GUIDELINES FOR PREPARING THE INTERNAL REVIEW REPORT OF AN ACADEMIC UNIT FOR THE ACADEMIC REVIEW

1. Curriculum

1.1 List of degree programmes offered - UG + PG - and enrollment.

The department offers the following degree programs:

Doctor of Philosophy

Master of Technology in Design of Mechanical Equipment
Master of Technology in Production Engineering
Master of Technology in Industrial Engineering
Master of Technology in Thermal Engineering

Bachelor of Technology in Mechanical Engineering
Bachelor of Technology in Production and Industrial Engineering

The enrollments at the admission time are given in Annexure 1-1.

The department also offered a Master of Technology programme in *Power Generation Technology* which was fully sponsored by NTPC from year 1997 until 2007. The program has been discontinued and, subsequently, NTPC engineers were admitted to one of the above four programmes based on their interest.

1.2 Consistency of curricula with academic vision of the department.

The department does not have any document where its academic vision has been articulated. The understood expectation is that the students should be taught what the faculty considers a requirement for the appropriate degree.

1.3 Quality of programmes:

(a) Periodicity of curriculum review UG and PG,

The undergraduate programs are reviewed once in ten (10) years when the Institute's review processes takes place. The M.Tech. program in Design was reviewed in 2012. A review of the UG and PG programs is currently under way; the first year courses were introduced in 2013-2014 academic year. The post-graduate curriculum is under review and is expected to be implemented with effect from 2013-2014 academic session.

(b) Mechanism for review at UG and PG level

UG: The department faculty board (DFB) discusses the concept/approach papers prepared by a central committee and offers comments. After the broad structure is approved by the Senate, the department details out the courses of for its programs.

The first iteration is conducted by the Department Undergraduate Committee (DUGC) which is then discussed in the DFB. Subsequently, the courses are classified into one of three areas of design, thermal or production & industrial, and the respective groups deliberate on their courses and offer comments. The DFB collates these comments which are forwarded to the Dean/Senate. After the program structure is approved, the detailed templates are prepared by the specialist faculty and compiled in the DFB. These tasks are performed by the faculty of this department only.

PG - M.Tech.: The department offers its comments on concept/approach papers prepared centrally which is ultimately approved by the Senate. The individual groups then prepare the curriculum structure and course templates. These are discussed in the DRC and then DFB and forwarded for approval by the Senate.

PG - Ph.D.: The department does not have a process for assessing and reviewing the Ph.D. program. The DRC has initiated discussions which would be discussed in the DFB and forwarded to Senate approval.

(c) Coursework for each UG, PG and PhD programme - Core / Elective,

The detailed programme structure for the Bachelors and Masters programs currently being followed are given in Annexure 1-2.

(d) Pre PhD courses offered,

The department has not offered any pre-Ph.D. course in the last 10 years. Ph.D. students' complete the course requirement of 6 credits (2 courses) from the existing Masters course offerings, and sometimes with UG-PG bridge (remedial) courses.

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

In 2012-2013, the M.Tech. in Design was revised and implemented in which nine new courses were introduced. The department has not introduced any new Pre-Ph.D. courses in the last five years.

(f) Overlap at (c), (d),

There is considerable overlap between some UG and PG courses. Also, some courses taken by Ph.D. students for their course requirement were also taken by UG students. The Ph.D. course work has a 100 % overlap with the courses that are listed as M.Tech. core or elective courses.

(g) Seminar series (weekly/regular) held each semester (provide list),

The department has made several attempts to run a seminar series. Between 2003 and 2010 a weekly seminar was organized by the Thermal group for M.Tech. & Ph.D. students. It was discontinued as it was not a mandatory requirement.

(h) Placement details (as per Annexure 1-3),

Placement details of B.Tech. graduates are given in Annexure 1-3. The four year trend from 2009 - 2013 shows that 55 % of ME1 and 21 % of ME2 graduates are placed in core engineering jobs, the remaining are placed in consulting, analytics and IT industries. Also, 87 % of ME1 and 79 % of ME2 were placed from the campus. Of the total graduates, 55 % of ME1 and 21 % of ME2 graduates are placed in core engineering jobs, the remaining were placed in consulting, analytics and IT industries. On an average about 2 % of UG graduates take up higher technical studies; an indicative listing is given in Annexure 1-4.

Placement amongst M.Tech. graduates is shown in Annexure 1-3. It shows that 56 % of MED, 40 % of MEE, 32 % of MEP and 43 % of MET graduates were placed from the campus. Of the total graduating class 46 % of MED, none of MEE, 13 % of MEP and 25 % of MET were placed in core engineering jobs; the remaining were placed in private teaching colleges and other non-core jobs.

(i) Relevance to recruiters

The department has never taken feedback or inputs from recruiters. The faculty believe that they are the best judges of what needs to be taught.

(j) Benchmarking

The various programs of the department have been benchmarked and are given in Annexure 1-5A to -5G for ME1, ME2, MED, MEE, MEP, MET and Ph.D. programs, respectively.

2. Teaching environment

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

Based on gross numbers, the student-teacher ratios are 17.4 for UG, 8.4 for M.Tech. and 5.6 for Ph.D. students, for a gross student-teacher ratio of 31.4.

2.2 No. of students graduated in each programme, incl. PhD, (data for 5 yrs)

The number of students graduated in each program over the last five years is shown in Annexure 1-3.

