IT IT-ITeS Sector Skills Council, NASSCOM®

Foundation Skills in Integrated Product Development - Mechanical Tools (FSIPD-MT)

Guideline Document for the Facilitator

in the Outcomes Based Format (OBF)

Powered by:
TCS

Supported by:
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First published in 2012

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Acknowledgements

NASSCOM would like to place on record it appreciation of its member companies—**TCS** —who have partnered with us in this initiative. We would also like to thank **Engineering Proficiency Program (EPP) members,** as mentioned in **Annexure VI,** for supporting this initiative, by structuring and fine-tuning the materials provided.

NASSCOM is highly appreciative of its member companies for believing in this initiative under the IT-ITeS Sector Skill Council, which aims to increase the industry readiness of the available student pool. This is achieved by developing and facilitating the implementation of programs of educational relevance with an aim to bridge the perceived industry –academia skill gaps and specific industry related competencies w.r.t. Engineering Services Sector.

The industry specific competencies (i.e. skills and knowledge) w.r.t **Integrated Product Development - Mechanical Tools** are aimed at empowering students with entry level **Design Engineer** related skills. NASSCOM recognizes that this is an initiative of great importance for all the stakeholders concerned, such as the industry, academia, and students. The tremendous work and ceaseless support offered by members of the working group / partnering companies in strategizing and designing the training material for **Foundation skills in Integrated Product Development - Mechanical Tools (FSIPD-MT)** is commendable.

NASSCOM would also like to thank the senior leadership of these partner companies for sharing their thoughts and invaluable inputs in the planning and execution of the FSIPD-MT program.

Introduction to the Program

The Foundation skills in **Integrated Product Development - Mechanical Tools (FSIPD-MT)** program will increase the industry readiness of students who want to start a career in engineering companies in the area of **Integrated Product Development**. This program has been developed by experts from member companies—**TCS**—with a vision to develop the skills of students graduating from colleges to match the industry requirement.

The Outcomes Based Format (OBF) used to develop this program helps one focus on the key skills required to perform a given job role. The program has two tracks—one that is concentrated on guiding the facilitator and the other for guiding the student.

Objective of the Program

The FSIPD-MT program has been developed with the following objectives:

- To facilitate the acquisition of the foundation skills in the tools and techniques in Integrated Product Development area of the Engineering Services industry.
- To prepare the student with adequate knowledge and make them industry ready.

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About the Program

To Increase the funnel of available quality students 'at entry' level, NASSCOM suggests the Basic Skills/Foundation Skills termed as **Foundation Skill in Integrated Product Development - Mechanical Tools (FSIPD-MT)** program to be run as an add-on program in various education institutions. One of the purposes of this initiative is that going forward; universities/colleges will consider making these programs compulsory for students or integrate the development of these skills into the teaching-learning program by allocating credits to these programs.

Eligibility

The program is targeted towards students perusing pre-final/ final year of graduate/post graduate courses in any of the engineering stream.

Program Duration

The program is expected to be conducted over **60** hours including a blend of guided or instructor-led learning, tutorials, and practical exercises.

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Table of Contents—Foundation skills in Integrated Product Development - Mechanical Tools (FSIPD-MT)

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2.1.2. Session: Material Models and Constuitive relationships

2.2 Unit: CAE Fundamentals **[1 Hr[**

2.2.1. Session: Single element Model

2.2.2. Session: Validation with Hand calculations

2.3 Unit: Preprocessing **[12 Hrs]**

2.3.1. Session: Geometry de-featuring - Simplification guidelines

2.3.2. Session: Meshing Fundamentals (Types of Elements and Properties and limitations, Performing a mesh convergence Study)

2.3.3. Session: Boundary conditions (Types of, Application in the software)

2.3.4. Session: Material Property definition (Purely Elastic, Elastic Plastic, Elastic Perfectly Plastic)

2.3.5. Session: Demo

2.3.6. Session: Project

2.4 Unit: Solution **[5.5 Hrs]**

2.4.1. Session: Types of Analysis

2.4.2. Session: Solver settings & Solution

2.4.3. Session: Demo

2.4.4. Session: Project

2.5 Unit: Post processing **[9.5 Hrs]**

2.5.1. Session: Post Processing (Nodal and elemental Plots, Path plots)

2.5.2. Session: Refinement if needed

2.5.3. Session: Demo

2.5.4. Session: Project

How to Use this Program?

In order to make the teaching-learning process effective, this program has been developed based on the OBF for curricula design.

