BMS **INSTITUTE OF TECHNOLOGY AND MANAGEMENT**

Avalahalli, Doddaballapur Main Road, Bengaluru - 560064

Open Course

On

Designing Lithium-Ion Battery for Electric Vehicles and Varied Applications

Organized by

Department of Mechanical Engineering

Dates: **13th to 17th June 2022**

Coordinators: **Dr. Ravichandra K R**
Dr. Nagamadhu M

Open Course Chief Coordinator:

Dr. Sathish Kumar K M

Professor and Head,
Department of Mechanical Engineering

B.M.S. INSTITUTE OF TECHNOLOGY AND MANAGEMENT

#6443, Doddaballapura Main Road, Avalahalli, Yelahanka, Bengaluru-560064

DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC YEAR: 2021 – 2022

BMS Institute of Technology and Management

Department of Mechanial Engineering

Rēthium Power Tech LLP

DESIGNING LITHIUM-ION BATTERY FOR ELECTRIC VEHICLES AND VARIED APPLICATIONS

OPEN COURSE

13th to 17th of June | 2022 **9:30 AM to 4:30 PM**

Preamble

Today's modern age is with smart devices and applications, which seeks huge amount of electrical energy storage. In addition to this, environmental and emission issues have led to search for Green solutions both in Automotive and Energy Sector. Thus, Electric Vehicles and Renewable Energy Power Plants (Viz. Solar and Wind) are in demand to combat the environmental and emission problems.

This Open Course intended to highlight the need for Energy Storage, various types of Energy Storage and then focusing on to Lithium-Ion batteries as energy storage device for Electrical Vehicles and other varied applications.

This course will impart the knowledge and exposure on Lithium-ion cells structure, Chemical Combination and Battery Pack design for intended application. It also emphasise on Next Generation Vehicle Simulation, Practical Demonstration of Electric Vehicle, Battery Management System, Thermal Management System and the issues related to joining of Cells to Bus bars.

Contents

- Energy Storage Systems
- Lithium Ion Battery
- Battery Managment System
- Battery Thermal Simulation
- Electric Vehilcles
- Next Generation Vehicle Simulation

Industry Importance

This course is designed in collaboration with **"Rethium Power Tech"**, a manufacturer and supplier of Lithium-Ion Batteries to Aircraft, Energy and Automotive sectors. The knowledge obtained will be useful while working in the following Engineering Sectors:

- Electric and Smart Vehicles
- Renewable Energy Harnessing
- Automated Warehousing
- Autonomous Supply Chain Management

Registration Link

projects.bmsit.ac.in

Payment Details

Course Fee : ₹ 400/-

Course Coordinator

- **Dr. Ravichandra K R**
  9880523462
- **Dr. Nagamadhu M**
  9611338626

email: nagamadhum@bmsit.in

Venue to attend open course : A202 (Academic block second floor)

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OPEN COURSE REPORT (2021-2022)

June 13-17, 2022

Department: Department of Mechanical Engineering		
Title of the Open Course		**Designing Lithium-Ion Battery for Electric Vehicles and Varied Applications**
Targeted Students from Branches		**Mechanical, Electronics and Communication, and Electrical Engineering.**
Registration Fee		**Rs.400/- (Four hundred only)**
No. of students attended		**Nos.13 (Paid the fees)**
Software/Hardware Tools used		**Solid works, battery-operated two-wheeler, and battery back.**
Delivery Methods		**Chalk and talk, PowerPoint presentation, lab, and hands-on experience.**
Assessment Methods (e.g.: Quiz, test, mini- project, report submission, etc.)		**Online test**
Open Course Chief Coordinator Details	Name	**Dr. Sathish Kumar K M**
	Mobile No.	**+91 9449178180**
	Email ID	**ravichandra@bmsit.in**
Internal Resource Person Details	Name	**Dr. Ravichandra K R**
	Designation	**Assistant Professor**
	Mobile Number	**+91 9880 523 462**
	Name	**Dr. Nagamadhu M**
	Designation	**Assistant Professor**
	Mobile Number	**+91 9611338626**
External Resource Person Details	Name	**Mr. Harsha S**
	Designation	**Director**
	Company/Organization	**Lithium Power Tech**
	Mobile Number/email-id	**+91 9900493153**
	Name	**Mr. Nithesh Kattathar**
	Designation	**Solutions Engineer**
	Company/Organization	**IPG Automotive GmbH, Karlsruhe, Baden-Württemberg, Germany**
	Mobile Number/email-id	