2.3 Student-T.A. (or student-hours/T.A.) ratio

Based on admissions at the beginning of the academic year, the number of Teaching Assistants available are about 115 (2013) and 155 (2014) M.Tech. and about 60 Ph.D. students.

2.4 No. of skilled technical staff

The list of skilled staff and their expertise are given in Annexure 2-1. The department has 29 technical staff encompassing a variety of skill expertise.

2.5 Gross laboratory space; break-up for core UG / PG teaching

The gross space with the department is 6148 m^2, detailed break-up is given in Annexure 2-2. Average office space is 15.3 m^2 (27 nos. of 17.9 m^2 + 11 nos. of 12.2 m^2 + 5 nos. of 8.9 m^2). There are 26 laboratories with an average area of 137 m^2. The administrative space is 422 m^2. The space for "tinkering laboratories" is about 30 m^2 in the Central Workshop.

All the laboratory space is used for a mix of UG teaching, PG teaching, student projects, M.Tech. students' thesis and Ph.D. students' research.

2.6 Modernization - UG / PG core / elective teaching laboratories in last 5 years

The major modernizations carried out in the last 10 years have been in Mechanisms laboratory, Production Engineering laboratory, Automation laboratory, and Thermal Science laboratory.

2.7 Course files for each course for last 5 years

The course files for various courses are available.

2.8 Study materials (monographs, notes, books, videos, etc.) prepared

The following study materials have been prepared by the faculty:

(a) Notes on Introductory Statistics (for course PG core course of MET programme MEL705 *Experimental Methods for Thermal Engineering*)

(b) Notes on Gas Dynamics and Propulsion (for UG elective course MEL341)

2.9 Research and Innovations in teaching-learning processes

The following innovations have been carried out in respect of teaching-learning processes:

(a) MEP100 Engineering Visualization and Communication
This course has been introduced in the last semester with an entirely new methodology from what had been the practice for many decades. Students are introduced to sketching and computer-aided drawing. The course caters to 425 students in each semester.

(b) MEP101 Product Realization
This course has been introduced in the last semester and is a major change from the practice prevailing in a traditional workshop course. The emphasis on hands-on learning and in making a small product. The course caters to 425 students in each semester.

(c) NIN100 Introduction to Engineering
An entirely new process was adopted to introduce all 850 newly joined students to engineering. It included talks by industry experts, faculty sharing experiences, and small group based activities that linked engineering education with the profession and everyday experiences.

(d) LMS-based instructional material, including videos in several courses.

(e) Skeletal notes in courses MEL342 Power Plant Technologies and MEL705 Experimental methods in Thermal Engineering.

(f) Hands-on learning in the core course (for ME1) laboratory MEL341 Thermal Engineering laboratory.

(g) Learning-by-doing in laboratory course MEL242 Energy Conversion (core course for ME1 programme).

(h) Team-based product realization in course MEP202 Design, Innovation and Manufacturing.

2.10 No. of students (UG/PG) who have spent at least a semester at overseas universities.

The number of students who spent at least a semester at an overseas institution is 41 undergraduates (IITD exchange program) and 05 M.Tech. (DAAD, etc.), and 02 Ph.D.

2.11 No. of students (UG and PG) from overseas universities who have taken classes / project work / internship in the department.

In-coming UG exchange students who have taken classes. project work, internship is 2-4 per semester. The number of foreign UG students who have undertaken project is nil, and internship is 03. The number of foreign PG students who have undertaken project are 06 and internship is nil.

2.12 No. of courses taught via NKN to other institutions (enrollment).

The following course were taught to other institutions:

(a) 1st semester 2011-2012: MEL342 Power Plant Technologies, to IIT Ropar (28 students) and IIT Mandi (40 students).

(b) 1st semester 2013-2014: MEL342 Power Plant Technologies, to IIT Mandi (30 students).

(c) 1st semester 2012-2013: MEL705 Experimental Techniques in Thermal Engineering to IIT Ropar (PG students) and IIT Mandi (UG and PG students).

2.13 Course feedback.

As per data for the last three semesters, the average feedback score on a 0 - 5 scale is 3.72 for all courses.

2.14 Industry experts who have delivered lecture(s), seminars, discussions as part of a core/elective course – UG and PG separately.

In five years, the number of industry experts who delivered lectures, seminars, discussions as part of core/elective courses are five per year (UG + PG).

2.15 Industry exposure – course-related visits to factories, sites, industry exhibitions, field trips, etc.

Visits have been conducted as part of the following courses:

MEN110	Introduction to Mechanical Engineering
MEL342	Power Plant Technologies
MEL740	Instrumentation and Automatic Control
MEL705	Experimental Methods in Thermal Engineering
MEL769	Metal Forming and Analysis
MEL311	Steam and Gas Turbines
MEL322	Operations Planning and Control
MEL710	Air-conditioning
MEL716	Micro-scale Heat Transfer
MEL436	Injection Moulding and Mould Design
MEL791	Composite Materials and Processing
MEL241	Energy Conversion
MEL818	Multiphase Flows

MEL314 Noise Engineering

3. Research

3.1 No. of Masters and PhD students - (i) Supported by Inst Assistantship, (ii) On projects, (iii) Others sources and (iv) Sponsored by external organizations.

