



Memorandum of Understanding

30TH APRIL 2014

FOR THE ESTABLISHMENT OF HAL R&D CHAIR

AT IIT KHARAGPUR



HINDUSTAN AERONAUTICS LIMITED

AND

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

HINDUSTAN AERONAUTICS LIMITED

AND

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

This Memorandum of understanding (this "MOU") is executed on 30th April 2014 is made

BETWEEN

- i) Hindustan Aeronautics Limited, a Company incorporated and existing under the laws of India, having its registered office at 15/1, Cubbon Road, Bangalore 560001 (hereinafter referred to as "HAL" which expression shall unless repugnant to the context or meaning thereof mean and include its successors, permitted assigns and representative) of the one part.

AND

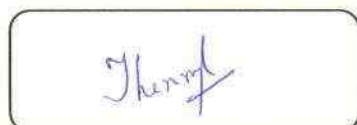
- ii) Indian Institute of Technology Kharagpur, an Institution of national importance, having its registered office at Indian Institute of Technology, Kharagpur 721302 (hereinafter referred as "IIT-KGP" which expression shall unless repugnant to the context or meaning thereof mean and include its successors, permitted assigns and representative) of the second part.

- I. HAL & IIT-KGP individually referred to as "Party" and collectively referred to as "Parties".

RECITALS

- II. Whereas HAL and IIT-KGP have both recognised the imperative need for scientific and engineering research to enable truly self-reliant and advanced aerospace development programme for the country in the coming years. The parties are convinced that sufficient skilled scientific and technical personnel exist at HAL and IIT-KGP, who can conduct applied research and tackle multi-disciplinary problems in the field of aerospace systems technology and its application, and that a strong research base already exists at IIT-KGP in the areas of direct

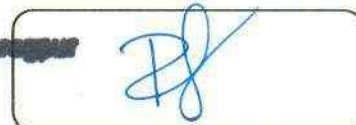
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relevance to the future programmes of HAL. The co-operation between the two organizations for the R&D work shall be beneficial to both of them.


- III. Whereas to facilitate, the research activities, the parties agreed to set-up a Faculty Chair (herein after referred to as "HAL Chair") at IIT-KGP sponsored by HAL.
- IV. Whereas the parties agreed that the HAL Chair will be responsible for carrying out research in various areas related to aerospace technologies, facilitating technical consultancy, training programs and addressing any other mutually agreed activities relevant to the HAL.

NOW THEREFORE IT IS MUTUALLY AGREED BY AND BETWEEN THE PARTIES AS UNDER

ARTICLE I

1. The objective of this MOU is to establish long-term mutually beneficial relationship between HAL and IIT-KGP for academic & research-based interactions for the promotion & development of new & breakthrough aerospace technologies in the areas identified at Annexure-A and mutually agreed by the parties as the responsibilities of the HAL Chair.
2. The HAL Chair shall,
 - i) Initiate new academic/training programs; Identify and initiate specific research & development at IIT-KGP in the identified technical areas
 - ii) Provide technical consultancy to HAL
 - iii) Facilitate development of training programs & training modules including mentoring/ coaching of HAL personnel for knowledge updation and capacity building
 - iv) Conceptualise & facilitate annual conference of defence related industries to provide platform to air new ideas, innovations, technologies etc.
3. The Chair shall also make efforts to conduct short-term courses by international faculty for the students of IIT-KGP and engineers of HAL to broaden their knowledge base in relevant new and emerging areas of the aerospace which may

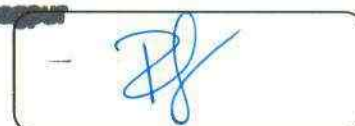
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be decided by the "Advisory Committee" whose functions, power and constituents are specified at ARTICLE VII.

4. Both HAL and IIT-KGP agree to fully cooperate and collaborate with each other for successful implementation of the MOU.

