Summary Report

About Department/Center/School: *The department came into existence in 1965 as the Department of Aeronautical Engineering. Later in 1988, it was renamed as the Department of Aerospace Engineering. Since its inception the department is engaged in imparting education in various aspects of aircraft and space technology. It aims to create an ambience in which new ideas and creativity flourish and from which research and scholarship and leaders and innovators of tomorrow emerge. It is actively working towards achieving its aspiration and has prepared a dynamic roadmap for this purpose.*

1. **Academic Programs (Range of Degrees and Disciplines):**

   i) ***B.Tech (Hons.)*** *– 4 years' duration*
   ii) ***Dual Degree*** *(B.Tech (Hons.)+M.Tech in Aerospace Engineering) – 5 years' duration*
   iii) ***M.Tech+Ph.D*** *in Aerospace Engineering – 2 years' M. Tech followed by an optional enrolment in the Ph.D progrmme*
   iv) ***Ph.D*** *in a) Fluid Dynamics, b) Flight Mechanics & Control, c) Solid Mechanics, d) Combustion/Aircraft Propulsion*

2. **Major 4-5 Thrust Areas of Research:** *i) Unmanned Aerial Vehicles and related Technologies; ii) Smart and Composite Structures; iii) Experimental and Computational Research on Turbulent Flows; iv) Propulsion & Combustion and v) Flight Dynamics & Control.*

3. **Curriculum and Courses & Teaching Environment**

Items	**Ratio/ Number**	**Items**	**Number/%**
Teacher-student Ratio	1:19.7	Average No. of students motivated (%) to opt of careers Eng/ Tech. Sectors UG/PG/PhD	50/58/22
No. of Faculty members as on today	15	Average No. of students motivated (%) to opt of careers in Science sectors UG/PG/PhD	4/2/2
Average No. of Tutorial Assistants	50	No. of teaching labs	4
No. of UG/DD students	119/105	Average No. of students per experiments in core courses	5
No. of PG students/PhD students	35/37	No. of Students' workshops/``Tinkering'' Labs	2
Average no. of tutors with more than 100 students	7 to 9	No. of new courses introduced	5
Average Students placements (%) (UG/DD/PG)	87/84/65	No. of New program introduced	NIL
No of major curriculum review in both UG & PG level	1	Undergraduate Vs PhD strength expressed as Percentage	17
No of UG lab (teaching labs) developed/set-ups	1/1	No of PG/research labs developed/new set up	4/4
No of E class rooms	6	No. of lab classes per week	4
Average No. of Course done per student for B. Tech/DD/M. Tech/Ph.D	56/65/16/4	No. of core/elective/seminar/projects subjects taken for B. Tech, DD, and M. Tech respectively	47/07/00/02 48/13/00/04 07/05/02/02

4. Research and Development & its Environment

Items	Number	Items	Number	Items	Number
Total No. of Publications in Journals (2008-13)	222 (166 Scopus)	Average no. of citation per paper based on Scopus data	10.80	No of large interdisciplinary research projects	04
Total No. of Publications in Conference & Symposium	314	Average Journal publication per year	37	Number of Int. conf./workshops attended by students	37
Total No of Books & e-books published	3	h-Index of the department since 2008/overall h-index in Scopus	23/29	No. of PDF hired in the department	00
Total No of Edited Conference Proceedings/book chapters	6/5	Number of papers with citation more that the average no. of citation of the Journals	33	No. of international Students as PhDs/PDFs	00
Total No. of Technology Developed/transferred	3/3	No. of recognitions & Awards, fellows etc to faculty/students (provide break up if necessary)	20/10	No. of International visiting researchers/adjunct faculty stayed here for at least a week	06/01
Total No. of Patents Filed/Obtained	1/1	Average Retention(%) of Young faculty for at least 10 years	100	No. of short courses/workshops /conf. organized with international participations	01/00/01
Total No. of Copyright Filed/Obtained	0/0	No. of Sponsored research Project /fund(lakh) generated from non-internal source	46/639	Average No. of PhD granted per year	04
No. of Publications per Faculty/Masters/ PhD students	15/49/391	No. of Consultancy /fund (lakh) generated from non-internal source	03/3.37	Average No. of PhD Granted per year per faculty	0.33
No. of Publications per Faculty/Masters/ PhD students in Top Ten Journals as Identified by the department	46/30/16	No of Internal and external Collaborations research papers/research projects/PhD students	147/6/6	Patent granted per faculty	0.07
Average No. of Citation per faculty per year	19	No of M. Tech students motivated into pursuing PhD/PhD graduates motivated to pursue career in Academics (abroad or IIT etc)	44/25	Number of articles in collaborations with ten countries*	67
Ranking of the department in terms of average citations per paper within the Institute	2	Ranking of the department in terms of total number of Journal publications within the Institute/publications per	19/16	No of articles of the dept. contributing towards h-index of the Institute since	8