The curricula framework highlights an integrated output that encompasses the following for the program:

- Outcomes
- Processes
- Inputs

The curricula framework enables every parameter to be detailed to maximize impact and empower the learner with the requisite skills and competencies toward lifelong learning and gainful employment.

For the expected learning outcomes, the facilitator must refer to the FSIPD-MT OBF detailed in the following pages.

The module content identified is followed by a suggested lesson plan and the associated assessments with assessment keys.

Outcomes Based Format for Curricula Design

Foundation Skills in Integrated Product Development - Mechanical Tools (FSIPD-MT)

Curricula Framework

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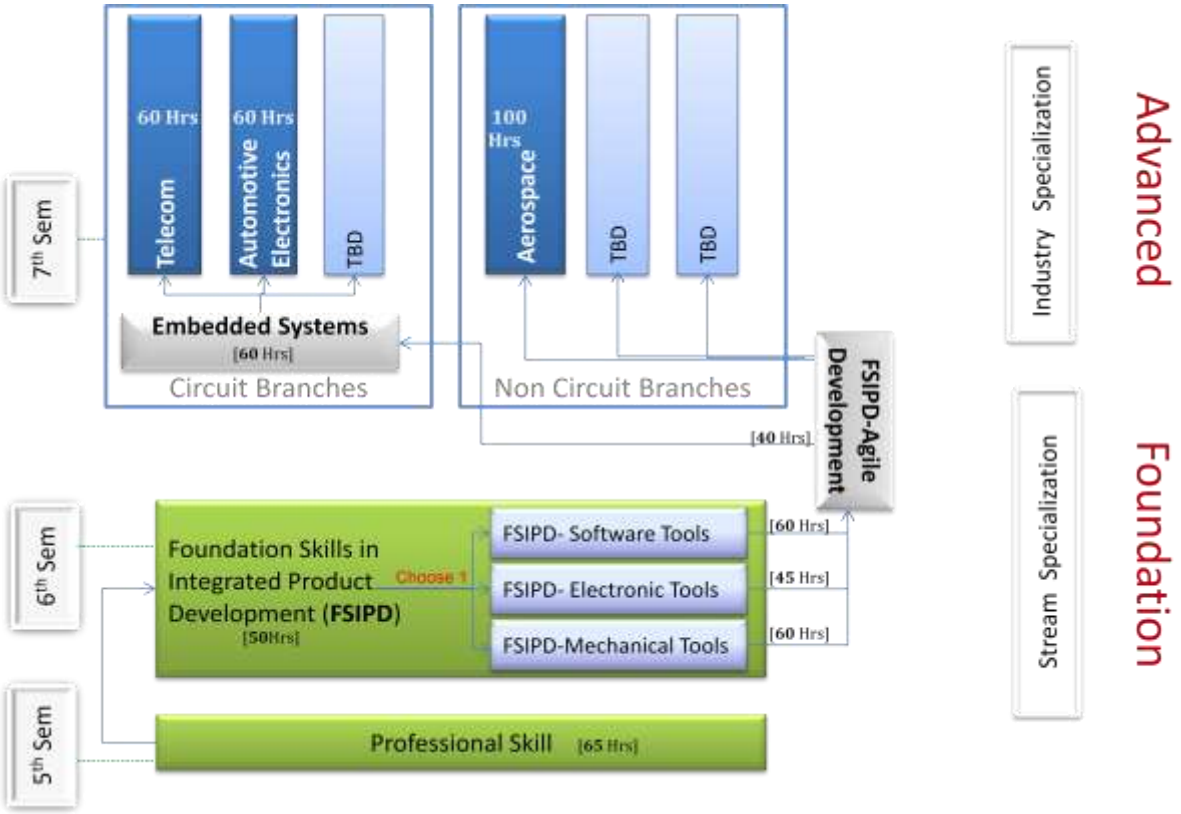
Outcomes Based Format for the Foundation and Engineering and R&D Services Curricular Framework

Framework for “Employment” oriented curricula

The “Curricula Framework” highlights an integrated output that encompasses “Outcomes”, “Processes” and “Inputs”. The framework will enable stakeholders to develop and customize programs of learning using different media to empower candidates with the desired foundation and advanced skills necessary for entry level employment in the Engineering and R&D Services industry.



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We propose the course assessments, formative and summative, to be based on the learning styles, as explained in the adaptation of the Bloom's taxonomy. Please refer to the illustration below.