ARTICLE II

5. In furtherance to the aforesaid objective, HAL agrees to create one Chair at IIT-KGP called HAL Chair. The main purpose of creating this Chair is to promote applied research, development and academic work in the field of new and emerging aerospace technologies as mentioned at ARTICLE I above.

ARTICLE III

6. HAL will fund the HAL Chair by making one-time payment of Rs 160 Lakh (Rupees One Hundred and Sixty Lakh only), to be deposited in the HAL Chair Corpus at IIT-KGP. The expenses towards the HAL Chair shall be met from this endowment as per prevailing IIT-KGP rules.
7. The corpus, however, shall remain untouched and only the interest from the corpus will be utilized to meet the expenses including any additional salary of the Chair Professor. Any unspent interest accruing to the corpus shall be added to the existing endowment corpus to build the same as a cushion against inflation.
8. Any expenses over and above the interest amount from the endowment for a particular year will be met by IIT-KGP. HAL will not be responsible for any expense overrun.
9. A separate account will be maintained for the Income & Expenditure pertaining to this endowment by IIT-KGP. The audited annual statement of Income & Expenditure relating to HAL Chair shall be furnished by IIT-KGP to HAL on or before 31st August of each year.
10. IIT-KGP shall appoint a distinguished academican from the relevant branch of engineering as the Chair Professor for a period of three years which can be extended by a period as decided by IIT-KGP, after due review of the HAL Chair's performance.

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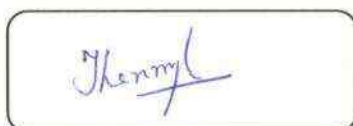


11. The Chair Professor may be selected from the existing faculty members of the Institute with the provision of additional salary as per IIT-KGP rules in such cases. The selection will be made by a duly constituted selection committee having one representative of HAL. The faculty so appointed as Chair Professor will be expected to fulfil the charter laid out in this MoU.

ARTICLE IV

12. The faculty so appointed to the Chair in addition to teaching shall,
- i) Coordinate effectively and meaningfully with the concerned departments and other agencies with a view to promote applied research, development and academic work in the field of new and emerging aerospace technologies as mentioned at ARTICLE I above
 - ii) Contribute to the deeper understanding and dissemination of knowledge in respect of recent technological advances in the area of aerospace technology, conduct research and preferably publish results in leading international and national journals etc.
 - iii) Establish & nurture long-term association between HAL and IIT-KGP for applied research, development & consultancy, academic interaction and exchange of technical & research information on aerospace technology.
 - iv) Facilitate HAL in meaningful harnessing/ deployment of new technologies thus developed.
 - v) Submit a semi-annual report to HAL, beginning with the month of June and second report in December of that particular year, on the details of various activities, projects, initiatives undertaken in furtherance to the objectives of this MOU including plans for the future.
 - vi) Assist HAL in other matters such as participation into and contribution of knowledge to seminars and conferences on the subject.
 - vii) Take all such initiatives and steps as may be considered necessary and desirable to achieve the objectives of this MOU successfully.
13. The Head of Strategic Electronics R&D Centre (SLRDC), HAL Hyderabad shall nominate a nodal officer from HAL side to interact and coordinate with the Chair

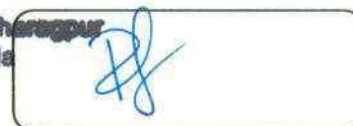
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Professor for providing necessary inputs and for transfer & absorption of technology developed in the process.

ARTICLE V

14. In the event of proposed R&D activities resulting into contemplation and development of a new technology, product, equipment or process etc, it shall be duly patented with patent ownership in the joint name of HAL and IIT-KGP. The details of its commercial utilization shall be worked out mutually on case to case basis.

ARTICLE VI

15. It is specifically agreed by the parties to this MOU that HAL shall finance an amount of Rs 160 lakh (Rupees One Hundred and Sixty Lakh only) to be given by HAL to IIT-KGP towards funding of one Chair after signing of this MOU by both the parties within a period of 60 days. This will enable HAL Chair to be in operation perpetually with effect from the date of appointment of distinguished academicians to the HAL Chair.