The current data of enrolled Ph.D. students is as under:

(a)	Supported by Institute Assistantship	51
(b)	Supported by projects	27
(c)	QIP	08
(d)	Sponsored part-time	61
(e)	Foreign national self-supported	08
(f)	CSIR	01
(g)	Interdisciplinary (TRIPP)	01

The number of M.Tech. students admitted in 2013-2014 session is as under:

(a)	Supported by Institute assistantship	134
(b)	Sponsored part-time	02

3.2 No. of Ph.D.s enrolled, graduated per faculty/year for last 5 years

On an average the number of Ph.D. students graduated is 0.22 per year per faculty. The year-wise graduation are as under:

2012-2013	08
2011-2012	07
2010-2011	08
2009-2010	15
2008-2009	09

3.3 Areas of research (e.g. areas listed in Prospectus, and others) by (i) Volume (quantifiable parameters), (ii) Breadth, and (iii) Years these have been research areas.

The details of research areas are given in Annexure 3-1.

3.4 Publications per faculty *(average per faculty for last five years)*.

The average number of publications per faculty per year averaged over the past 5 years is 2.6. The full list is given in Annexure 3-2.

3.5 Publications (journal and conference) per (a) Ph.D. student, (b) Masters student, (c) UG student.

This data is being compiled and is not available.

3.6 Best papers in last 10 years: (i) Individual best 3, (ii) department best 10; and brief justifications.

The highest cited top ten papers of the department over the last 10 years are listed in Annexure 3-3.

3.7 Average citation per department

The average citation per faculty per year (since 2009) is 55. There are 30 papers with more than 50 citations.

3.8 Changes, modifications, etc. done to improve the quality of (i) M.Tech., and (ii) Ph.D. graduates

Individual faculty have been making modifications and innovations in courses taught by them to improve the M.Tech. education. However, the department has not undertaken any major steps to improve the quality of M.Tech. and Ph.D. programmes. Similarly, the Ph.D. student is primarily advised and mentored by the supervisor.

3.9 Sponsored projects - (i) individually, (ii) with another faculty of the group/section of the department, (iii) with another faculty of the department but from another group/section of the department (iv) with another faculty of another dept/center

The complete list of sponsored projects undertaken in the last 5 years is given in Annexure 3-4. The percentage of sponsored projects done individually are 27 %, with another faculty of the same group is 37 %, with another faculty from another group of the department is 14 %, and with another faculty member of another academic unit of the institute is 22 %. The total value was Rs. 25.38 crores for the preceding 5 years.

3.10 Industry consultancies

The complete list of industrial consultancies done by the faculty (through IRD and FITT) are given in listed in Annexures 3-5 and 3-6, respectively. The total amount over the last 5 years was Rs. 11.21 crores.

3.11 New areas of research which are different from the faculty's PhD thesis area.

Research areas which are different from the faculty's Ph.D. thesis area are listed in Annexure 3-7.

3.12 Methodology for (i) identifying obsolescence in research areas, and (ii) identification of new areas for future research.

The department has no set policy/methodology for identifying obsolescence in research areas. New areas are identified by faculty based on their interests and availability of funds.

3.13 Number of large interdisciplinary projects (within department's areas, and across the institute).

The list of major projects that are interdisciplinary in nature are given in Annexure 3-8. About 44 % of the projects are with faculty from different groups of the department and 56 % are with a faculty member from outside the department.

4. Innovation, Design and Development

4.1 No. of students who have been funded for innovating (TePP, PRISM, etc.)

Over the last five years, 16 students were funded for innovating.

4.2 Technology developed *(give list and brief information)*

The technologies developed by the faculty over the last ten years are given in Annexure 4-1. Of these, one is in commercial use.

4.3 Technology transferred *(give list and brief information)*

The list of technologies transferred are given in Annexure 4-1.

4.4 No. of patents granted, and patents granted as a fraction of patents filed

Annexure 4-1 gives a complete listing of patents filed by the faculty and those that were granted.

4.5 Innovations of products, processes, designs, etc. in the department.

A list of innovations of products, processes and designs by the department faculty are listed in Annexure 4-1.

4.6 Availability of students' workshops, "tinkering laboratories" to students so that they may pursue their own ideas.

The department faculty have been instrumental in creating the following facilities as innovation and 'tinkering' laboratories:

(a) Students Innovation Center (located in Central Workshop)
(b) Junk Yard (located in Central Workshop)
(c) Large assembly and fabrication (in TBIU)
(d) Small assembly and prototyping (in TBIU)
(e) Tinkering and brainstorming/soft prototyping area (in TBIU)

4.7 No. of students who have competed in national / international competitions, and outcome

Students of the department have competed in the following competitions:

(a) Mini Baja (since 2004)
(b) Formula SAE (since 2008)
(c) Robocon (since 2004)
(d) CANSAT (Can Size Satellite Challenge)
(e) ASME Innovation Showcase

(f) ASME Bioengineering Design Challenge
(g) Mahindra Satyam Young Innovation
(h) Samsung Innovation

5. R & D Environment

5.1 No. of post-doctoral scholars hired in the dept./centre from (i) abroad, (ii) on project, and (iii) others, and outcomes.

The department has not hired any post-doctoral scholars in the last 5 years.

5.2 No. of foreign students enrolled in (i) Masters, and (ii) PhD programmes.

Over the past five years 03 foreign students were/are enrolled in the M.Tech. program as full-time students. During the same period, 07 foreign students were/are enrolled in the Ph.D. program as full-time students.