Current Practice % (anecdotal evidence)	Level as per Bloom's Taxonomy	Proposed System % (Subject to module requirement)	Split of 60 Hrs
80	Remembering	20	10
15	Understanding	20	10
5	Applying	60	40
	Analyzing	-	-
	Evaluating	-	-
	Creating	-	-

Part 1: Outcomes and Processes (are combined in this template)

Part-I: Outcomes
Name of the Program: Foundation skills in Integrated Product Development - Mechanical Tools (FSIPD-MT) This program can be offered with UG or equivalent programs/courses for Mechanical engineering stream. This program is also applicable for Mechanical stream PG graduates who aspire to join the engineering industry at the entry level. The FSIPD-MT program aims to improve student's awareness and understanding of the tools and technologies involved in Mechanical Product Design. Students, who undergo this program, will stand a better chance to be considered for jobs in the Engineering industry.

1. Program Outcomes	Course Outcomes	Duration (Hrs.)
I. Professional Outcomes	Details are covered separately in professional skills OBF	
II. Course Outcomes (**Domain: Integrated Product Development – Mechanical Tools**)	After completing this program, the student will be able to obtain the following technical skills needed to effectively play the entry level design engineer role in an engineering organization: • Understand the role of CAD in engineering domain. • Understand the different types of tools used in the CAD/CAE. • Understand the need for CAD and CAE software tools. • Understand the functions and features of the CAD and CAE tools. • Perform CAD activities – Part modeling, Assembly modeling and Drafting – in one of the commercial software (CATIA / Unigraphics/ ProE). • Perform CAE activities – Geometry simplification, Meshing, Boundary conditions, Analysis and Post processing in one of the commercial software (Hypermesh, Nastran / Patran or Ansys or Abacus).	**60 Hrs**
III. Employability Outcomes	Students will develop skills relevant to: • Profession in Computer Aided Design (CAD) and Computer Aided Engineering (CAE) • Design Engineer	
	Total	**60 hrs**

Program Outcomes	Student Learning Outcomes	Student Learning Objectives	Key Performance Indicators (KPI)	Performance Ensuring Measures (PEM) / Assessments Continuous (C), Summative (S), Final (F)	Duration (Hrs.)	Process (How to do)
Course Outcomes (Domain Subject)	Knowledge	At the end of the program, the students will be able to gain knowledge about the CAD tools specifically: • Define the Computer aided tools (CAx) employed in IPD • Know the background of CAD tools evolution • Define the part modeling and types • Define the assembly modeling and the types • Define the drafting features • Know the commercially available CAD software and their environment and file classifications	The student is able to: • Describe the CAx tools in IPD process • Explain the CAD tools evolution • List the various part modeling techniques • Describe the assembly modeling techniques • List various drafting features to be used in a drawing • List the commercial CAD software, file structure and environment	Presentation and Classroom discussions Quiz	1 1 1 1 1	Topic presentation by faculty, followed by class discussions “Did I get this?” quiz activities after each session

	Knowledge	At the end of the program, the students will be able to Gain knowledge about the CAE tools specifically: • Recollect the basics of structural mechanics and know the principle of virtual work, constitutive relationships • Know the single element model and validating it with hand calculations • Understand the CAE activities such as meshing fundamentals, element types, mesh convergence, boundary conditions, analysis types, solver settings, solution, post processing plots and refinements	The student is able to: • Describe the structural mechanics topics • Explain the validation process with hand calculations • Explain the sequence of CAE activities – Meshing, boundary condition application, solution and post processing	Presentation and Classroom discussions Quiz	2 1 2	Topic presentation by faculty, followed by class discussions “Did I get this?” quiz activities after each session
	Understanding/Comprehension	At the end of the program, the students will be able to explain the functionalities of CAD tool, specifically • File storage and environment of the	The student is able to describe the functionalities of the CAD tool, specifically • File storage and environment of the	CAD tool live demo	0.5	Live demo of any CAD tool in

