

## CO-OPERATION AGREEMENT

This Cooperation Agreement (this "Agreement") is between

**Maharashi Karve Stree Shikshan Sanstha Cummins College of Engineering for Women**, [Income Tax PAN AAATM1969L] with Registered Address at Karve Nagar, Pune Maharashtra 411052 , INDIA (hereinafter called "Institute"/"College")

And

**Danfoss Technologies Private Limited**, [U74999TN2020PTC136283] a private limited company under the Companies Act, 2013 with Registered Address at S 03, 602A, RMZ MILLENIA BUSINESS PARK, PHASE-II 4B CAMPUS, NO. 143, Dr. MGR ROAD, PERUNGUDI CHENNAI TN 600096 INDIA , (hereinafter called "Danfoss"/ "Sponsor")

[The terms "Institute"/"College"/"University" and "Danfoss"/ "Sponsor" shall mean and include their respective successors-in-interest and permitted assigns]

### RECITALS

- A. Sponsor is interested in engaging with the Institute broadly in areas of mutual interest , not necessarily restricted to only to those mentioned in this Agreement
- B. Parties are keen that Sponsor sets up **Danfoss' Hydraulic Center of Excellence ["COE"]** at the Institute comprising, *inter alia*, of Hydraulics course curriculum and lab infrastructure for hands on training of students; **COE** will help students to gain knowledge and experience on new technologies in the market.

In consideration of these recitals and the mutual benefits to be

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**derived, the Parties agree on the following Terms & Conditions**

**1. Programs etc.**

- a. Sponsor is permitted to conduct technical sessions and programs in chosen and agreed topics of interest to the institute's students.
- b. Sponsor is permitted to offer Internship to talented students which is an opportunity for students to gain experience on working in an engineering environment to build competencies along with their academic requirements. A platform to learn and prove their potential.
- c. Sponsor is permitted to conduct campus hiring interviews
- d. Sponsor is permitted to offer scholarships and other reward programs
- e. Sponsor is permitted to display of posters, product cut-outs and organize events etc. within the campus of the Institute
- f. Opportunity for fundamental and applied research projects
- g. Frequent interaction between Institute's faculty and Sponsor's employees to exchange ideas and explore the possibilities in engineering and technology.
- h. Sponsor will also be permitted to conduct training programs for its customers with prior intimation to the College. Cost modalities can be worked out mutually and agreed to in writing.
- i. Opportunity for Sponsor to work with the Institute for tailor-made courses/ training programs for Sponsor's employees or nominee/s. Modalities and fees etc., to be worked out mutually and agreed to in writing .
- j. All equipment and products provided by Sponsor under this Agreement will be maintained by Institute in consultation with Sponsor and at the costs and expense as may be agreed to in writing.
- k. The Institute can depute the experts to Sponsor's factory/plant as and when required at the cost and expense of the Institute.
- l. The Institute can conduct seminars/expert lectures/workshop at Sponsor's place on need basis.

**2. The Danfoss Hydraulics course curriculum**

Institute hereby agrees to roll out course content and curriculum to its students

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as per **Annexure A**. Danfoss can change or modify course content or curriculum as and when needed in consultation with the Institute.

**3. The Danfoss Hydraulics COE Lab (Hyd COE Lab)**

Institute hereby agrees to provide appropriate land & built-up space free of cost for the Sponsor to set up the 'Hyd COE Lab' and install Danfoss products, product cut outs and Danfoss corporate branding as identified in this Agreement or as may be mutually agreed from time to time. Cummins College respective department head owns up the responsibility of Sponsor.

**4. Other Obligations & Rights of Sponsor**

It is agreed to and understood by the parties that the Sponsor shall invest in infrastructure like renovation of the room, movable wall partition, necessary tables and accessories. Sponsor will install products and product applications, product cutouts and Danfoss branding collaterals. For the smooth functioning, Sponsor will provide appropriate consultancy and guidance.