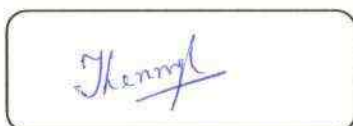
ARTICLE VII

16. It is agreed that an Advisory Committee shall be constituted for taking policy decisions, necessary to ensure successful implementation of this MOU and oversee proper functioning of HAL Chair. The said committee shall be responsible for general review of the functioning of the HAL chair as laid down in this MOU including proper budget utilization for the Chair activities.

17. The Advisory Committee shall consist of the following.

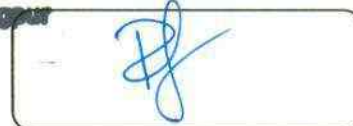
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|--|------------------|
| i) Director, IIT-KGP | Chairman |
| ii) Managing Director (Accys)/ Head of HAL Accessories Complex | Co-chairman |
| iii) Two representatives of IIT-KGP faculty nominated by Director, IIT-KGP | Members |
| iv) Two representatives of HAL nominated by Managing Director (Accys)/ Head of HAL Accessories Complex | Members |
| v) HAL Chair Professor | Member Secretary |

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18. The committee can co-opt members from HAL and IIT-KGP as the requirement arises.
19. The Advisory Committee shall meet on regular basis but not less than once in a financial year to review the functioning of HAL Chair.
20. The meetings of the Advisory Committee shall have a quorum of minimum 4 persons with two members each from IIT-KGP and HAL.

ARTICLE VIII

21. This MOU shall be valid perpetually from the date of appointment of Chair Professor. HAL Chair professor shall hold this position for three years after which IIT-KGP shall appoint same or another Professor through due procedure.

ARTICLE IX

Dispute Resolution

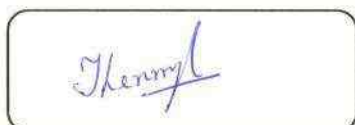
22. In case of dispute, HAL and IIT-KGP agree to schedule a mandatory meeting at Bangalore to resolve it, which will be attended by at least one senior official from each party. At the meeting, each side will present its dispute and the senior officials will enter into good faith negotiation in an attempt to resolve the dispute.
23. Failing to resolve the dispute the matter shall be finally settled by Chairman, HAL and Director, IIT-KGP in the spirit of independence, mutual respect, and shared responsibility.

ARTICLE X

Non-Disclosure

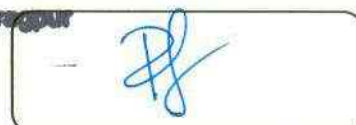
24. The Chair Faculty and other officials of IIT-KGP shall not disclose HAL's confidential information nor any other information concerning national security that they may receive from HAL in furtherance of this MOU and operation of HAL Chair's activities to any person or persons in any form whatsoever in terms of the Indian Official Secret Act, 1923, Government of India.

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All Confidential Information disclosed by HAL shall be used for the Purposes of MoU alone and the said information can be disclosed on a need to know basis only to persons associated with IIT-KGP alone such as Faculty, Research Associates etc.

For the purposes of this MoU, 'Confidential Information, includes but not limited to Proprietary Information and extends to any technical or commercial information (whether in visual or machine readable form) disclosed by and identified by a suitable legend or marking as being 'Confidential' or 'Proprietary' as well as:

Confidential Information disclosed orally by one party to the other which was described as being proprietary or confidential at the time of disclosure and thereafter is reduced to writing, appropriately identified and a copy thereof sent to the receiving party within 15 working days of the original oral disclosure. Confidential Information shall also include copies, abstracts or any other form of partial or full reproduction of such information.

Intellectual Property

25. IIT-KGP and HAL agree to respect each other's rights to intellectual property. Further, the intellectual property rights that arises as a result of collaborative research or activity under this MOU shall be jointly held by HAL & IIT-KGP, and will be consistent with officially laid down IPR policies of the two institutions.