	CAD tool • Part modeling techniques • Assembly modeling techniques • Drafting	CAD tool • Part modeling techniques • Assembly modeling techniques • Drafting		1.5 2 1	lab with an example for part modeling, assembly modeling and drafting
Understanding/Comprehension	At the end of the program, the students will be able to Explain the functionalities of CAE tool, specifically: • Model simplification • Meshing • Applying Material properties, Boundary conditions and solution • Post processing and reporting • Refinement, if needed	The student is able to Describe the functionalities of the CAE tool, specifically: • Model simplification • Meshing • Applying Material properties, Boundary conditions/solution • Post processing and reporting • Refinement, if needed	CAE tool live demo	0.5 1 1 2 0.5	Live demo of any CAE tool in lab with an example for model simplification, meshing, BC, solution, post processing, reporting and refinement.
Application	At the end of the program, student will be able to: • Perform a CAD project	The student is able to: • Complete the CAD project work	Project work in CAD lab	20	Project topic could be either a standalone task or linked to the IPD project work

		work comprising • Part modeling • Assembly modeling • Drafting	involving • Part modeling • Assembly modeling • Drafting	Assessment		Assessment based on project work
	Application	At the end of the program, student will be able to Perform a CAE project work comprising • Importing CAD model and simplification • Meshing • Applying Material properties, Boundary conditions and solution • Post processing and reporting • Refinement, if needed	The student is able to Complete the CAE project work involving • Model simplification • Meshing • Applying Material properties, Boundary conditions and solution • Post processing and reporting • Refinement, if needed	Project work in CAE lab Assessment	20	Project topic could be either a standalone task or linked to the IPD project work Assessment based on project work
	Analysis (HOTS)	None	None	None		
	Evaluation (HOTS)	None	None	None		
	Synthesis(HOTS)	None	None	None		

Program Outcomes	Student Learning Outcomes	Student Learning Objectives	Key Performance Indicators (KPI)	Performance Ensuring Measures (PEM)	Duration (Hrs.)	Process (How to do)
Employability Outcomes	Knowledge	At the end of the program, the students will be able to: • Know how to use CAD/CAE tools	The student is able to: • Demonstrate the skills in using CAD/CAE tools	Lab	-	The employability skills needed to function as CAD/CAE engineer are integrated in to the project work
	Understanding/Comprehension	At the end of the program, the students will be able to: • Understand the use of CAD/CAE tools in specific operations	The student is able to: • Use CAD/CAE tools in specific operations			
	Application	At the end of the program, the students will be able to: • Develop an attention to detail • Reason and take logical steps/decisions in any given situation • Provide and manage the end–to-end solution for a given project • Manage time efficiently and effectively • Use the CAD/CAE Tools	The student is able to: • Attention to detail • Abstract reasoning • Project report writing skills • Successfully achieve the given project outcomes • Attain the desired range scores / grades necessary as cut-offs for employment			
	Analysis (HOTS)	None	None	None		
	Evaluation (HOTS)	None	None	None		
	Synthesis(HOTS)	None	None	None		

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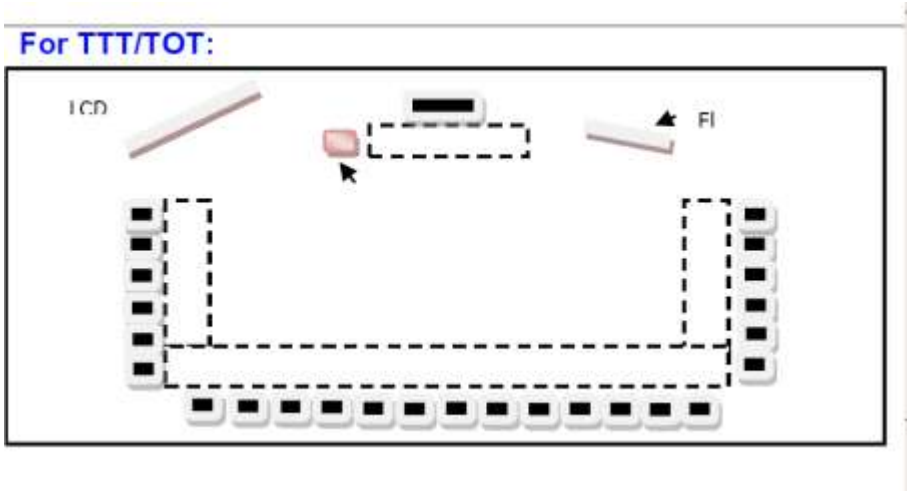
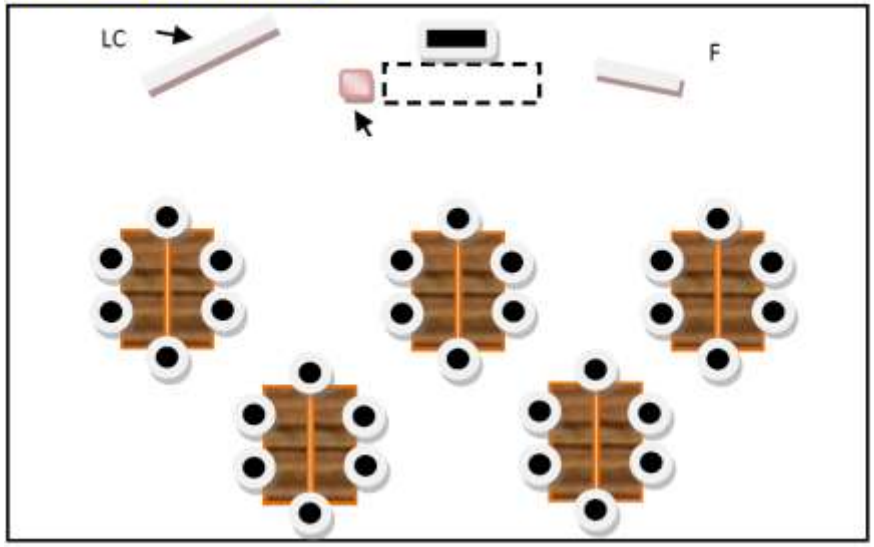
PART-II Inputs for facilitating and achieving the Outcomes