Sponsor shall have the right to use **Hyd COE Lab**, which is mainly designed to benefit Institute's students to perform experiments and gain knowledge in the area of hydraulics. Both parties agree to keep the **Hyd COE Lab** open for Danfoss' customers and industry experts so as to showcase Danfoss' technologies, including latest technologies; conduct training for Danfoss 'employees and Danfoss' channel partners as and when required.

**5. Evaluation of Co-operation**

The parties will conduct joint periodic reviews to monitor and optimize their co-operation under this Agreement.

The Institute is liable for joint initiatives at the Institute like the conducting experiments, application research. Joint sponsored research setups etc., will not be available for use or view of the public or Sponsor competitors

**6. Confidentiality Information Obligations**

- a. "Confidential Information" means and includes (i) the existence and the content of this Agreement, (ii) the existence of the discussions concerning the Purpose, and (iii) all information disclosed by a Party or its Affiliates in writing ("Disclosing

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Party”) to the other Party or its Affiliates (“Receiving Party”) in connection with the Purpose, if such information is designated as confidential and all copies, reproductions, thereof. “Affiliate” means, with respect to any entity, any other entity that directly or indirectly controls, is controlled by or is under common control with that entity of more than fifty (50%) percent of its controlling securities/stock.

- b. Confidential Information does not include information that (i) is or enters the public domain prior to the disclosure of information under this Agreement; or becomes publicly available without breach of this or any other Agreement, (ii) can be demonstrated to have been known to Receiving Party at the time of its receipt from Disclosing Party, (iii) is disclosed to Receiving Party from any third party without any confidentiality obligation and who did not acquire or disclose such information by a wrongful or tortious act, or (iv) can be demonstrated to have been independently developed by Receiving Party without reference to any Confidential Information.
- c. Receiving Party may disclose Confidential Information as required to comply with orders of courts, regulatory or governmental entities with jurisdiction over it, if Receiving Party to the extent permitted by law (i) gives Disclosing Party prior written notice in order that the Disclosing Party may seek a protective order or other remedy, (ii) discloses only such information as is required by the court, regulatory or governmental entity, and (iii) reasonably co-operates with the disclosing party in its reasonable efforts to obtain confidential treatment for any Confidential Information so disclosed.
- d. Receiving Party may use Confidential Information only for the Purpose. Except as provided/permitted in or through this Agreement, Receiving Party will not disclose Confidential Information to anyone without Disclosing Party’s prior written consent. Receiving Party will take all reasonable measures to avoid disclosure, dissemination or unauthorized use of Confidential Information, including, at a minimum, those measures it takes to maintain its own confidential information of a similar nature.
- e. Receiving Party will restrict the disclosure of Confidential Information to each of

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its own and its Affiliates' employees and subcontractors who (i) have a need to know the Confidential Information for the Purpose, and (ii) is legally obligated to maintain the Confidential Information to the same degree as required under this Agreement.

- f. All Confidential Information will remain the exclusive property of the Disclosing Party. Disclosing Party's disclosure of Confidential Information will not constitute an express or implied grant to Receiving Party of any rights to or interest in under Disclosing Party's patents, copyrights, trade secrets, trademarks or other intellectual property rights, whether registered or not. All Confidential Information is provided "AS IS".
  - g. Receiving Party will notify Disclosing Party immediately upon discovery of any unauthorized use or disclosure of Confidential Information or any other breach of this Agreement. Receiving Party will immediately take necessary action against the unauthorized disclosure and act on instructions to prevent further disclosure and damages. Further, the Receiving Party shall reasonably cooperate with Disclosing Party to help Disclosing Party regain possession of such Confidential Information and prevent its further unauthorized use and disclosure.
  - h. Receiving Party will delete all electronic data containing Confidential Information and will return or destroy all tangible materials containing Confidential Information (in any form and including, without limitation, all copies of Confidential Information) without undue delay following expiry or termination of this Agreement or Disclosing Party's written request.
7. **Publication**
- Sponsor recognizes that under its policy, the Institute shall have the right, to publish material regarding the Hydraulic Center of Excellence in Cummins College publicity material. Institute shall notify Sponsor at least 14 days before publishing. & obtain consent for the same from Sponsor.