5.3 No. of Indian and foreign faculty/researchers who have spent a sabbatical in the department.

The following are the faculty/researchers who have spent a sabbatical in the department:

(a) Dr. C. W. Lim
Assistant Professor
Hanbat National University
Korea
(February 2013- January 2014)

5.4 Sabbatical taken by faculty and where spent.

Detailed of sabbatical taken by faculty are given in Annexure 5-1.

5.5 Number of seminars given by the faculty (i) in the department, (ii) in other departments, (iii) at other institutions.

The number of seminars given by faculty are:

(i)	In the department	07
(ii)	In other departments	07
(iii)	At other institutions	13

5.6 No. of faculty/researchers invited by the department for giving (i) seminars, (ii) spending at least a week in the department.

The number of faculty/researchers invited by the department for delivering seminars was 49 over the last five years.

Over the last five years, the department did not invite any faculty/researchers for spending at least a week in the department over the last five years.

5.7 No. of faculty/researchers who visited the department on their initiative for giving (i) seminars, (ii) spending at least a week in the department.

The number of faculty/researchers who visited the department on their initiative delivering a seminar over the last five years was three.

The number of faculty/researchers who visited the department on their initiative for spending at least a week in the department over the last five years was nil.

5.8 Adequacy of research infrastructure.

There is an acute shortage of research infrastructure. The major items are:

(a) Space
(b) Electric power supply
(c) Air-conditioned space
(d) Safety related facilities
(e) Space for project engineers
(f) Space for Ph.D. and masters students
(g) Space for supporting staff
(h) Availability of cluster-based supercomputing
(i) Soft water for experiments and equipment
(j) Storage for spare parts, equipment, and consumables (gases, oils, etc.)

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

Annexure 5-2 gives a list of technical staff members of the department and their expertise. The department is in the process of projecting its needs of skills and their utilization for the future. Overall, there is a shortage in numbers, inadequacy of skills required for the current experiments, and inadequate use of existing skills. The department is also in the process of identifying training for staff.

5.10 Work space available for (a) Masters students, (b) Ph.D. students, (c) project staff, (d) post doctoral scholars.

(a) There is no dedicated earmarked space for Masters students. Some students are working in a laboratory.

(b) There is limited space earmarked for Ph.D. students. At the current time, about 15 students have a shared office space, and several others are working in a laboratory.

(c) There is no dedicated earmarked space for project staff. Many faculty members have accommodated project staff in their office or in a laboratory.

(d) There is no dedicated earmarked space for post-doctoral scholars. Visiting faculty are provided an office in the department.

5.11 No. of national conference/workshops/seminars attended by PhD students (*total and per student for 5 years*).

The average number of national conference/workshops/seminars attended by Ph.D. students on rolls is two.

5.12 No. of international overseas conference/workshops/seminars attended by PhD student (*total and per student for 5 years*).

The average number of international conference/workshops/seminars attended by Ph.D. students on roll is one.

5.13 No. of students who have continued to Ph.D. (i) in same dept., (ii) other departments of IITD, (iii) in India, and (iv) abroad (separately for M.Tech. and B.Tech. students).

Over the last 10 years, the number of B.Tech. students who have continued to Ph.D. are as follows:

(i)	In the same department	02
(ii)	Other departments of IITD	NIL
(iii)	In India	01
(iv)	Abroad	15 (approx.)

Over the last 10 years, the number of M.Tech. students who have continued to Ph.D. are:

(i)	In the same department	04
(ii)	Other departments of IITD	01
(iii)	In India	01
(iv)	Abroad	08

5.14 No. of projects with co-guide from industry.

Of all the M.Tech. projects, about 5 % have had a co-guide from industry.
Of the Ph.D. projects, about 1 % have had a co-guide from industry.

5.15 No. of students who have spent time in industry as part of thesis/project work (*give number and duration*).

This data is not available and is being compiled.

5.16 Self assessment reports of the department/centers/schools, if any.

The department has not undertaken any self assessment in the last ten years.

5.17 Placement of M.Tech. and PhD graduates in technical careers (*as per format at Annexure-5*).

The statistics on placement in technical jobs for M.Tech. and Ph.D. students are presented in Annexure 2-3.

5.18 Inter-disciplinary work:- (i) joint thesis guidance by faculty across groups/ departments/centres, (ii) Proposals submitted and funded – PI-CoPI and their group/department affiliations.

Of the 47 Ph.D. thesis completed in the last five years, none had joint guidance by faculty across groups of the department, and 4 % had a co-guide from another academic unit of IITD.

6. Outreach / External stakeholder engagement

6.1 Educational

(a) Workshops/Short term courses – topical research for disseminating research of IITD

The department has conducted 17 short term courses for industry and/or faculty of other engineering colleges as listed in Annexure 6-1.

(b) Workshops/Short term courses – educational methods (teaching, learning resources, pedagogy)

The department has not conducted any workshops/short-term courses for disseminating educational methods related to teaching-learning processes, pedagogy, etc. for sharing education related experiences and innovations with faculty/teachers of other institutions.

(c) Learning, research material on the website

Several faculty members have been maintaining web pages containing learning and research material.

(d) Science & technology for public information – on website

The department's website contains some web pages containing information about science and technology for public use.