Inputs	
Curriculum	**TOC**
Syllabus	**Module: Computer Aided Design (CAD) Tools** Introduction to CAD-Theory Part Modeling Assembly Modeling Drafting CAD software environment **Module: Computed Aided Engineering (CAE) Tools** Review of Structural Mechanics CAE Fundamentals Preprocessing Solution Post processing
Infrastructure Required	Infrastructure: i. Classroom layout (classroom diagram)

	For TTT/TOT: 

For student training:



ii. Classroom infrastructure & ICT requirement

For TTT/TOT (batch of 25 trainers):

- Classroom size—Min. 10 ft. x 15 ft.
- U-Shaped table with a seating capacity of 25
- Computer/Laptop with speakers & CD ROM—1 (for master trainer)
- Computer lab with 25 Computers (desktop) with following:
  - CD Rom
  - MS Office
  - Speakers
  - Headphones with microphone—25
  - Internet
- LCD Projector & Screen—1
- Whiteboard—1
- Flip Charts—5
-

	For Student Training (batch of 30 candidates):
	• Classroom size—Min. 10 ft. x 15 ft.
	• Tables/chairs - 30
	• Computer/Laptop with speakers & CD ROM—1 (for trainer)
	• Computer lab with 25 Computers (desktop) with following:
	  ◦ CD Rom
	  ◦ MS Office
	  ◦ Typing Tutor (software)
	  ◦ Speakers
	  ◦ Headphones with microphone—30
	  ◦ Internet
	• LCD Projector & Screen—1
	• Whiteboard—1
	• Flip Charts—5
	
	iii. Labs
	• Physical
	  • A lab with a computing peripherals (2G RAM)- loaded with one of the CAD and CAE software
	  • The lab should have licensed software available to build and install the operating systems, domains and email systems, and a facility to record
	  • The lab should have internet facility (with 2mps speed) available to students
	  • Preferably online classrooms with projector will enhance the learning experience in the classroom
	  • White board and marker pens
	  • Lab guides
	
	• Virtual
	  • None

Faculty and Support Staff	Faculty: • Qualifications: B-Tech, B.E in Mechanical Engineering • Experience: 8-10 years, preferably with training experience Support staff: • Qualifications • Experience
Library	• Library - Physical and virtual i. CBT • WBT • Articles

	• Books • Internet references
Text books	
Practical -Labs infrastructure & ICT requirements	Practical: • Labs • Physical • Virtual • Tutorials
Internship programs	Internship: • Company • Simulated in classroom
Lesson Plans Template	Lesson Plans for Delivery (a sample lesson Plan for each is to be prepared) and attaches as annexure Course/program delivery using Blended learning: • Lectures • Role plays • Presentations • Assignments (classrooms and homework) • Discussion forums & Group discussions
Projects	Projects: • Lab based • Classroom based • Online projects
Assessment & Evaluation Practice Details Sample question papers;	Assessments and Evaluation • Continuous • End of Module assessments
End of Course Certification	None
Employment Skill Assessment	None

ANNEXURE-I

Content Outline Weekly Plan —Guideline document for the Trainer: To be filled in by the trainer while customizing delivery

