GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

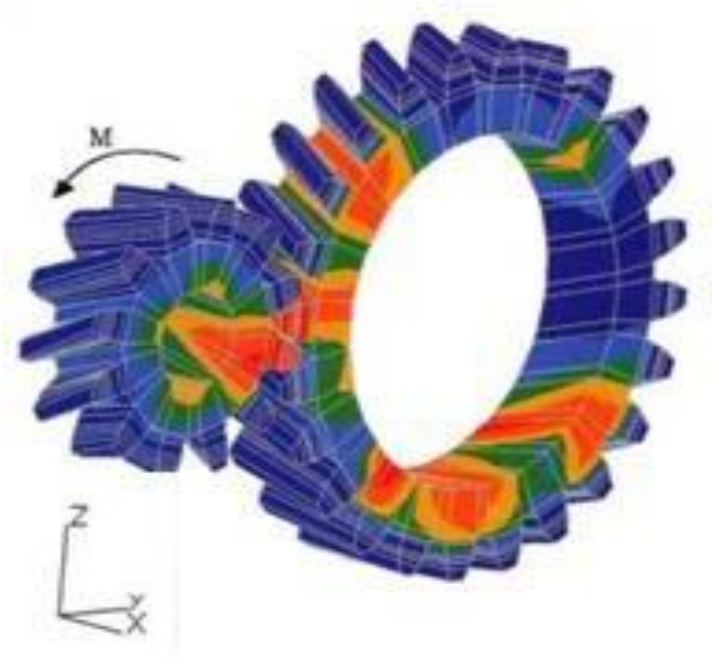
COMPETENCY BASED CURRICULUM

VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD)

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD)

(Engineering Trade)

(Revised in 2024)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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CONTENTS

1. COURSE INFORMATION

During the two-year duration of Virtual Analysis and Designer FEM (Finite Element Method) trade, the candidate is trained on subjects, Professional Skill, Professional Knowledge and Employability Skills related to job role. In addition to this, a candidate is entrusted to make/do project work and Extra-Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing tasks.

The content broadly covers using computers where in the course introduces to computer aided engineering to learn to develop the geometric designing, modelling, developing finite element models and perform various analysis with the aid of software packages like CAE software. The broad components covered under Professional Skill subject are as below: -

FIRST YEAR: In this year, the contents cover from safety aspect related to trade, basics of product design and development, introduction to Engineering drawing, introduction to Computer Aided Design (CAD), familiarization to Computer Aided Engineering (CAE) software, importing geometry and setting up the geometry for discretization (meshing), meshing the geometry with 1D, 2D and 3D elements, editing and updating the mesh, checking the mesh quality, assigning material and element properties, running a linear static analysis for simple components.

The trainee learns generating the 2D drawing of simple components using basic engineering drawing skills, generating sketches for simple problems, generating 3D model for the concept, editing and modifying of the design, creation of 2D drawings, exploded views of the design, creation of bill of materials, meshing of sheet metal and stamped components, applying the loads and appropriate boundary conditions to simulate the physical problem, analyzing simple automotive / general engineering components for linear static analysis.

SECOND YEAR: In this year, advance structural analysis methods such as inertia relief analysis, use of special types of elements such as spring elements, mass elements, rigid elements, material and geometric non-linear analysis, modal analysis, thermal analysis etc. are covered. The trainee learns advanced analysis such as, nonlinear analysis, modal, inertia relief method, thermal analysis, frequency response analysis and other analysis. The list of exercise problems includes of beams, trusses, simple frame, automotive components, simple aircraft component and general machinery components.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labor market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

Virtual Analysis and Designer FEM (Finite Element Method) trade under CTS is delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Employability Skills) impart requisite core skill & knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Check the task/job for functioning, identify and rectify errors in task/job.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

On the Job Training (OJT)/ Group Project	150	150
Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240	240

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification or add on short term courses.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India trade Test for awarding NTC will be conducted by **Controller of examinations**, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome**

and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency.