(e) Courses taught to students of other IITs/NITs/Other institutions

Several faculty members of the department have, on their initiative, taught courses to students of other IITs/NITs/other institutions; a listing is given in Annexure 6-2.

(f) Courses taught via NKN

The following full courses have been taught via NKN to students at other institutions:

Semester Acad. session	Course no. & name (at IITD)	Faculty	Other institutions
1st semester 2011-2012	MEL342 Power Plant Technologies	S R Kale	IIT Ropar IIT Mandi
1st semester 2012-2013	MEL705 Experimental Methods for Thermal Engineering	S R Kale	IIT Ropar IIT Mandi
1st semester 2013-2014	MEL342 Power Plant Technologies	S R Kale	IIT Mandi

(g) Courses developed for NPTEL

The courses developed for NPTEL are listed in Annexure 6-3.

(h) Books, monographs, study material made available outside IITD

The following teaching/learning materials have been made available to students/faculty at other institutions:

Gaur, R. R., Rajeev Sangal, and G. P. Bagaria. A *Foundation Course in Human Values and Professionals Ethics*. Excel Books India, 2010.

Shah, Suril Vijaykumar, Subir Kumar Saha, and Jayanta Kumar Dutt. *Dynamics of Tree-type Robotic Systems*. Springer Netherlands, 2013.

Saha, Subir Kumar. *Introduction to Robotics*. China Machine Press, 2010.

Dhar, P. L. *Engineering Thermodynamics: A Generalized Approach*. Elsevier, New Delhi, 2009.

(i) Experiments developed and made available to other institutions

The faculty of the department have assisted in the development of experiments at other institutions:

(i) Product Realization Laboratory at IIT Ropar
(ii) Product Realization Laboratory / Innovation Center at IIT Mandi
(iii) Thermo-fluids Laboratory at IIT Ropar and IIT Mandi

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

The department faculty have delivered 13 seminars to other institutions in India/abroad.

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

As a concerted effort, the department has not reached out to other schools, NCERT, KVs for enhancing teaching-learning materials. However, some faculty have on their initiative have had engagements with KV to help in laboratory resources and developing learning materials, and engaged with schools on topical issues (e.g. robotics, automobiles). Some faculty have arranged visits by school students to department facilities. The department has showcased its laboratories and research innovations to school children in the NCR every year through the Institute Open House.

(l) Mentoring of other institutions, e.g. new IITs, NITs, universities, etc. including faculty mentoring, curriculum development, laboratory development, etc.

Several faculty of this department have had a long engagement with IIT Ropar and IIT Mandi dating back to the establishment of the new IITs. This included:

(a) Travelling to Ropar / Mandi to take classes on weekly/fortnightly basis
(b) Planning and setting-up of laboratories
(c) Developing the curriculum
(d) Assisting with purchase, installation and commissioning of equipment
(e) Arranging for skilled personnel to assist in the conduct of experiments
(f) Campus design
(g) Faculty mentoring
(h) Mentoring the students

6.2 Industry collaboration

(a) No. of student (Ph.D./Masters) directly linked to industry funded projects.

Most part-time thesis are linked to industry projects.

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

About six engineers from industry have taken a regular course for the entire semester.

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

(a)	Transfer to companies	10
(b)	Transfer to government/govt. agencies	03
(c)	NGOs	02

(d) Continuing education/courses for industry.

The faculty have conducted at least five continuing education courses for industry.

(e) Faculty secondment to industry

No faculty member has availed of this facility.

(f) Research projects undertaken with industry as partner

At least ten projects have been undertaken in partnership with an industry.

(g) Laboratories, equipment, etc. provided by industry for use in UG / PG laboratories and student projects.

There are no laboratories of equipment in use that have been provided by industry.

(h) Seminars/workshops held with industry by the department.

Four seminars/workshops have been conducted in partnership with industry.

6.3 Professional

(a) Service as Board, Senate, selection committee member at other IITs, NITs, and Universities.

Several faculty members have served/are serving as Board of Governor member of an IIT, member of Senate of another IIT, as member of Academic Council at a University, or as member of selection committee at IIT/NIT/Universities. The total number is 36.

(b) Service as PhD thesis examiner at other institutions.

There have been about a 100 instances where faculty have served as Ph.D. thesis examiner at other institutions.

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

There are 23 cases where faculty have served as technical expert on various committees.

(d) Technical expert on policy, regulatory, laws, standards, committees.

There are five instances where faculty have served as technical experts on different policy, regulatory, laws, standards, etc. committees.

(e) Member of Board/Advisory Board of public and private sector corporations.

There are nine instances of faculty serving on the Board/Advisory Board of various corporations.

(f) Positions (e.g. Director, Vice Chancellor, etc.) held by faculty on lien.

Two faculty members are currently on lien as Director IIITM, Gwalior (Prof. S. G. Deshmukh), and Director, SLIET, Longowal (Prof. S. Pandey).

6.4 Contribution to national development goals

(a) Projects undertaken and their outcome.

Several faculty members have conducted research, design and development projects aimed at national development goals, such as, affordable health care, devices for visually challenged, energy efficient devices (wood cook stoves, furnaces, etc.), rural development (micro hydro, potter's wheel, etc.), energy efficiency, sustainable transport, amongst others.

(b) Policy inputs – implications, visible impact on society.

Some faculty members have worked with policy makers and provided inputs.

