

11.4 Any other documents developed by the department, a group / section of the department /center

All such documents are available in the department library. We plan to make them available in our internal website.

11.5 Feedback documentation and action taken on the same, and its outcomes

Such reports are not currently available. We would like to design an online and offline systems of such mechanisms of feedback and action taken reports.