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination body. The following marking pattern to be adopted for formative assessment:

Performance Level	Evidence

(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Marks in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Designer understands, creates, edits and modifies the engineering drawings, creates 2D sketches, 3D CAD models, and detailed assembly models. Import the geometry from native CAD environment, clean up and edit the geometry for design modification. The designer selects the CAD data, clean up the design for meshing, creates the mesh with 1D, 2D and 3D elements, maintains the quality of the mesh by choosing industry accepted quality parameters, applies the appropriate materials & element properties, applies correct loads and boundary conditions, prepare the finite element model for the analysis, analyze the structure depending on the type of the problem, submits the finite element model to the solver and controls the solver. The designer checks the equilibrium and compatibility of the mode, post process the results for various quantities such as deformation, stresses, strains etc., interprets the result by post processing the data, recommends the design changes to improve the design, modifies the mesh and resubmit the model to visualize the effect of the design change. Then the designer details the design and prepares the geometry for additive manufacturing.

In addition, Virtual Analysis and Designer FEM (Finite Element Method) have the ability to visualize the job, good coordination, attitude, manual dexterity and perform work related mathematical calculations.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Design Engineer; performs complex assignments pertaining to the design, testing and assessment of mechanical and electrical devices and systems to assist in the production or packaging process. They also develop prototypes for testing; provide feasibility testing on new and current designs under modification. They help in functional reviews of product architecture to assure design integrity and compliance with company specifications and recognized industry design practices.

Designer, Machine Mechanical Engineer, Designs; Machine Designer plans and designs various types of machines, tools and equipment for manufacture or experiment. Studies details and performance of existing machinery. Examines manufacturing process, production cost, wastage, etc. for preparing improved designs. Calculates data and develops new designs of machines, tools and equipment involving manufacture, repairs, replacement or modification to effect improvement. Prepares sketches, drawings etc. showing new features, dimensions, specifications, working details, limits (accuracy) and all other necessary information for accurate, easy and economical production. Advices party and management on various technical (Mechanical) problems with regard to construction, erection and installation of machinery, production methods,

alteration and modification of machines, tools and equipment purchase of plants and materials, machine and building lay out, etc. May prepare designs for submitting tenders for machines and equipment. May specialize in preparing a design of a particular type of machinery in any specific industry. Equipment Designer is also known as Tool Designer. Individuals at this job need to design details of the equipment mechanisms, fixtures, tools, gauges and other instruments for manufacturing and measuring the quality standards of the production process.

Product Design Engineer; is broadly responsible for designing the product using CAD & CAE systems by understanding all the product requirements. The role is also responsible for supporting the manager in ensuring that the designed product includes aspects related to telematics, human machine interface, ergonomics and design FMEA.

Verification Engineer; also known as 'Functional Verification Engineer is responsible for performing checks to ensure functionality of the design conforms to the input output specification. The individual at work studies the design specifications, develops test cases and runs a verification program on the module's function-design using software and specific tools to validate the results with the specification. The individual is also responsible for coordinating with other departments involved in system-on-chip (SOC) design development for effective design implementation.

Design Engineer-EA; is responsible for carrying out engineering analysis problems like stress calculations, static and dynamic analysis, thermal analysis, etc. They also provide support in the assessment and testing of advanced technology systems, subsystems and components.

Reference NCO-2015:

a) 2523.0401 – Design Engineer
b) 2144.0200 – Designer, Machine
c) 2144.0301 – Equipment Designer
d) 2144.0803 – Product Design Engineer
e) 2152.0901 – Verification Engineer
f) 2512.0601 – Design Engineer – Engineering Analysis

Reference NOS:

a) CSC/N9477
b) CSC/N9478
c) CSC/N9479
d) CSC/N9480
e) CSC/N9483
f) CSC/N9484
g) CSC/N9576
h) CSC/N9485
i) CSC/N9486
j) CSC/N9487
k) CSC/N9401
l) CSC/N9402

4. GENERAL INFORMATION

Name of the Trade	**VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD)**
Trade Code	DGT/2025
NCO – 2015	2523.0401, 2144.0200, 2144.0301, 2144.0803, 2152.0901, 2512.0601
NOS Covered	CSC/N9576, CSC/N9477, CSC/N9478, CSC/N9479, CSC/N9480, CSC/N9483, CSC/N9484, CSC/N9485, CSC/N9486, CSC/N9487, CSC/N9401, CSC/N9402
NSQF Level	Level-4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, CP, LC, DW, AA, BLIND, LV, DEAF, HH, AUTISM, ID, SLD
Unit Strength (No. Of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	192 Sq. m
Power Norms	17 KW
Instructors Qualification for	
1. Virtual Analysis and Designer FEM (Finite Element Method) Trade	B.Voc/Degree in Mechanical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Virtual Analysis and Designer FEM (Finite Element Method)" With three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***NOTE: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***