(c) Entrepreneurship development.

The following faculty members have start-up companies in the TBIU of IIT Delhi:

Prof. Naresh Bhatnagar	Shalya Medical Technologies Pvt. Ltd.
Prof. S. Mukherjee	Faros Technologies Pvt. Ltd.
Prof. A. Chawla	PLANiN Space Innovation and Consultancy Services

Dr. Sunil Jha	Innovative Mechatronix Solutions Pvt. Ltd.
Prof. S. P. Singh & Dr. A. K. Darpe	Silver Knight Technologies Pvt. Ltd.
Prof. S. Pandey	Kentellus Welding & manufacturing Pvt. Ltd.

6.5 Alumni engagement

(a) Regular interactions / engagement with alumni and outcomes

Interactions with alumni are limited to Reunions and casual visits by alumni to the department. There is no pro-active engagement with alumni.

(b) Contributions from alumni

There have been no department specific contributions from alumni. They have contributed to the development of the Students Innovation Center which is being coordinated by faculty from the department.

6.6 Recognitions and Awards

(a) Awards to faculty

Over the past 5 years, faculty members have received a total of 22 awards.

(b) Fellows of academies, INAE, etc.

One faculty member of the department is a fellow of the INAE.

7. Governance

7.1 Governance

(a) Organization structure – their autonomy/ terms of reference

The organization chart of the department is shown in Annexure 7-1. The major units are the three groups, viz. Design, Production & Industrial Engineering, and Thermal Engineering. Each faculty member is associated with one group only.

The Department Faculty Board (DFB) is the apex decision making body in all matters. Its sub-committees include the Department Research Committee (DRC), Department Undergraduate Committee (DUGC), Space Management Committee, Faculty Search Committee. The Committee of Professors is responsible for making recommendations on faculty recruitment and promotion. The management of each M.Tech. programme is carried out by a faculty member who is designated as Programme Coordinator. The constitution and terms of reference of these committees are given in Annexure 7-2.

B.Tech. major project and M.Tech. thesis are evaluated by a committee of 3-4 faculty members and an examiner, twice a semester.

(b) Planning documents developed by the department – space, faculty, staff related.

The department has not developed planning documents for aspects related to space, faculty and staff. The process for space audit is in progress. A staff planning process has been initiated.

(c) Records of discussions within the department – internal documents (meeting minutes, position papers, etc.)

A hard copy of the records of meetings are archived in the department office. These are available as Annexure 7-3.

(d) Physical resources – percentage utilization for UG teaching, PG teaching, UG and PG student projects, Ph.D. student research. Projections for future.

Of the 26 laboratories, a few laboratories are used for experiments related to undergraduate core courses. Postgraduate core experiments and UG elective experiments are conducted in several laboratories. Almost all laboratories are used for students to perform experiments related to B.Tech. mini-project and major project, and M.Tech. thesis related work.

(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. Outcomes of funds utilization. Changes in funding pattern and funds utilization, and effects on departmental strategy.

(i) Funds provided to the department

Annexure 7-4 gives details of plan and non-plan funds received by the department.

(ii) Processes of distribution

The Plan and Non-Plan funds are distributed amongst the three groups by the DFB and each group prepares a plan of purchases. The consolidated list is discussed and approved in the DFB. Subsequently, individual faculty are required to execute the purchase.

(iii) Funding for focus areas

The department has not planned the allocation of funds for focus areas. The groups while making their priorities account for their respective focus areas.

(iv) Funding for UG and PG core teaching laboratories

Funding for UG and PG teaching laboratories is done by the groups. Separate documentation for the same is not available.

Outcomes of funds utilization

The department has not performed an exhaustive audit of effectiveness of funds utilization, changes in funding pattern and funds utilization. About 20 % of UG experiments and 18 % of PG experiments have been revamped in the last 10 years. The department has not developed its future strategy and the funds required for the same.

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

Decision-making within the department has been delegated to various committees. The detailed processes for financial and academic management have not been documented. For the former, the institute's procedures are followed. There is no procedure for the review of these processes.

7.2 Department management and operations

(a) Organization structure - mandates, flexibility, etc.

The organization structure of the department is given in Annexure 7-1. the structure is being reviewed for flexibility, etc.

(b) Processes for curriculum planning

The curriculum planning for UG programs is finalized by the DFB based on inputs from the groups. Certain inputs are obtained from the DUGC. PG curriculum planning is based on the parameters provided by the institute and each group draws up the curriculum for its own M.Tech. program.

(c) Processes and methods for teaching resources management.

The teaching loads are allocated by the group in-charges. Teaching assistantships to M.Tech. students are allocated by the respective program coordinators. TA duties for Ph.D. students are allocated by the group in-charges based on data from Secretary DRC.

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

The department has availed the services of two guest faculty and instructors per semester for several semesters to meet the teaching commitments.

(e) Faculty short-listing criteria.

The faculty short-listing criterion are given in Annexure 7-5.

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

Almost all work is done individually or with a few other colleagues. The only collective activity of the faculty is in the meetings of the Department Faculty Board.

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

Until the recent past, the department had been hampered by lack of efficient support staff. Several steps have been taken and the outcomes have been positive. There is a shortage of staff for supporting purchases and executing routine matters. With increase in project funding there a felt need for professional project management staff.

7.3 Faculty

(a) Faculty profile, and a critique of the same.