8. **Duration of Agreement and Termination**

- a. This Agreement shall commence on the date of last signature.
- b. Each party reserves the right to terminate this Agreement, without liability to

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the other party, if such other party repudiates or commits a material breach to any of the terms of this Agreement, or fails to make progress so as to endanger timely and proper completion of its services or provision of deliverables required by it, and does not correct such repudiation failure or breach within thirty (30) days (or such shorter period of time if commercially reasonable under the circumstances) after receipt of written notice from the non-breaching party specifying such repudiation, failure or breach.

- c. This Agreement is effective for an unlimited period of time, unless terminated in accordance with one of the following alternatives:
- d. Sponsor may also terminate this Agreement at any time without assigning any reason by giving written notice to Institute, such termination to be effective ninety (90) days after the date of such notice.
- e. Institute may also terminate all or any part of this Agreement at any time without assigning by giving written notice to Sponsor, such termination to be effective ninety (90) days after the date of such notice.
- f. **Upon termination, Sponsor shall be entitled to enter the campus of the Institute to dismantle and take away all Sponsor's equipment and goods and temporary installations. Any permanent buildings / installations or the like shall be left as is after removal of equipment.**

**9. Assignment**

The rights, duties and privileges of the parties under this Agreement shall not be assigned by any party without the prior written consent of the other. No delegation of the services or other obligations owed by any party to the other, shall be made without the other party's prior written permission.

**10. Compensation**

No liability for indirect damages. Neither party shall be liable to the other for any incidental, indirect, special, or consequential damages, including but not limited, to loss of profits, loss of use, loss of revenues or damages to business or

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reputation arising out of or in connection with this Agreement or any aspect thereof. Neither Party shall be liable to the other by reason of the termination or expiry of this Agreement for compensation or damages on account of the loss of prospective business or on account of expenditures in expectation thereof.

**11. Force Majeure**

Any delay or failure in performance by the party to this Agreement, shall not constitute default hereunder to give rise to any claims for damages against said party, if any, to the extent caused by matters beyond the control of said party including but not limited to acts of God, Strikes, Lock outs or other concerted acts of workmen, fires, floods, explosions, blockages, embargoes, riots, war (declared or undeclared), rebellion, sabotage, extraordinary severe weather, civil commotion and criminal acts of third persons. If the work is delayed by such force majeure, then upon the happening of such delay, Institute within 14 days of the happening of such event, shall give notice in writing to Sponsor, requesting for extension of time indicating the period for which extension is desired. Sponsor may give fair and reasonable extension of time for the projects at their discretion, but no monetary allowances shall be made to Institute for any such delay and Institute may not make any claim for damages by reasons of any such delays unless both parties agree to such payment.

**12. Entire Agreement**

This Agreement constitutes the entire agreement of the parties with respect to its subject matter. Any change to this Agreement shall be discussed and agreed upon mutually in writing.

**13. Dispute and Settlement**

The following provisions apply if any dispute or difference ('Dispute/s') arises between the Parties. Dispute will be deemed to arise when one Party serves on the other a notice stating the nature of the Dispute (a 'Notice of Dispute'). The Parties agree that they will use all reasonable efforts to resolve, any Disputes arising out of or relating to this Agreement through negotiations. Any Disputes not so settled through

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negotiations within FIVE [5] days or within such no. of days as may the Parties may otherwise agree upon, shall be finally settled by arbitration as per the Arbitration and Conciliation Act 1996 as in force by a SOLE arbitrator appointed by the Parties. The arbitration shall be conducted in English and a daily transcript in English shall be prepared. Unless otherwise agreed, the arbitration shall be a “documents only”, evidence through affidavits, including through emails, WhatsApp/Signal or similar platforms, video conferencing and/or similar facilities “fast track” arbitration. The seat of arbitration shall be Chennai. The Party prevailing in the arbitration shall be reimbursed the entire costs incurred in the arbitration (including attorney's fees) as determined by the arbitrator.