ARTICLE XI

26. Any amendment to this MOU, in order to be valid and binding shall be by an instrument in writing and signed by both the parties hereto.

ARTICLE XII

27. This memorandum of understanding is prepared and duly signed in two original copies and both equally valid and one to be kept by each party.
28. IIT-Kharagpur hereby represents that, it is authorized by all laws, byelaws, rules, regulations etc., to which it is subject, to carry out all the activities lay down under this MoU.

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Indian Institute of Technology Kharagpur
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29. IN WITNESS WHEREOF the Parties their respective duly authorized representatives have executed this MOU at IIT, Kharagpur on the 30th day of April, 2014.

Signed by
For and on behalf of
Hindustan Aeronautics Ltd
Bangalore

Signature: _____

Name: S. Thenmozhi

Designation: Offg. GM, SLRDC

Date: 30/04/2014

एस. तेनमोली / S. THENMOZHI
स्थानापन्न महाप्रबन्धक / Offg. General Manager
एस एल आर डी सी, एच ए एल-हैदराबाद
SLRDC, HAL-Hyderabad.

In the presence of Witness:

1. Sign: _____

Name: N. Ganesh

Designation: AGM (D-Comm)

एच. गणेश / N. GANESH
अ.प्र. महाप्रबन्धक (आ.प्र.संचार)
Addl. General Manager (D-Commn.)
कर्म सं/Sl. No. ई/ई-815
एच ए एल, हैदराबाद - 42.
HAL-HYDERABAD - 42.

2. Sign: _____

Name: Alok Verma

Designation: DGM (HR)

ड.अ.प्र. (मा.सं.)/DGM (HR)
एच ए एल, हैद./HAL, HYD-42.

Signed by
For and on behalf of
Indian Institute of Technology
Kharagpur

Signature: _____

Name: Prof. P. P. Chakrabarti

Designation: Director, IIT-Kharagpur

Date: 30/04/2014

प्रोफेसर पार्थ पी. चक्रवर्ती
Prof. Partha P. Chakrabarti
निदेशक
Director
भारतीय प्रौद्योगिकी संस्थान खड़गपुर
Indian Institute of Technology Kharagpur
खड़गपुर-721302, भारत
Kharagpur - 721302, India

In the presence of Witness:

1. Sign: _____

Name: Prof. S. Das Gupta

Designation: Dean, SRIC

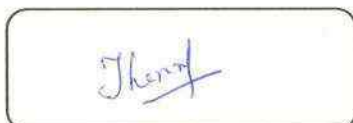
(Prof. S. DasGupta)
Dean (SRIC)
IIT Kharagpur

2. Sign: _____

Name: Prof. B. N. Singh

Designation: Head, Aerospace Engg.

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COLLABORATIVE RESEARCH AREAS FOR HAL CHAIR AT IIT KHARAGPUR**1. PRIMARY RESEARCH AREAS**

The primary areas of specialisation of HAL Chair shall be Radar and Electronic Warfare related technological advancements catering to aerospace applications. Some such topics of current interest are given below, which shall be periodically updated under the guidance of advisory committee, keeping in view the global research trends and national/ HAL requirements.

1.1 Radar related technologies & processes, involving

- Active Electronically Scanned Array (AESA) Antenna System
- Ultra Low Side-lobe Antenna System for AESA Application
- Transmit/Receive (T/R) modules for AESA Antenna System
- Radar Beam Shaping, Switching & Steering
- Signal & data processing for target detection and tracking
- Low observable Radar Cross-section (RCS) and Stealth techniques
- RCS simulation and Prediction algorithms
- Detection & tracking of stealth targets and targets during jamming.
- Air-to-Air, Air-to-Ground & Air-to-Surface modes of operation for Radar
- Multi-core processor, High-speed Field programmable gate array (FPGA), High speed data bus and System on Chip (SOC) based data processing
- Algorithms for various military radar applications - fire control, maritime patrol & surveillance, air defence, secondary surveillance, synthetic aperture radar (SAR), inverse SAR, space, radar signature analysis etc
- Technologies associated with detection and search radars, threat radars, missile guidance systems, battlefield and reconnaissance radars, air traffic control & navigation radars, space and range instrumentation radars and weather sensing radar systems