2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in it is with short term ToT Course in Employability Skills.
5. Minimum age for Instructor	21 years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES

FIRST YEAR:

1. Identify product concept, design, and development using computers to suit client requirements while adhering to safety precautions. (NOS: CSC/N9576)
2. Apply engineering drawing approaches and CAD/CAE software, create 2D drawings of simple components and perform finite element analysis viz. create and modify 2D and 3D models of the components in CAD/CAE software. (NOS: CSC/N9576)
3. Create 2D drawing of the assembly made up of individual components and perform Sheet metal design for essential assembly components. (NOS: CSC/N9576)
4. Demonstrate the FEM (Finite Element Model) capabilities of CAE (Computer Aided Engineering) SOFTWARE. (NOS: CSC/N9478)
5. Create finite element model of different components like Geometry clean-up to prepare geometry for FE modelling, concept of meshing, modelling 1D, 2D and 3D elements, creating mesh based on structures, setting element quality criteria and checking quality and updating the mesh. (NOS: CSC/N9479)
6. Prepare components for the sample analysis by applying appropriate load and boundary conditions. [Simple Analysis: - *Linear static analysis] (*NOS: CSC/N9480)
7. Read and apply engineering drawing for different application in the field of work. *(*NOS: CSC/N9401)
8. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. *(*NOS: CSC/N9402)

SECOND YEAR:

9. Analyze component by inertial relief method and by non- linear analysis. (NOS: CSC/N9483)
10. Perform modal analysis of component, brackets and assemblies and apply the concept about the mode shapes (Rigid and local body) and frequencies. (NOS: CSC/N9484)
11. Execute basic thermal analysis of simple components like plate, beam for conduction and convection in variable temperature. (NOS: CSC/N9485)
12. Perform frequency response analysis of beam and any suspension component. (NOS: CSC/N9486)

13. Perform Thermo-mechanical analysis of engine components, welded joints etc. (NOS: CSC/N9487)
14. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Identify product concept, design, and development using computers to suit client requirements while adhering to safety precautions. (NOS: CSC/N9576)	Generating idea and defining the given problem.
	Brainstorming and generating different concepts for the problem.
	Presenting the market research report for appropriate concept.
	Making a report on the business feasibility of the concept.
	Developing the product design with detailed specification, testing and analysis methods using computer aided software and finite element method approach.
	Presentation on how to launch the product.
2. Apply engineering drawing approaches and CAD/CAE software, create 2D drawings of simple components and perform finite element analysis *viz.* create and modify 2D and 3D models of the components in CAD/CAE software. (NOS: CSC/N9576)	Create sketches of the parts, 2D drawings of parts using Engineering drawing methodologies using CAD/CAE software.
	Create 3D models of the parts ensuring the dimensional accuracy.
	Create a proper model tree.
	Check for the geometric clashes and the model integrity, update as required to suit the specification.
	Perform the detailing of the design and create the various views in accordance with the prevailing standards.
3. Create 2D drawing of the assembly made up of individual components and perform Sheet metal design for essential assembly components. (NOS: CSC/N9576)	Perform the dimensioning activity for the 2D drawings and assembly.
	Create the Bill of Materials (BoM).
	Plan for the proper views ensuring capturing of all the details.
	Create assembly from individual parts and develop sheet metal design to ensure to arrive at FE method.
	Create the exploded view of the 3D model. Convert the drawing to identify the parts to update to sheet metal design.
	Edit the geometry if the geometry does not meet the correct size. Perform parametrization to update the model.
4. Demonstrate the FEM (Finite Element Model) capabilities of CAE (Computer Aided Engineering) SOFTWARE.	GUI of CAE SOFTWARE.
	Building geometric models in the CAE software.
	Familiarization with the FEM capabilities of CAE software.
	Familiarization with types of finite element modules.
	Familiarization the various types of materials, properties, and