Abstract (Details of the Open Course)	Today's modern age is with smart devices and applications, which seek a huge amount of electrical energy storage. In addition to this, environmental and emission issues have led to a search for Green solutions both in the Automotive and Energy sectors. Thus, Electric Vehicles and Renewable Energy Power Plants (Viz. Solar and Wind) are in demand to combat the environmental and emission problems. This Open Course intended to highlight the need for Energy Storage and various types of Energy Storage and then focusing on to Lithium-Ion batteries as an energy storage device for Electrical Vehicles and other varied applications. This course will impart the knowledge and exposure on Lithium-ion cells structure, Chemical Combination and Battery Pack design for intended application. It also emphasise on Next Generation

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	Vehicle Simulation, Practical Demonstration of Electric Vehicle, Battery Management System, Thermal Management System and the issues related to joining of Cells to Bus bars. This course is designed in collaboration with "**Rethium Power Tech**", a manufacturer and supplier of Lithium-Ion Batteries for Aircraft, Energy and Automotive sectors. Being today's engineers, having knowledge on Lithium-Ion batteries and their associated issues will always help to deal with energy related problem in engineering professional life.

Photograph of the event:

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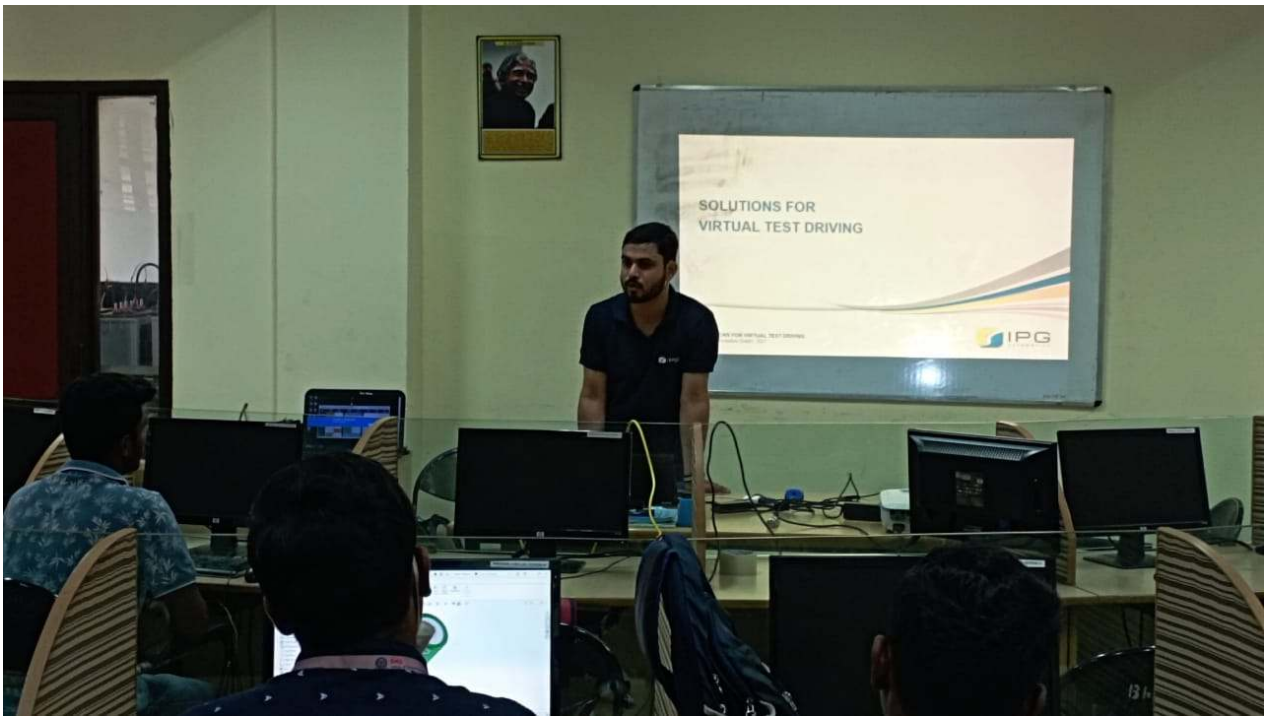
OPEN COURSE REPORT (2021-2022)