1.2 Integrated Electronic Warfare technologies and techniques, involving

- Passive use of electromagnetic (EM) spectrum for gaining intelligence about adversary to find, identify, locate & intercept potential threats or targets - Electronic Support Measure (ESM)
- Active use of EM spectrum to deny its use by an adversary by jamming/incapacitating adversary operation(s) or causing EM deception to avoid harm from potential threats - Electronic Counter Measures (ECM) like communications jamming, Integrated Air Defence System (IADS) suppression,

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Directed Energy Weapon/ Laser attack, expendable decoys like chaff & flares and radio controlled improvised explosive devices

- Techniques to foil/ defeat ECM actions in order to protect own personnel, facilities, equipment or mission - Electronic Counter Counter Measures (ECCM) like frequency hopping, spread spectrum & crypto-security; emissions control; low observability or stealth; and self-protection suite having directed infrared countermeasures, Infrared countermeasures & Flare (for IR guided missiles) and Chaff (for radar guided missiles) etc
- EW using Infrared, ultraviolet, electro-optical and other less used portions of the EM spectrum; EM compatibility & deception; EM hardening, interference, intrusion & jamming; electronic masking, probing, intelligence & reconnaissance; electronics security; EW reprogramming; emission control; and spectrum management

1.3 Spread spectrum techniques, involving

- Mode-5 reply encryption & decryption of Identification of friend or foe (IFF) signals
- Direct sequence data spreading for interrogation & disspreading of WALSH encoded data in IFF system
- Error detection and correction techniques covering Reed-Solomon techniques of interrogation/reply data sequence.

1.4 Terrain Simulation techniques for,

- Frequency modulated continuous wave (FMCW) type Radio Altimeter operating in 'C' band 4.2 to 4.4 GHz.
- Terrains with different reflectivity coefficient and scattering parameter (Sand, Grass, Water, Ice, Marsh land, concrete etc).

1.5 'L' Band Power Amplifier for,

- Airborne pulsed transmitter for IFF, Tactical Air Navigation (TACAN), Distance Measuring Equipment (DME) and Traffic Alert & Collision Avoidance System (TCAS) applications
- Active wave shape control with low power consumption for airborne applications.

1.6 Airborne Antenna Radiation pattern analysis tools & techniques

1.7 Compression/ decompression algorithm and Image processing techniques for on-board video, audio and data recording and replay applications

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2. OTHER RESEARCH AREAS

In addition to the aforesaid, the HAL Chair shall also facilitate & engage in applied research work related to technological advancements in the broader domain of avionics and aerospace systems. Some such topics of current interest are given below, which shall be periodically updated under the guidance of advisory committee, keeping in view the global trends and national/ HAL requirements.


2.1 Airborne System Simulation, Design algorithms, Technologies related to,

- Embedded conformal/ small size antennae for MHz range
- Graphic processing for high pixel & low data latency
- Open architecture system with high speed data bus/fibre-optic link
- Active Matrix Liquid Crystal Display (AMLCD) based colour display systems
- Vehicle Control and Guidance System - algorithms, techniques
- Electrical Power Generation & Controls - drives, techniques, technologies
- Electro-Magnetic Systems -technologies
- flight path reconstruction based on longitude & latitude inputs recorded in recorder and overlaying the flight path on terrain map

2.2 Airborne System Analysis & Design Validation using,

- CAE Analysis of mechanical systems for environmental stresses
- Stress, Thermal & Fatigue Analysis of airborne components
- Computational Fluid Dynamics Analysis
- Computational analysis for aero foils of different size & shape
- Acoustic Noise level measurement of aircraft on ground and flight.

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