(NOS: CSC/N9478)	elements, concept of discretization.
5. Create finite element model of different components like Geometry cleanup to prepare geometry for FE modelling, concept of meshing, modelling 1D, 2D and 3D elements, creating mesh based on structures, setting element quality criteria and checking quality and updating the mesh. (NOS: CSC/N9479)	Import the geometry of the design for the meshing. Critically assess the mode with regard to the type of meshing required.
	Modify / edit the geometry to suit the requirement of the meshing. Extract mid surfaces if the meshing needs to be by 2D elements.
	Create the mesh for the geometry by specified / exploring the meshing technique, associated the software.
	Check for free edges / free faces, element normal. If failed to meet the criteria, correct the mesh. .
	Check the element geometry check and compare it against the given specifications. Correct the geometry if required.
	Assign the appropriate material and element properties to the components of the model.
	Perform the sanity checks on the model.
6. Prepare components for the simple analysis by applying appropriate loads and boundary conditions. *[Simple Analysis: - Linear static analysis]* (NOS: CSC/N9480)	Prepare the finite element model as required or use the finite element model that has been already created.
	Explain the physical behaviour of the component.
	Based on the physical behaviour, assign appropriate boundary conditions.
	Apply the specified loads on the finite element model.
	Export the model to the solver. Run the analysis. Once the results are obtained, check the validity of the results from first principles, verify the displacement behaviour of the component, interpret the other parameters such as stress etc. Recommend a suitable change if the design is not meeting structural requirement.
7. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
8. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of	Solve different mathematical problems
	Explain concept of basic science related to the field of study

study. (NOS: CSC/N9402)	
SECOND YEAR	
9. Analyze the components by inertial relief method and by non-linear analysis. (NOS: CSC/N9483)	Import the geometry/create the geometry of the component.
	Create finite element model of the component.
	Assign the material properties to the component. Ensure to have correct nonlinear properties updated for non-Linear analysis
	Check the elemental orientation and perform mesh quality check.
	Apply loads and boundary conditions. Ensure to adopt the process of inertia relief method. For nonlinear analysis ensure to update the time steps to apply loads in interval of loads.
	Run the analysis to get the reactions.
	Review the results, forces and reactions and compare with result with the calculated results data.
10. Perform modal analysis of component, brackets and assemblies and apply the concept about the mode shapes (Rigid and local body) and frequencies. (NOS: CSC/N9484)	Import the geometry/create the geometry of the component.
	Create finite element model of the component.
	Assign the material properties to component.
	Check the elemental orientation and perform mesh quality check.
	Select the solution type to Modal analysis, requesting the rigid and local modes for the component.
	Review the results for desired modes and mode shapes and confirm the rigid and local modes as calculated and as desired.
11. Execute basic thermal analysis of simple components like plate, beam for conduction and convection in variable temperature. (NOS: CSC/N9485)	Import the geometry/create the geometry of the component.
	Create finite element model of the component.
	Assign the material properties to the component. Ensure to have the correct thermal properties in the material properties.
	Check the elemental orientation and perform mesh quality check.
	Apply loads and boundary conditions suitable for thermal analysis.
	Select the solution type to Thermal and run for results.
	Review the results and check for Temperature distribution across the component and heat flux.
12. Perform frequency response analysis of beam and any suspension component.	Import the geometry/create the geometry of the component.
	Create finite element model of the component.
	Assign the material properties for the component. Density of

(NOS: CSC/N9486)	the material is must.
	Check the elemental orientation and perform mesh quality check.
	Assign sinusoidal load at the free end of component and support at the required location.
	Select the solution type to transient analysis.
	Review the results and displacement to have proper displacement velocity, strains.
13. Perform Thermo-mechanical analysis of engine components, welded joints etc. (NOS: CSC/N9487)	Import the geometry/create the geometry of the component.
	Create finite element model of the component.
	Assign the material properties of the component. Ensure to add the thermal properties of the material.
	Convert any load in terms mechanical loads such that it can be applied as point load or pressure etc., and include temperature loads as well applied to required regions of the components.
	Select the solution type to static structural analysis.
	Review the results and displacement to have proper displacement, stress and strains and principle stresses to check the levels of stresses to be under the limit of allowable to ensure the component is safe.
14. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD) TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 60 Hrs Professional Knowledge 15 Hrs	Identify product concept, design, and development using computers to suit client requirements while adhering to safety precautions.	1. The significance of trade learning, List of tools & Machinery utilized in the trade. 2. The trainee's safety attitude is developed by instructing them how to wear Personal Protective Equipment. (PPE). 3. Introduction First Aid kit and its usage in emergency 4. Disposal of waste materials such as cotton waste, metal chips/burrs, and so on in a safe way. 5. Identifying and avoiding hazard. 6. Danger, Warning, Caution, and Personal Safety Message Signs. 7. Preventive precautions and steps to follow in the event of an electrical accident. 8. An introduction of fire extinguishers and their applicability. 9. While working on a fitting project, learn and apply safety practices. 10. Use of tools and equipment in a sensible way.	Newcomers should be given all required assistance in learning how the Industrial Training Institute system operates, including store procedures. The necessity of soft skills and the job area at the completion of the course, Safety and general measures to be taken in the industry/shop floor to be discussed. Introduction of First aid, working with electrical mains and its safety precautions, PPEs and is applicability, Response to emergencies e.g.- power failure, fire, and system failure. Introduction to 5S concept & its application (kaizen) to practice good housekeeping & shop floor maintenance. Introduction to Occupational Health& Safety: Guidelines, legislations, regulations and applicability. Knowledge of Hot working conditions, space, material,