Course Name: FSIPD-MT Module :		**Hours**							Lesson Plan for each activity in place Yes / No
		Face -to-Face	Team Work	Individual project/ Internship + Feedback	Practical + Feedback	Practical+ Feedback	Assessments +Feedback		
							Continuous	Summative	
A	CAD-Theory	**5**	**5**						**No**
B	CAD-Practice				**20**				**No**
C	CAE-Theory	**5**	**5**						**No**
D	CAE-Practice				**20**				**No**
E									
F									
G									
H									
	Total	**10**	**10**		**40**				

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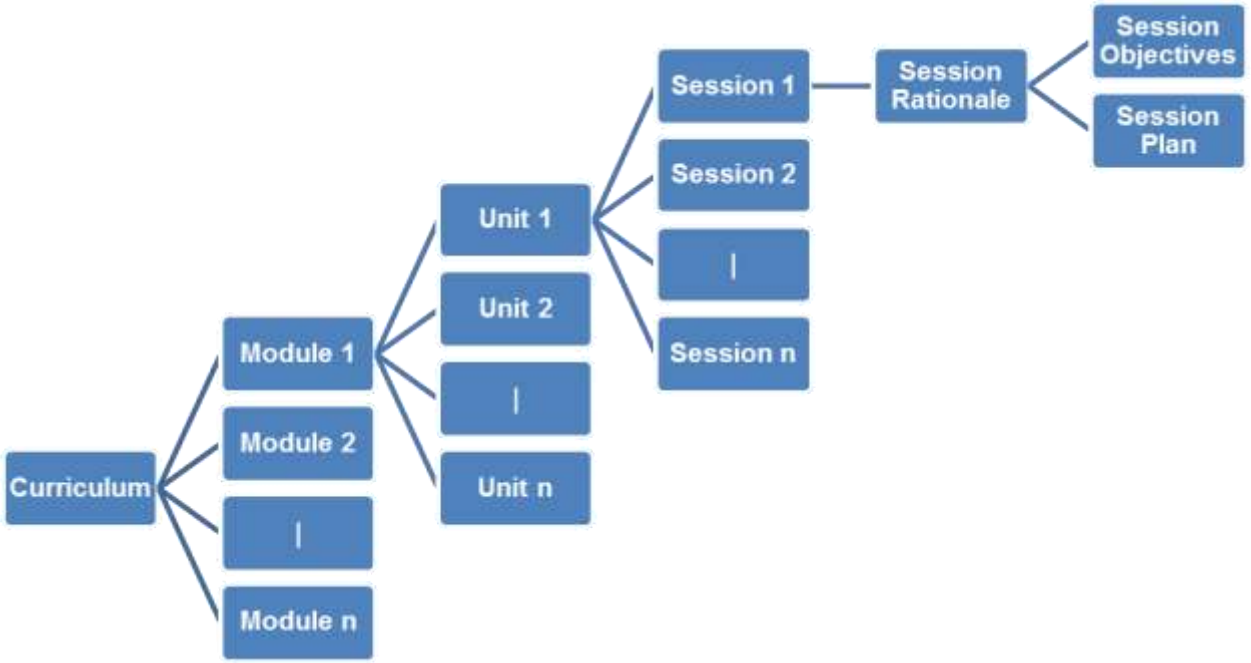
ANNEXURE-II

Directional Guideline Plan for Modules



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ANNEXURE-III

A. Lesson Plan Template:

***Day-wise Template**

Note: This table is to be filled by the facilitator for each session based on the schedule and class information.

Course Name	FSIPD-MT
Date, Day, Time	DD/MM/YYYY, <Day>, HH:MM
Name of Faculty	Mr./Ms/ XXX
Name of Company/ College/University	XXX University/ YYY College
Number and Nature of Students	30 students in engineering stream
Base Equipment	Overhead Projector/Chart Board/Pens etc) in Class or Conference Room

***Course Lesson Plan templates**

Course Rationale, Objective & Plan

Course Rationale & Objective:

Course Rationale: The purpose of learning this course on **FSIPD-MT** is to improve student's awareness and understanding of the tools and technologies involved in **Mechanical Product Design**.
Course Objective: At the end of this module on Computer Aided Design (CAD) Tools, the learner will be able to: • Understand the role of CAD tools in Mechanical product design. • Obtain exposure level skill in usage of CAD tools.

Session Rationale, Objective & Plan

Session Rationale: The purpose of learning this session on **Introduction to CAD system** is to provide an overview to the evolution of CAD system from the past to the current state.
Session Objective: At the end of this session on **Introduction to CAD system**, the learner will be able to: • Understand and describe the need of CAD system • Understand how CAD system evolved over the period of time in accelerating time to market aspect and consistency aspects of th engineering product artifacts.