		faculty		2008	

5. External Stakeholder Engagement and others

Items	Number	Amount Lakh
No. of PhD/Master students' thesis funded by Industries	07/15	NA
Total number of Industry sponsored projects and its income (Lakh)	10	114
No. of Curriculum Development Initiative for Industries	06	NA
No of Technology transfer/adopted by Industry/Labs	03/03	NA
No. of Nationally relevant research projects	15	NA
No of Policy inputs/consultancies provided	07	NA
No. of Research grant and seed money from internal savings of the Institute per young faculty of the department and its total fund	03	8
No. of Community Relevant projects	NIL	NA

6. Vision for the Future (in brief):

(a) Departments/centers/schools should spell out its Mission and Vision Statements, (b) Plans for future to achieve the projected goals and (c) measures adopted towards above.

The Department aims to align with the Mission, Vision and Vision 2020 of the Institute. The Department has set its own Objectives, Goals and made Strategies and Initiatives for the proper propagation of Vision 2020. The vision of the Department is to be among the top 20 departments of the world. The Department has identified seven key transformational themes and initiatives as given below to achieve this goal: (i)Teaching Excellence, (ii) Research Excellence, (iii)Faculty Excellence, (iv) Industry Collaboration, (v) Branding and Visibility, (vi) Funding Sources, and (vii) Governance and Administration.

The Department has made its own road map to act on the transformational initiatives over the next 5 years in a coordinated way to achieve goals of the vision and has identified metrics for monitoring the progress of the same.

7. External peer review of the Dept./centre/schools (in brief): (a) Date: *December 6, 2014*

(b) Name of the Experts involved and their affiliations in short: *(1). Dr. A. R. Upadhya, Ex. Director, NAL Bangalore, (2) Prof. Dayanand Yadav, Visiting Professor, Aerospace Engineering Dept, IIT Kanpur, and (3)Dr. A. K. Ghosh, Project Director(AMCA), ADA Bangalore*

(c) Overall recommendations of the peer review committee: Strengths, weaknesses, suggestions and comments

The activities of the department are in tune with the defined Vision and Mission statements. Given the current limited faculty and supporting staff (lab. technicians), the department has done remarkably well, comparable to other departments of IIT, Kharagpur and other leading institutions in India and abroad.

The Vision 2020 of the Department is to be among the top 20 departments of the world. The Department has identified seven key transformational themes and taken initiatives to achieve this goal: In order to achieve this, the faculty strength and supporting staff (Laboratory Technicians) strength has to be increased. Industry collaboration, branding and visibility and funding sources have to be improved considerably from the present levels.

The department has done exceedingly well in terms of UG and PG courses, research and publications and sponsored research in spite of limited faculty and other constraints. Their publications rank is well, comparable with national and international averages.

- *Faculty and staff position needs to be improved; adhoc/ quick hire schemes may be considered.*
- *Interdisciplinary areas such as stealth, avionics, on-board systems, materials and manufacturing etc. need to be introduced with other concerned departments.*
- *Visibility needs to be improved with greater industry interaction.*
- *Laboratories need to be modernized and enlarged; Training to staff to be imparted.*
- *In the assessment of performance of faculty, weightage to be given to participation in national mission mode projects, experimental work, patents, quality of papers etc.*
- *Innovation to be encouraged in students.*
- *Aircraft-Design course to be a comprehensive course.*
- *The department should strive to be recognized as an acknowledged centre of excellence in at least a couple of areas, while maintaining a wider coverage in general terms.*

(d) Measures adopted/action taken at the department level to address the recommendations of the peer review report:

The department constituted an internal committee to study the report of the peer review committee and suggest a complete roadmap to take possible course of action to implement the recommendation of the peer committee. The committee has submitted its report and suggested action plans. The department has started implementing the recommendations of the committee in a phased manner. Two ISWT courses namely "Aircraft Design Practices" and "Multi-scale modeling of Advanced Materials are being offered for the students, R & D labs and Industry during winter 2014. The department has identified challenge problems to encourage innovation in students and providing working environment on 24x7 bases. The laboratories have been augmented and modernized and are being further augmented and updated. The department is in process of appointing adjunct faculty from Industry to enhance industry collaboration. Several other steps are being taken to implement the recommendations in a letter and spirit

8. **Strengths, Weaknesses, Opportunities & Threats (SWOT) Analysis of the Department**