June 13-17, 2022



Mr. Nithesh Kattathar delivered a session on Solutions for virtual test driving

Hands-on dismantling and assembling of electric vehicle

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OPEN COURSE REPORT (2021-2022)

June 13-17, 2022

Open Course Outcomes	**CO-1**	Describe the necessity for Affordable Clean and Green Energy and Sustainable Transport System in the context of UN's Sustainable Development Goals (SDGs).
	CO-2	Summarize the chemical and material aspects involved in the various Lithium-Ion battery cells.
	CO-3	Design and analyse the Lithium-Ion Battery Pack for Electric Vehicle Application.

CO-PO Mapping for open course of "Designing Lithium-Ion Battery for Electric Vehicles and Varied Applications"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO3	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3						3				3			2		2	
CO2	3															3	
CO3	3	3	3		3					3		3		3	3	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

CO PO Justification:

	Explanation
CO-1	**Substantially correlated to PO1** as the fundamental engineering knowledge gained in this topic will help the students to apply while formulating sustainable solutions for complex engineering problems under energy and transportation sectors **Moderately correlated to PO7** because the students learn to apply the knowledge on environmental issues and sustainable developments while implementing any projects in their career. **Slightly correlated to PO11** because the students learn to apply the knowledge on environmental issues and sustainable developments while being team leader or group manager to take appropriate decisions while implementing any projects in their career.
CO-2	**Substantially correlated to PO1** as the fundamental engineering knowledge gained in this topic will help the students to choose appropriate battery cell and its material composition while working in professional life.
CO-3	**Substantially correlated to PO1** because the students apply the basic engineering knowledge while understanding and implementing product life cycle management in any project. **Substantially correlated to PO2** because the students are expected to apply analytical skills using modern IT tools to develop a battery pack and analyse the electrical and thermal behaviour in virtual mode. **Substantially correlated to PO2** because the students are expected to apply knowledge and skill to design develop a battery pack for a given application. **Substantially correlated to PO5** because the students are expected to use modern CAD and CAE tools to develop a battery pack and analyse the electrical and thermal behaviour in virtual mode. **Substantially related to PO9** because the students are expected to work in group while developing virtual mock-up of a product assembly. **Substantially related to PO12** because students are experiencing and acquiring skills on use of modern tools in virtual product development which leads them for lifelong

	learning,

CO PSO Justification:

	Explanation
CO1	**Moderately correlated to PSO1 and PSO 3** because students can apply this knowledge while designing and manufacturing the battery pack for an intended application.
CO2	**Moderately correlated to PSO 3** because students can apply this knowledge while manufacturing the battery pack for an intended application.
CO3	**Substantially related to PSO1 & Moderately to PSO2** because students will use the knowledge and skill developed in this topic while designing and conducting thermal management analysis of lithium ion battery cells. **Moderately correlated to PSO 3** because students can apply this knowledge and skill developed in this topic while manufacturing the battery pack for an intended application.

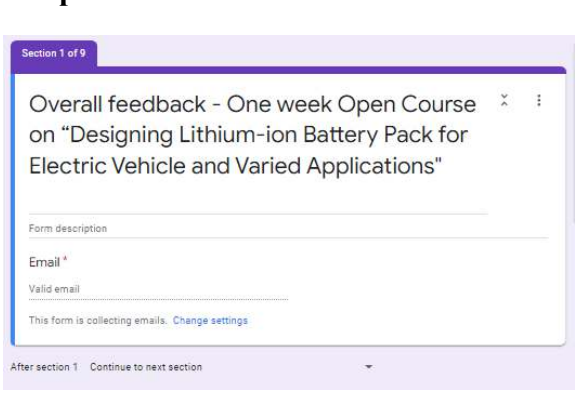
Feedback from external expert:
External Speaker appreciated the participants for being interactive

Feedback (critical) from students:
Interested in hybrid methods in vehicles

Feedback from External participants (if any):
1. – NIL-

Corrective methods/suggestions to consider while conducting open course next time (at least two points)
1. As per students payment methods need to improve -digital payment during registration
2. Sufficient time must be given to participants for registration, regarding course introductions.
3. Certificates has to issues during valedictory session.
4. Duration need to reduce for three days.