**14. Communications & notices - Thru WhatsApp / Signal also**

Any communication, including notices, shall be in English, with same deemed delivered *if*, : by facsimile or other electronic transmission including through WhatsApp/Signal or other application, upon acknowledgment of receipt of electronic transmission or confirmation on sender's device that recipient has received or read message; by courier, upon written verification of receipt; by personal delivery, when actually delivered; by certified mail return receipt requested or registered mail/postal acknowledgement due, upon verification of receipt or print or screen shot of postal department's webpage displaying delivery confirmation.

These shall be sent to the phone number/s/addresses set forth herein or to such other phone number/s/addresses as may be provided from time to time.

**15. Governing law**

This Agreement is governed by Indian law.

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**PARTIES HAVE EXECUTED THE AGREEMENT [IN DUPLICATE] THUS**

Sign →	 	 
Name	Dr. Madhuri	Anil Ghegade
Designation	Principal	Sr. Director
Place	Pune	Pune
Date	19 <sup>th</sup> Aug 2022	19 <sup>th</sup> Aug 2022
Party	Institute	Sponsor

**Contact Details**

Name	Dr. Gautam Chandekar	Hrishikesh Thakur
Designation	HOD- Mechanical Engineering	Manager
Email/s	<a href="mailto:gautam.chandekar@cumminscollgege.in">gautam.chandekar@cumminscollgege.in</a>	<a href="mailto:hrishikesh.thakur@danfoss.com">hrishikesh.thakur@danfoss.com</a>
Mobile Nos.	7020196272	9975707746
Party	Institute	Sponsor



## ANNEXURE A

### **Intelligent Hydraulic Systems course curriculum**

#### **Objective:**

Foster education enhancement in local engineering community

**Contribute** to academia and help in strengthening the employability of under-grad/grad students in hydraulics industry

**Bridge** the current gap in available subjects by laying out a curriculum on intelligent hydraulics which can be chosen by students from mechanical / electrical / electronic disciplines

#### **Course objective**

Provide opportunity for students to gain appreciation and understanding of a typical intelligent hydraulic system comprised of electro-hydraulic components – this is the confluence of mechanical, hydraulics and electrical/electronic disciplines.

Prepare student for interdisciplinary approach and use latest tools to solve problems

Provide comprehensive knowledge of different electro-hydraulic components, circuits, applications and trends

Prepare students to draw intelligence out of a typical EH circuit for diagnosis and prediction

Encourage self-learning

#### **Course outcome**

Ability to understand, identify and select electro-hydraulics components

Analyze circuits and understand failure modes

Ability to model and decide design components for intelligent hydraulic system

Enhancement in application knowledge of hydraulics, electronics and programming

#### **Course structure**

Starting Aug'2022 the course will be introduced for B-Tech (Mechanical) programmed as per the levels given below.

Introduction to hydraulic systems Third Year 6<sup>th</sup> semester open elective II. Lecture 3 hours per week, 15-week course. Recommended for students planning to pursue project / internship with Danfoss India Innovation Center.

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Project / Internship: Fourth year 7<sup>th</sup> Sem. Final year project spanning over the span of six month to be taken up by students in fluid power. Open for students from Mechanical, Electronics and Computer science.

Intelligent hydraulic systems: Fourth year 8<sup>th</sup> semester open elective III. 3 hours per week, 15-week course This course will be mandatory for students who have preplacement offer from Danfoss and optional for other students of mechanical engineering.