STRENGTHS √ Good quality faculty √ Adequate and Quality Research outputs √ Creamy layer of students √ Brand image due to about 48 years of standing of the department √ Conducive ambiance and well endowed computational and academic infrastructure facilities √ Alumni are in Senior/influential positions √ Good placement record √ Periodic updating of curriculum √ Conferences and continuing education programmes organized on regular basis √ Periodic feedback of the students **WEAKNESSES** √ Low teacher-student ratio √ Low teacher-staff especially technical staff ratio √ Inadequate and insufficiently trained supporting staff √ Low consultancy output √ Low national and international awards √ In-adequate sophisticated equipment and labs in the areas of emerging technologies & cutting edge disciplines for post graduate teaching and research √ Inadequate linkages with industry and community	**OPPORTUNITIES** √ Boom in industrial development and challenges in Aerospace fields put demand for quality technical manpower √ To increase research activities: PhD and sponsored research √ Establishment of more centres of excellence and advanced studies √ To innovate new products/processes/designs and acquire patents √ Possibility of more international and national collaborations and joint ventures √ Training of technical supporting staff √ Tapping of Alumni experience; developing labs, chair professorships, collaborative programs with world class universities/ industries of international repute. **THREATS** √ More attractive opportunities outside the Department pose greatest threat to attract and retain good quality faculty and technical staff √ Competition with the Indian campuses of foreign universities √ Boom in self financing institutions √ Lack of good quality faculty may permit mediocrity to overtake excellence √ Lack of incentives at par with world class institutes such as MIT, CalTech, etc and the world class industries

***Ten countries: US, UK, Germany, Japan, Canada, France, Italy, Australia, Singapore, S. Korea**

Important Highlights

1. Time Line of Major Events:

1965: Department of Aeronautical Engineering 1967: First batch of students Received the degree 1975:M. Tech and PhD started 1977: First PhD (78 PhD completed so far) 1988: Renamed as Department of Aerospace Engineering 1999: Centre of Excellence for Composite Structures Technology (Phase –I) 2006-2008: Academic training Program for HAL Design and MTs (about 250 trainees)	2008: Academic program for Korean Students (two weeks) 2008: Centre of Excellence for Associate Node for CFD at IIT Kharagpur 2009: Boeing-University Relation Program 1999: Centre of Excellence for Composite Structures Technology (Phase-III) 2014: MoU with HAL to set up Chair Professor 2014: Academic training Program for HAL Design and MTs (82 MTs)

2. Major Initiatives Taken:

- Roadmap for the department to achieve objectives & goals of the vision 2020 of the department based on the SWOT Analysis
- Identified five major thrust areas of research, conducted Peer review of the department from external experts and identified Challenge problems for the students
- Identified Top Ten Journals in Aerospace Engineering & Interdisciplinary Areas and also identified Top ten best academic conferences around the world. The faculty and students are being encouraged to publish their articles in the top ten Journals and conferences.
- Offering two International summer/winter terms(ISWT course) on "Aircraft Design Practices" and "Multi scale Modeling of Advanced Materials" during winter with International faculty
- Regular feedback of students and other stake holders on a regular basis on academics
- Major updating of the department website and evolved a mechanism to update the information on regular basis
- Research scholars day to provide platform to the scholars to share their works and interact with external experts
- Identified a list of metrics for next five years to monitor the progress of the goals on SWOT basis

Metrics	Current (13-14) Dept	Institute	2014-15	2015-16	2016-17	2017-18	2018-19
Faculty strength	15	575	16	18	21	24	27
Faculty student ratio (FSR)	18.7:1	18.2:1	17.11:1	15.67:1	13:6	11.88:1	10.7:1
Average Publications per faculty per year	3.6	2.95	3.8	4.1	4.4	4.8	5.0
Research funding per year per faculty (lakh)	19.46	25	22	24.5	26	28	30
Av. no. of Research projects per year per faculty	0.3	-	0.4	0.5	0.6	0.7	1.0
Average number of research scholars (RS) per faculty	2.3	3.4	2.875	3.17	3.23	3.25	3.33
Rs/UG strength	0.172	0.33	0.22	0.273	0.325	0.373	0.43
% of RS wrt total strength of the dept.	11.65	20	14.42	17.27	19.95	22.22	24.79

PhD granted per year per faculty	0.33	0.31	0.38	0.40	0.42	0.46	0.50
Patent granted/filed	0.07		1	1	2	2	3
International conf/short term courses organised	0.33		1	2	3	4	5