The listing of the faculty is given in Annexure 7-6.

(b) Diversity in profile: gender, category, region, Ph.D. institution, post-doctoral institutions, organizations worked in, employment prior to joining the department.

Annexures 7-7 and 7-8 show the overall and group-wise diversity in faculty in respect of institutions attended and professional/post-doctoral experience. As can be seen there is considerable variation amongst the groups. 40 % of the faculty were working at another IIT/NIT/other engineering college in India just before joining the department.

(c) Procedure for faculty searches.

Until recently, the department has relied on its advertisement for attracting potential faculty. The search committee is now actively scouting young Ph.D. and contacting them for their interest in a faculty position in the department. The application is scrutinized by the Search Committee and its recommendations are examined by the Professorial Committee. Candidates cleared by the Professorial Committee are invited for an interaction session, including a presentation. Alternately, they are required to give a seminar to the faculty. Based on the assessment done by the Professorial Committee the candidate is rejected or is recommended for interview by a Selection Committee. The Selection Committee makes the final decision on selection.

(d) Result of faculty searches – area-wise, number of applicants, short-listed and offered a position, their educational qualifications & experience.

Over the last 3 years, 302 applications were received. Of these 96 (32 %) were recommended to the Professorial Committee by the Search Committee. Of these 32. (33 %) were recommended to the Selection Committee. Out of these 07 nos. (22 %) were selected for making an offer. Of these 07. who were made an offer, 03 (42 %) have joined and 02 (28 %) are expected to join. The department is host to one DST - INSPIRE faculty fellow.

(e) Success in recruitment (data for last 5 years), and offers that the persons had from other IITs/IISc/TIFR.

During the last five years, five faculty have joined.

(f) Faculty lost.

In the past 15 years, the department has lost three faculty members, Dr. Sandeep Juneja (B.Tech., IITD, Ph.D. Stanford U.), Dr Atul Bhaskar (B.Tech. IITK, Ph.D. U. Cambridge) and Dr. Sujit Saraf (B.Tech. IITD, Ph.D. UC, Berkeley).

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

On the average the faculty spends 22 % time in class with another 30 % on course-related activities outside the class, 7 % in meetings, 9 % in project/consultancy work/ management, 12 % on M.Tech. thesis guidance, and 20 % administrative work.

(h) Level of harmony amongst department faculty.

By and large the faculty work harmoniously. However, there are instances of disagreement which primarily arises due to compartmentalization. The department undertook a faculty retreat that was facilitated by alumni to develop the vision of the department. The retreat was very well received by all the participants.

7.4 Students

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

The short-listing criterion for admission to M.Tech. and Ph.D. admissions are given in Annexure 7-9.

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

Most Ph.D. and M.Tech. students are given access to the laboratories as per their requirements. These are managed by individual faculty members in their role as thesis guide.

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

The department has not conducted any mentoring seminars/sessions for career planning for Ph.D. students.

8. Benchmarking

8.1 Identify departments/centres within IITD as peers.

8.2 Identify departments/centres/schools/divisions from other IITs, IISc, NITs, private universities as peers, and reasons/criteria there for.

8.3 Identify departments/centres from institutions in other countries as peers.

The institutions identified for benchmarking are detailed in the attached Annexures.

Annexure 1-5A B.Tech. in Mechanical Engineering
Annexure 1-5B B.Tech. in Production and Industrial Engineering

Annexure 1-5C M.Tech. in Design of Mechanical Equipment/Systems
Annexure 1-5D M.Tech. in Industrial Engineering
Annexure 1-5E M.Tech. in Production Engineering
Annexure 1-5F M.Tech. in Thermal Engineering

Annexure 1-5G Ph.D. programme

8.4 Define parameters for benchmarking (i) research, (ii) curriculum, separately for UG, Masters, and Ph.D. programmes, (iii) teaching-learning processes.

The curricula have been compared on a broad range of parameters as detailed in the Annexures 1-5A to G.

8.5 Perform benchmarking and report the analysis/findings with 5 year and 10 year targets.

In all our M.Tech. programs, the number of core courses is 6-7 which is comparable to other IITs except IIT Kharagpur where the number of core courses is 11-13. At overseas universities, the core courses are greater at some institutions while they are less at some other institutions. However, the numbers are comparable. As regards the thesis requirement, all IITs have a mandatory thesis requirement, whereas at overseas institutions it is mandatory at some institutions, optional a others and not a requirement at other institutions.

9. Feedback systems and results

9.1 System for feedback from UG students and its results.

The department does not have any system for taking feedback from UG students.

9.2 System for feedback from PG, Master's and Ph.D., students, and their outcome.

The department does not have any system for taking feedback from PG students.

9.3 System for feedback from recruiters (i) on-campus, and (b) off-campus - separately for UG and PG graduates; and the results.

The department does not have any system for taking feedback from any recruiters.

9.4 Mechanism of obtaining industry feedback and the findings.

The department does not have any system for taking feedback from any industry. Most of feedback is the form of informal discussions during meetings with industry engineers/executives and alumni.

9.5 Alumni feedback mechanism and its outcome.

The department does not have any system for taking feedback from alumni.

9.6 Placement records – Ph.D., M.Tech. and B.Tech. graduates.

The placement statistics for graduates is given in Annexure 9-1. Detailed listing of organizations where graduates were placed is given in Annexure 9-2.