### Introduction to Hydraulic systems (6<sup>th</sup> Sem)

Teaching Scheme

Lectures: 3 hrs./week, 15 weeks

Examination Scheme

In Sem 50 marks

End Sem - 50 marks

#### Unit 1:

#### **Introduction to fluid power (6**

**hrs)**

Evolution of fluid power systems, Hydraulic leverage and comparison with mechanical leverage, components of fluid power, how pressure is created, pressure built in series and parallel paths having different resistance, pressure drop through an orifice, introduction to work and power. Principles: Principles of pressure and flow. Hydraulic fluids: purpose of the fluid, compressible and incompressible fluids, Fluid properties, SAE grades and ISO viscosity numbers, selection of fluid, sources of fluids and additives, Analogies with electrical components, Merits and Demerits of fluid power systems, Numerical examples on leverage and power

**Note:** It is expected that fluid mechanics/topics covering basic laws are reinforced as part of unit 1 introduction.

#### Unit 2 :

#### **Reservoirs and Filters (3**

**hrs)**

Reservoir function and its components, standard reservoir designs, reservoir sizing and heat exchanger. Sources and effect of contamination, relative size and measurement of contamination, method of taking fluid samples, ISO contaminant code, establishing and achieving a target cleanliness level, Filters, types, rating and filter construction

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### **Unit 3: Actuators and Motors**

**(9 hrs)**

Hydraulic Cylinders, classification based on function and mounts, construction and operation, sealing, cushioning, types and cushion performance. Pressure intensification (booster), actuator speed, Selection of mounts with FBD, buckling, and bearing calculations. ASME/DNV standards for cylinder body, Numerical examples for cushion, stop tube, sizing, speed and buckling. Hydraulic motors, motor ratings, classification, Geroler motor, Axial Piston motor with Gear box, free body diagrams of motor components, basic knowledge of flow path in typical motors, modeling leakages path to derive the volumetric losses, model the friction losses to derive the mechanical losses. Symbols for motor and actuators, modeling of Flow and torque ripple characteristic of different motors. Numerical examples for torque, speed, power and efficiencies.

### **Unit 4: Hydraulics valves**

**(9**

**hrs)**

Classification of valves based on pressure, flow and direction control. Direction control: Check valves, mounting, spool positions, direct acting valves, two stage valves and deceleration valves. Pressure control: relief, unloading relief, pressure reducing, direct acting, spool type and pressure control valves. Flow controls: flow control methods, temperature compensation, proportional control and deceleration valves. Cartridge and Stack valves: Cartridge valve concept, screw-in cartridge valves, functional characteristics, direction control, Valvistor screw-in cartridge valves, slip-in cartridge valves, stack valves, symbols and circuits. Proportional valves: proportional solenoid valves, basic hydraulic principles of proportional valves, proportional pressure, direction and flow control valves, application guidelines, load compensation. Servo valves: Mechanical servo valves, electrohydraulic servo valves, flapper nozzle, jet pipe servo valves, high performance valve capacities, servo valve performance,

### **Unit 5: Hydraulics pump**

**(9**

**hrs)**

Types of pumps, fixed and variable displacement pumps, Aeration, cavitation, Fixed

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displacement pumps: gear pumps, vane pumps, piston pumps. Variable displacement pumps: vane, radial piston, bent axis, in-line piston pumps

Pump controls, free body diagrams of pump components, modeling leakages path to derive the volumetric losses, model the friction losses to derive the mechanical losses, characteristics and efficiencies. Power, Pump selection and Symbols. Numerical examples for power, efficiencies.

**Unit 6: Piping, fittings and seals**  
**(hrs)**

(3

Fluid conductors, material considerations, installation recommendation, compatibility of hydraulic fluids with hose material, design parameters (cover, tube & reinforcement) and manufacturing processes, governing standards (performance & reliability test for hoses). Determining pipe size requirements, velocity in pipes.