Session Plan

Time	Content	Learning Aid / Methodology	Trainer Approach	Learner Activity	Learning Outcome (Skill, Competency)
9:00 to 9.10 AM	Product design in early days and the associated issues – longer time to market, dependence on manual skills, difficulty in configuration management.	PPT/Lecture	Discussion	Participation	Acknowledge importance of session.
9.10 to 9.40 AM	CAD system – evolution 2D non-editable systems, 2D editable systems, 3D systems – Benefits	PPT/Lecture	Discussion	Participation	Understanding of CAD system.
9.40 to 9.50 AM	“Did I get it?” self check exercises	Web based questions	-	Participation	Verification of the concepts learnt
9.50 to 10.00 AM	Conclusion & Summary	Supplementary information and links	Discussion	Participation	Get a recap of things learnt and links for further learning

ANNEXURE-IV

Assessment Templates:

Any further assessments required by the trainer can be developed.

ANNEXURE-V

Employment Assessment
NASSCOM Assessment of Competence-Tech (NAC-Tech)

About NAC-Tech

NAC-Tech has been conceived as an industry standard assessment and certification program to ensure the transformation of a "trainable" workforce into an "employable" workforce, hence creating a robust and continuous pipeline of talent for the IT/engineering industry. It is targeted at final year and pre-final year students, who will be seeking employment opportunities in the IT/engineering sector.

Conceptualization of NAC-Tech

In-depth meetings with the large recruiters in the industry were conducted to understand their recruitment practices, cause of attrition desired skills in a candidate, etc. Based on this, a job-skill matrix was developed which formed the basis for the design of this assessment program. Core and working committees from the industry were formed and constant interactions were made to make sure that the program was in line with the industry requirements. An evaluation committee was set up to finalize the vendors and decide on the approach to the pilot. Multi-tier evaluation of the vendors happened after the initial interaction. The identified vendors provided the content and technology to run the test. The companies that have helped develop the assessment program are—TCS, Wipro, Infosys, Accenture, Cognizant and HCL.

Key Features of NAC-Tech

Eligibility for NAC-Tech
- Any candidate appearing in “final year” of BE, B. Tech, MCA, M. Sc-IT is eligible to take the test
- Preferred scores of candidates: 60% aggregate in graduation, 12th standard & 10th standard

Advantages of NAC-Tech for various stakeholders

α. For Colleges/Universities
- Enable the college to generate a quantifiable picture of the knowledge and skill level of its students.
- Approach industry aggressively and in a more organized way for placement opportunities.

β. For Students
- Detailed feedback on their knowledge and skills help them decide career opportunities in different areas of IT.
- NAC-Tech score card enables them to leap-frog to the next level of selection to multiple companies endorsing the program.

χ. For the Industry
- Industry gets a pool of pre-assessed candidates mapped against competencies required for entry level professionals.
- It helps them reach out to a wider geography and access talent from level 2 and 3 cities and institutions.

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Test Matrix for NAC-Tech is illustrated below:

Part A (this must be attempted by all candidates)

Skill	Competencies Checked	Duration (in min)	Mode of delivery
Verbal Ability	To assess candidate's verbal building blocks by evaluating skills like grammar, spellings, punctuations, and vocabulary. To assess English usage by evaluating skills like structure, arguments, and verbal reasoning.	20	Online
Reading Comprehension	To assess candidate's comprehension of English passages and ability to make inferences from a large amount of information. Be able to connect the dots and make an assessment based on information and ideas spread across the passage.	10	Online
Analytical Reasoning	To assess problem-solving skills through questions on quantitative reasoning. To assess candidate's logical skills by evaluating skills like deduction, induction and visualization.	25	Online
Attention to Detail	To assess candidates eye for detail.	5	Online
	total duration	**60**	

Part B - Optional (can be attempted if the student desires so) (The candidate can choose any one of the domains)

Skill	Competencies Checked	Duration (in min)	Mode of delivery
IT	To assess candidate's technical skills in the core area of education.	30	Online
Electrical	-do-	30	Online
Electronics	-do-	30	Online
Mechanical	-do-	30	Online
Civil	-do-	30	Online
Chemical	-do-	30	Online
Textile	-do-	30	Online
Bio-Technology	-do-	30	Online
Telecommunications	-do-	30	Online
	total duration	**30**	