Sample course feedback form



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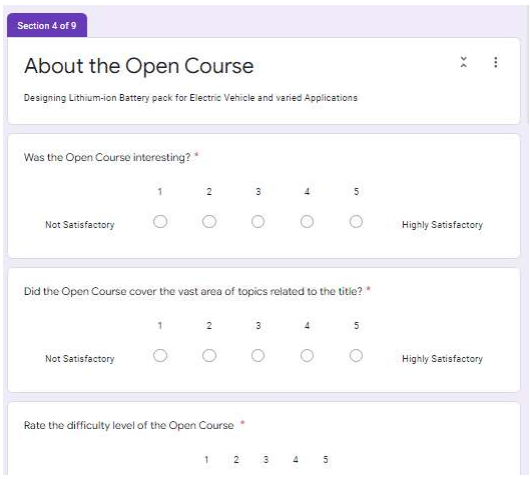
OPEN COURSE REPORT (2021-2022)

June 13-17, 2022


Section 4 of 9

About the Open Course

Designing Lithium-ion Battery pack for Electric Vehicle and varied Applications

Was the Open Course interesting? *

1 2 3 4 5

Not Satisfactory ○ ○ ○ ○ ○ Highly Satisfactory

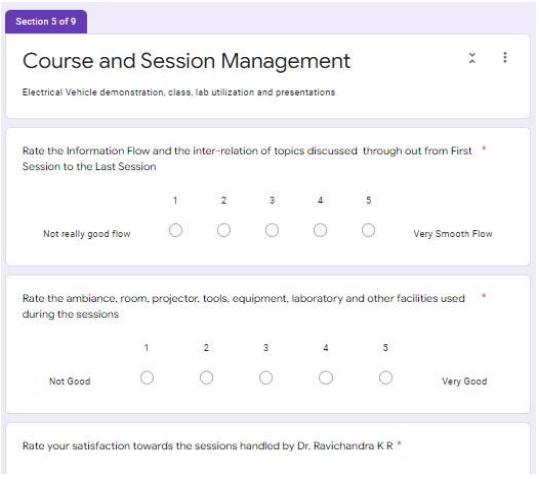
Did the Open Course cover the vast area of topics related to the title? *

1 2 3 4 5

Not Satisfactory ○ ○ ○ ○ ○ Highly Satisfactory

Rate the difficulty level of the Open Course *

1 2 3 4 5


Section 5 of 9

Course and Session Management

Electrical Vehicle demonstration, class, lab utilization and presentations

Rate the Information Flow and the inter-relation of topics discussed through out from First Session to the Last Session *

1 2 3 4 5

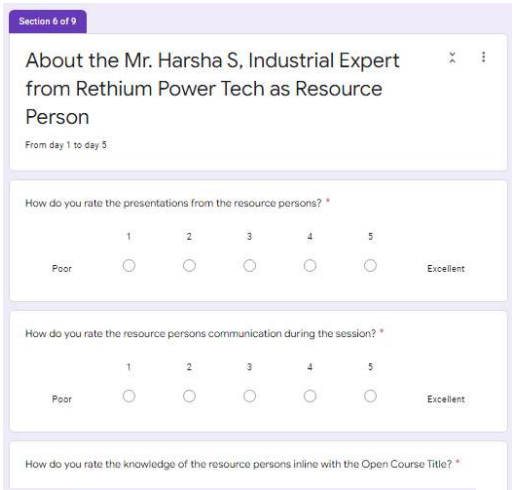
Not really good flow ○ ○ ○ ○ ○ Very Smooth Flow

Rate the ambiance, room, projector, tools, equipment, laboratory and other facilities used during the sessions *

1 2 3 4 5

Not Good ○ ○ ○ ○ ○ Very Good

Rate your satisfaction towards the sessions handled by Dr. Ravichandra K R *


Section 6 of 9

About the Mr. Harsha S, Industrial Expert from Rethium Power Tech as Resource Person