Seals: Sealing, static and dynamic seals, backup rings, different types of static and dynamic seals, seal materials

**Unit 7 System accessories and design of simple hydraulic systems**  
**(hrs)**

(3

Accumulator, smoothing pressure pulsations by accumulators, absorption of hydraulic shocks by accumulators, pressure switch, heat exchangers for cooling of hydraulic systems. Build a simple hydraulic system to protect and control the system. Demonstrate how to use valves, actuator, pump and motors in simple hydraulic systems.

**Fluid Power Lab work**

**(3hrs)**

Tear down analysis of pump, valve motors

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## Intelligent Hydraulic Systems (8<sup>th</sup> Sem)

Teaching Scheme

Lectures: 3 hrs./week, 15 weeks

Examination Scheme

In Sem 50marks

End Sem - 50 marks

### Unit 1

Introduction (3

hrs)

Review of hydraulic Component and Symbols, Selection of Pump, Valve, filter, Cooling System, Horsepower & tank Sizing, Fluid recommendation for Simple ram type Press

### Unit-2

Hydraulic Circuit (6

hrs)

Different type of pumping system like fixed pump Hi-Low system, Fixed pump with Load Sense, Variable pump with pressure compensator, Load sense, Torque Control & Electronic Displacement control (EDC). Meter-in & Meter-Out Circuit, Regeneration Circuit, Sequencing Circuit, Decompression Circuit, Use of Counter of balance Valve, Pre fill Valve, Fail Safe Circuit, (Vertical down Cylinder Using Pilot to DCV & Pilot Operated Check Valve Overload protection), Sizing & Selection Cylinders & Hydro Motor based on function, Series and Parallel Circuit speed Control of Hydraulic Circuit

### Unit-3

Proportional and Servo Valve (6

hrs)

Proportional Valve – Principles of Operation. (Solenoid, Sensor & amplifier). Proportional Valve types, Open Loop Vs Loop Closed Loop Control Components Vs Proportional Valve with numerical , Valve Sizing. Servo Valves – Principles of Operation Specification & Selection of Servo Valve, Valve Sizing.

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**Unit-4****System Analysis (6**

hrs)

Closed Loop System Analysis, Block Diagram, Open Loop Gain, System Response, Hydraulic Stiffness, Load Natural Frequency. Determination of open Loop gain, Estimation of System Performance, Position Control System. Velocity Control System, Force Control System.

**Unit 5****Introduction to Electro-Hydraulics****(6hrs)**

Basics of hydraulic circuits and analogies with electronic components, significance of electronics in the hydraulic systems, Basic circuit theory and electrical component, analogue electronic components and devices, power supplies and voltage regulators, power electronics-devices, controller and processor, A/D & D/A convertor, signal conditioning circuits using operational amplifiers, noise problems, grounding and shielding

**Unit 6****Introduction to Software Development****(6hrs)**

Introduction to assemblers, linkers, and loaders; binary file formats for processor executable files; typical timer-interrupt driven programs. GNU-GCC compiler introduction and gnu debugging, gnu insight with step level trace debugging, make file interaction, building and execution; embedded C-programming concepts: functions, modifiers, data types, device drivers, interrupt service routines, cross-compiler optimization for speed/memory needs. Overview of Firmware and Software V&V. Overview and application of controls.

**Unit 7****Local intelligence (6**

hrs)

Sensors - Measurement principles, sensor and actuator techniques, technical properties of sensors and actuators, methods of sensor and actuator classification, types of sensors (sensors of linear and angular displacement, speed sensors, accelerometers, force and torque; pressure sensors, level and flow; sensors for measuring temperature and humidity, proximity sensors, tactile sensors). Sensor interface (Analog/ Digital), Edge computing

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**Unit 8: Connected Intelligence and Vehicle Autonomy (6 hrs)**

Overview of IoT, Industry 4.0, machine to machine (M2M) communication, IoT network and application architecture, Client Server Architecture, Publish Subscribe Architecture, Cyber-Security Overview (threat and prevention)

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