Technical requirements for NAC-Tech

Minimum Configuration for NAC-Tech Tests	
Description	**Client PC (Test Taking PC) (with a Monitor, Mouse, & Keyboard)**
Operating System	Windows® XP SP3+, or 7
CPU	Pentium® IV and higher
RAM	1GB RAM and above
HDD	At least 500 MB free disk space
Web browser:	Internet Explorer 6.0, 7.0 or 8.0
Broadband Internet connection	E1 with a bandwidth of at least 1Mbps or Shared DSL or cable with a bandwidth of at least 2 Mbps for 25–30 users
Sound Card with necessary audio and video drivers	Yes (Should support recording & playback capabilities)— OPTIONAL
Headset with Microphone	Headset with a USB headset is strongly recommended -- OPTIONAL
Java Scripts	JRE 1.6 (Enabled in the browser)
Adobe Flash Player 10.0	Yes
UPS (assuming that generator will be used during power failure)	2 Hours Battery Backup
Generator (may be used for 8 hours or more if needed)	Yes
CD-ROM Drive	OPTIONAL
USB Ports	OPTIONAL
Antivirus	Yes
Screen resolution	1024 x 768 pixels
Network security access to allow http://202.138.124.234/Nactech2 (port 80)	
Disable pop-up blocker on all machines	

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ANNEXURE-VI

Engineering Proficiency Program Members

S. No.	Name of the Company	Contact Person	Email id
1.	HCL	**Manjunatha Hebbar**	Manjunatha.Hebbar@hcl.com
2.	HCL	**Vayu Nandan Kumar**	Nandankumar.Kv@hcl.com
3.	HCL	**Ashok G**	Ashok.G@hcl.com
4.	TCS	**S Selvan**	selvan.ss@tcs.com
5.	Infosys	**KNS Acharya**	Sriranga_Acharya@infosys.com
6.	Infosys	**Tomy Thomas**	Tomy_thomas@infosys.com
7.	Infotech Enterprises	**Ramanand pattige**	Ramanand.Puttige@infotech-enterprises.com
8.	Defiance	**KN Varadarajan**	Varadarajan.KN@defiance-tech.com
9.	L&T Integrated Engineering Services	**Krishnakumar**	Krishnakumar.Nair@lnties.com
10.	iGate	**Santanu Ray**	Santanu.Ray@igate.com
11.	iGate	**Sheela Jain**	sheela.jain@igatepatni.com
12.	iGate	**Animesh Das**	Animesh.das@igate.com
13.	EMC	**Veda**	Veda.Srinivasan@emc.com
14.	KPIT Cummins	**Prashant Ghanekar**	Prashant.Ghanekar@kpitcummins.com
15.	KPIT Cummins	**Renuka Krishna**	Renuka.Krishna@kpitcummins.com
16.	Microsoft	**Phani Kondepudi**	phanikon@microsoft.com
17.	Microsoft	**Vinay Tamboli**	Vinayt@microsoft.com
18.	Wipro	**Hemachandra Bhat**	hemachandra.bhat@wipro.com
19.	Alcatel Lucent	**Murthy Bhamidi**	murthy.bhamidi@alcatel-lucent.com
20.	Alcatel Lucent	**RadhaKrishna**	rk.arvapally@alcatel-lucent.com
21.	Synapse	**Naren Nande**	naren@synapse-da.com / nsnande@gmail.com
22.	Aricent	**MC Parameswaran**	mc.parameswaran@aricent.com

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<Development Partner, if any>

23.	Mahindra Satyam	**Srinivas Ramanathan**	Srinivas_Ramanathan@mahindrasatyam.com
24.	UTC Aerospace Systems	**Sharatkumar Variyar**	sharatkumar.variyar@goodrich.com
25.	Bosch	**Ajay Kumar**	Ajaykumar.KK@in.bosch.com
26.	Bosch	**Anju Bhadoria**	Anju.Bhadoria@in.bosch.com
27.	Tata Technologies	**Ravindra Ranade**	RAVINDRA.RANADE@tatatechnologies.com
28.	Mahindra Engineering	**Prabu Sunil**	PRABHU.SUNIL@mahindraengg.com
29.	Mahindra Engineering	**Durgaprasad Shukla**	Shukla.durgaprasad@mahindra.com
30.	Airbus	**Suraj Chettri**	suraj.chettri@airbus.com
31.	SAP	**Jai Prakash Nethala**	nethala.jai.prakash@sap.com
32.	Intel	**Apreeta Singh**	apreeta.singh@intel.com
33.	SASKEN	**Vijai Simha**	vijai.simha@sasken.com
34.	Huawei	**Ashok Gopinath**	ashokg@huawei.com

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