10. Future vision for next 5-10 years

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

(i) Curricula

The focus of the department in respect of curricula are:

(a) To strengthen the Ph.D. programme the department will augment the course, include a course on Research Methodologies, and make available facilities for enhancing communication skills. The monitoring of the progress will be enhanced by more frequent meetings of the Student Research Committee (SRC). The department shall make a weekly Seminar Series as a regular feature. It is also proposed to set-up a Research Scholars' forum. Career planning workshops shall be organized for Ph.D. students, especially for taking up academic jobs.

(b) A comprehensive review of the M.Tech. curricula shall be carried out. The project activity will be made more professional and rigorous, including adoption of professional project management techniques. Industry involvement shall also be increased in the projects.

(c) In the undergraduate program, the emphasis shall be on synthesis type projects with relevance to practical problems. As needed, an interdisciplinary approach (with students of other programs) shall also be incorporated. A similar approach shall be adopted for the core laboratory work. The laboratory facilities for manufacturing and engineering visualization shall be revamped. Dedicated laboratories shall be made for UG teaching.

(ii) Research

The department shall initiate 3-5 large path-breaking inter-disciplinary projects of societal relevance. The target for Ph.D. graduates is 25 per year and 130 M.Tech. graduates. The target for annual funding via sponsored projects is Rs. 15 crores. The target for SCOPUS publications is three per faculty per year.

(iii) Outreach

The department shall aim for taking a leadership position in research on teaching-learning processes, and in the development of learning materials and their dissemination across the nation. Special emphasis shall be on producing experiments for hands-on learning experiences in a cross-topical setting. The department shall also arrange summer programs for faculty and students of other institutions. The offering of courses over NKN shall be augmented.

(iv) Processes for regular internal assessment

The department shall put in place a committee and a schedule for assessment of the changes planned. Inputs shall be taken from graduates, alumni and practicing engineers in a systematic manner. The review shall be undertaken once every two years.

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

Details are given in 10.1 above.

10.3 Areas identified for improvement in (i) curriculum, (ii) teaching-learning processes.

Details are given in 10.1 above.

10.4 New areas for research and Masters programmes, and industry participation in these.

These areas are under discussion and shall be identified in the near future. The department faculty are in discussions with several organizations for large funded projects in select areas.

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

(i) The department shall aim to attract funding to the tune of Rs. 15 crores per year.
(ii) The faculty shall aim to publish three SCOPUS publications per year per faculty.

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

The department targets to graduate 25 Ph.D., 130 M.Tech. and 120 B.Tech. graduates per year.

10.7 Projected faculty profile, and areas for recruitment of faculty.

The current faculty shortage (almost 50 % of sanctioned strength) shall be in all areas of mechanical engineering, especially in Industrial Engineering and Operations Research, Design Engineering and Thermal Engineering.

10.8 Projections for future benchmarking (for comparison after 5 years) - institutions in India and abroad, and parameters for future comparison.

The benchmarking shall be against 4-5 institutions in India, 4-5 institutions in Asia /BRICS nations, and 4-5 institutions in OECD nations. the comparison parameters shall be programme specific. The comparisons shall explore the pedagogy and quality in teaching-learning processes, in particular self-learning by students.

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

(a) The department has an acute shortage of space for all operations. A space audit is underway to quantify the extent and nature of future space requirements.

(b) A reorganization of laboratories shall be carried out with improvement in resource sharing and better space utilization.

(c) Special efforts will be made to upgrade the skills of technical staff and have better utilization of their skills across various laboratories.

(d) An institute level ERP for all functions is a need of the hour.

(e) There is a need to upgrade secretarial services and project support services for managing large projects.

(f) The electricity power supply needs to be improve drastically.

(g) The department shall make efforts to improve safety in the laboratories.

10.10 Working with other departments/centers and institutions in teaching and research.

The department is in the process of discussions with other departments/centres for rationalizing UG and PG course teaching. The faculty plan to undertake large inter-disciplinary projects in teams with faculty from other departments/centres.

10.11 New initiatives that the department/centre will undertake.

Besides the above, the department plans to (a) undertake large projects involving large number of faculty,(b) work closely with industry and alumni, and (c) actively engage for laboratory to market transition.

10.12 Outreach goals and anticipated limitations in the attainment of these.

Target for outreach is in the form of ten web-based courses, laboratory development, research into teaching-learning processes, and NKN based courses to other institutions.

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

The department shall put in place an internal standing committee for periodic review of various aspects, e.g. infrastructure, safety, curriculum, and research quality, amongst others.

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

(a) How many programs (UG + PG) should the department offer?
(b) What is a reasonable teaching load in view of targeted increase in research?
(c) How can team work be promoted, and mechanisms for its recognition?
(d) How should faculty output (quality and quantity) be assessed?

11. Information in public domain

11.1 Minutes of all meetings.

These are available.

11.2 All reports archived in the central/department/centre libraries.

Students' reports and thesis are available as hard copy in the department library. Soft copy of the Ph.D. dissertations are available in the Central Library.

11.3 Past vision documents, review documents, Standing Review Committee documents.

The past review committee reports are available.

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

A concept cum approach paper prepared by the Thermal group on M.Tech. curriculum is available.

11.5 Feedback documentation and action taken on the same, and its outcome.

The department has no systematic documentation of feedback from faculty, staff students, alumni or other stakeholders.

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