From day 1 to day 5

How do you rate the presentations from the resource persons? *

1 2 3 4 5

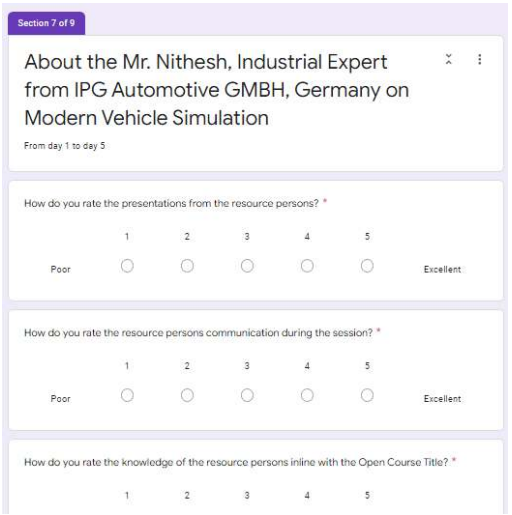
Poor ○ ○ ○ ○ ○ Excellent

How do you rate the resource persons communication during the session? *

1 2 3 4 5

Poor ○ ○ ○ ○ ○ Excellent

How do you rate the knowledge of the resource persons inline with the Open Course Title? *


Section 7 of 9

About the Mr. Nithesh, Industrial Expert from IPG Automotive GMBH, Germany on Modern Vehicle Simulation

From day 1 to day 5

How do you rate the presentations from the resource persons? *

1 2 3 4 5

Poor ○ ○ ○ ○ ○ Excellent

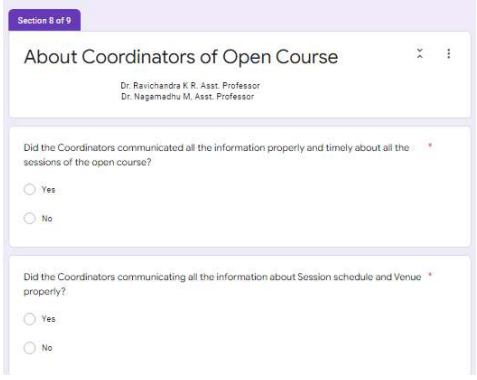
How do you rate the resource persons communication during the session? *

1 2 3 4 5

Poor ○ ○ ○ ○ ○ Excellent

How do you rate the knowledge of the resource persons inline with the Open Course Title? *

1 2 3 4 5


Section 8 of 9

About Coordinators of Open Course

Dr. Ravichandra K R, Asst. Professor
Dr. Nagamadhu M, Asst. Professor

Did the Coordinators communicated all the information properly and timely about all the sessions of the open course? *

Yes

No

Did the Coordinators communicating all the information about Session schedule and Venue properly? *

Yes

No

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(Autonomous Under VTU)

Doddaballapur Main Road, Avalahalli, Yelahanka, Bengaluru - 560064

Department of Mechanical Engineering

Open Course on

'A Future of all Industry'

Using AUTODESK Fusion 360

In this course students will get started with product design in Autodesk Fusion 360.During the course you will learn how to sculpt your idea, then move to parts and assembly modelling and as a final steps, create drawings, renderings and prepare for manufacturing on CNC machine or 3D printer.

Fusion 360 is a cloud-based CAD/CAM tool for collaborative product development. Fusion 360 enables exploration and iteration on product ideas and collaboration within distributed product development team. Most importantly, Autodesk Fusion 360 combines organic shapes modelling, mechanical design and manufacturing in one comprehensive package.

What you will learn:

- Introductions to Fusion 360
- Cloud Collaboration
- Sketching
- Part Modeling
- Assembly Modeling
- Drawing
- Sculpt
- Simulation
- Structural constraints and loads
- Generative Design

Date | 13th to 17th June 2022

Time | 9:30am to 4:30pm

Internal Resource Persons

Dr. Keerthi Kumar N
9743634934

Prof. Madhu M C
8105572970

Register at: projects.bmsit.ac.in

Course Fee: ₹400/-

Venue: Computing Facility Lab-1 (A-420)

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Malamaddi, Dharwad-580007
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Visit: www.isctonline.com

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OPEN COURSE REPORT (2021-2022)