3. Major Achievements:

- The department ranks 1 and 2 in terms of citations per paper and h index, respectively in the last five years in comparison with all national peers
- The department ranks comparable in terms of citations per paper in the last five years in comparison with top international peers and even better than many international peers
- The department ranks 2 in terms of citations per paper in the last five years in comparison with the departments/centres within the institute across disciplines
- The department ranks 3 (about 14%) in terms of contribution towards h-index, i.e., 57 of the Institute in the last five years in comparison with other departments/centres/schools within the institute
- The faculty brought many laurels and awards in the last five years **and** the students brought many awards and prizes for the department such as Mahindra Satyam awards, best papers awards, etc.
- The faculties are involved in a large number of major nationally relevant research projects such as Chandrayaan, ACECOST.Ph. III, AMCA, ISRO, Indian Railway etc.

4. Major Facilities:

Aerodynamics Laboratory: An airflow bench, subsonic wind tunnel, supersonic tunnel, cascade tunnel and smoke tunnel, etc. The other major wind tunnels include an industrial tunnel for studying wind effect on structures and a gust tunnel for studying unsteady flow problems.

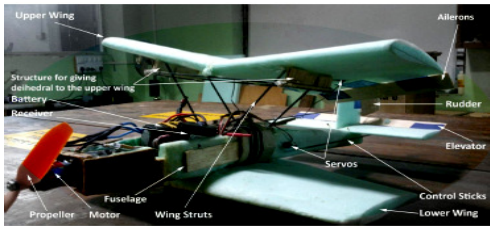
Structures Laboratory: Electrodynamics vibration shakers, Multi-axis Shake Table, Instron 1342 (upgraded model), Vibration Shake Table, a ten ton capacity universal testing machine, a torsion testing machine, computerized experiments related to deflection of curved bars, shear centre apparatus and buckling of struts having Interface for digital display of force, strain, deflection and angle with Experiment Software for each experiment, vibration fundamental kits(VFT), , a microprocessor controlled Brabender climatic chamber and an ultrasonic flaw detector, photo elasticity unit with artificial vision system,

Propulsion Laboratory: Educational Gas Turbine Jet Engine, Oxygen Bomb Calorimeter, Axial Flow Fan Test Set, Centrifugal Fan Test Unit, Ram Jet and Pulse Jet facility, Reaction Turbine Test facility, Nozzle Pressure Distribution Unit, Flame Propagation and Stabilization Unit, Nozzle Performance and Jet Reaction Unit and Droplet Combustion Test Rig.

System & Control Laboratory: 2DOF Rotor System, Inverted Pendulum system, Magnetic Levitator System, Servo system, etc. **Computational and Aeromodelling Laboratory:** High performance computational facilities besides a large number of workstations and high end PCs.; Vacuum assisted resin transfer molding facility to build any model of laminated composites material; Fabrication facility for any type of Balsa wood model ranging from MAV to UAV; Thermocol (Polystyrene) cutting facility for model building, IC engine test bench for model aircraft and Battery charging kits for all type of rechargeable batteries and Adequate facilities to the students to design build and fly remotely controlled/auto-controlled model aircrafts including UAVs and MAVs.

Major Students' program: (i) **Boeing University Relations Programme** (Sponsor: Boeing Co., USA) since 2009

Student Scholarships – 10 UG scholarships per year; Students Projects-Students have designed, built and flown a solar power assisted UAV and several MAV models over the past several years



(ii) **DRDO scholarships to deserving undergraduate and DD students (10 Nos)- the program is running since long**

5. Conferences/short terms courses/ training organized/being organized in the last five years

- International Conference on Theoretical, Applied, Computational and Experimental Mechanics **(ICTACEM -VI, 2014)** to be held on: December 29 - 31, 2014.
- International summer/winter terms (ISWT) subject course with International Faculty (Prof. Samit Roy, University of Alabama) on Multi-scale Modeling of advanced Materials to be held during dec. 22-31, 2014
- International summer/winter terms (ISWT) subject course with International Faculty (Prof. C. D. Kong, Chosun University Korea) on Aircraft Design practices to be held during Dec. 22-31, 2014
- Training program for 82 HAL Management Trainees (MTs) to be held during May 12, 2014 to June 7, 2014 & June 23, 2014 to July 17, 2014 (Budget: about 53 lakhs).
- Training program for about 250 HAL Management Trainees (MTs) & Design trainees held during 2006 to 2008 (Budget: about 114 lakhs).
- International Conference on Theoretical, Applied, Computational and Experimental Mechanics **(ICTACEM -V, 2010)** Held on: December 27 - 29, 2010. (About 250 delegates from India and abroad)
- One week short term academic program for Korean students (12 B tech students) during 2008