June 13-17, 2022

Department: Mechanical Engineering		
Title of the Open Course		**A Future of all Industry -Fusion 360**
Targeted Students from Branches		**60**
Registration Fee		**Rs 400**
No. of students attended		**61**
Software/Hardware Tools used		**Autodesk- Fusion 360 software**
Delivery Methods		**Videos, ppt and Hands on training**
Assessment Methods (e.g.: Quiz, test, mini- project, report submission, etc.)		**Quiz, Sketching assembly drawings.**
Open Course Chief Coordinator Details	Name	**Dr. Satish Kumar**
	Mobile No.	**9980500700**
	Email ID	
Internal Resource Person Details	Name	**Dr. Keerthi Kumar N**
	Designation	**Assistant Professor**
	Mobile Number	**9743634934**
	Name	**Prof. Madhu MC**
	Designation	**Assistant Professor**
	Mobile Number	**8105572970**
External Resource Person Details	Name	Mr Kiran Patil
	Designation	Head-CAD operations,ISCT Dharwad
	Company/Organization	Autodesk
	Mobile Number/email-id	8971062676
	Name	Mr. Mohan Murali
	Designation	Fusion 360 faculty
	Company/Organization	**Autodesk**
	Mobile Number/email-id	9916481806
Curriculum Gaps: (Please indicate the gaps in terms of POs/PSOs) PO5 is attained since the students are exposed to modern tools PO12 is attained since self-learning leads to life long experience. PSO 1 is attained since this software is a design tool.		
Abstract (Details of the Open Course)	**The course on Auto desk-Fusion 360 will help the students to sculpt their ideas and learn part and assembly drawing, create drawings, renderings and simulation. Fusion 360 is a cloud based CAD/CAM tool for collaborative product development. It enables exploration and iteration on product ideas and collaboration with distributed product development team. Autodesk Fusion 360 combines organic shapes, modelling, mechanical design and manufacturing in one comprehensive package.**	

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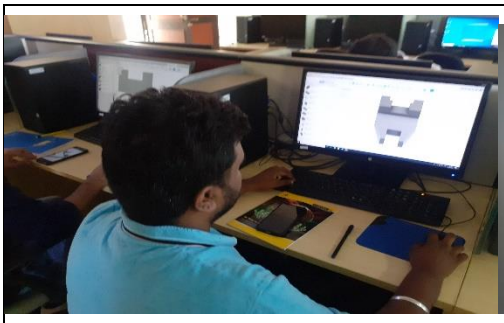

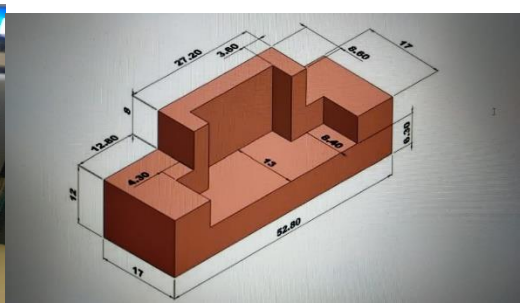

Photograph of the event:

Open Course Outcomes	**CO-1**	**Apply the knowledge of Engineering to build a part and assemble to make a final model.**
	CO-2	**Analyze the created model by structural and thermal simulation.**
	CO-3	**Evaluate the Engineering models by programming using reverse Engineering method.**
	CO-4	**Optimization of components which helps reduction in weight and increase efficien**
	CO-5	**Create Nonlinear profiles and non-parametric design.**

CO-PO Mapping for open course of "A Future of all Industry –AUTODESK Fusion 360

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3		3						2	3	3
CO2	3	3	3		3						2	3	3
CO3					3							3	3
CO4	3				3						3	3	3

Feedback from external expert:

1. External Speaker appreciated the participants for being interactive
   Mr Mohan Murali has appreciated the student's involvement in the course and their keen interst in modelling and sketching components.
2. Mr Kiran Patil has mentioned that the program was well organized and students were diligent and showed keen interest in the course.

Feedback (critical) from students:

1 . Students mentioned that they need more time for hands on practice.

Feedback from External participants (if any):

1. NIL

Corrective methods/suggestions to consider while conducting open course next time (at least two points)

1. Sufficient time to be allocated for practice sessions.

2. More exposure to recent software is required.

Sample course feedback form

RISHABH	Very good experience .learned a lot of new things	
Dhananjay raju	good experience ,would like to learn further	
Nishanth R Nayak	It was a very good experience in doing Autodesk software and enjoyed doing for 5 days, Thank you	