			equipment handling.
		11. Idea generation for the given problem. 12. Brainstorming and creation of different concepts. 13. Researching the market for customer needs, growth potential and competition. 14. Do a thorough Business analysis by understanding if the product is commercially feasible. 15. Develop the product with the detailed technical specifications, analyze the product with computer aided software. 16. Testing and quality assessment. 17. Launching the product.	Introduction to product, design, development, stages of product development, design framework. Steps in design, need for testing and analysis, selection of materials. Concept generation, concept selection and concept testing, relevance of computers in the product development. Concept of load path and failure modes, introduction to Computer Aided Engineering (CAE).
Professional Skill 150 Hrs Professional Knowledge 30 Hrs	Apply engineering drawing approaches and CAD/CAE software, create 2D drawings of simple components and perform finite element analysis *viz.* create and modify 2D and 3D models of the components in CAD/CAE software.	18. Drawing of simple components using the engineering drawing skills and converting them to geometric model using sketch tools. Create: Point, Line, Circle, Polygon, Arc, Ellipse, Parabola, Spline. Basic shapes using CAD/CAE software. 19. Using Sketch learn to operations like Move, Copy, Array, mirror Chamfer, Fillet trim offset etc., tools. 20. Create basic 2D sketches of different parts using sketching and modifying tools. Create dimensioning as per the part drawing. 21. Smoothing the surface by modifying any sharp edges by using fillet and chamfer tools. 22. Learn using different 3D modelling commands,	2D sketching concepts Introduction to engineering drawing concepts, to learn point, line, plane, Projections, 2d drawings and 3d drawings Introduction to 2D Graphic User Interface of CAD/CAE software. Introduction to point, Line, different shapes, arc, ellipse, surface generation and modifying them using Trim, Offset, Fillet, Chamfer etc., Move, Copy, Array Commands. Introduction to mid-surface. 3D concept modeling Introduction to 3D Modeling graphic user interface CAD/CAE Software Introduction to user interface 3d modeling tools like pull, extrude, revolve, sweep,

		Extrude, Revolve, Sweep Loft etc., available in CAE software. 23. Learn modifying the 3D geometry by changing the dimensions and building parametric mode Editing a feature by adding ribs, mirroring, pattern generation, offsets, splitting, blending, etc., tools. 24. Draw 3D solid part by applying Sketching features. 25. Create different cross-section (I, C, H, T, tube etc., section) beam with filleted edges using sketcher and 3D commands. 26. Create different 3D solid parts of an assembly. 27. Import existing 3D model. Use the features to edit and clean-up the geometry. 28. In the assembly window perform assembly operation for the previously created 3D parts. Check for the geometric clashes and the model integrity.	offset, split, mirror, chamfer, loft, fillet, patterns (linear, circular etc.,), shell, filling tools, sectioning tools, generation of coordinate systems, blending, and other model generation tools in the CAE software. Editing the 3D model using modifying tool and converting it to parametric model to modify model as per requirement. Use of Features like ribs, mirror, offsets thickening, 3D viewing styles. Introduction to mid-surface. Material selection and assignment Importing CAD model and carrying out clean up using tools like disfeaturing, split, stitching, smoothing surfaces etc., to prepare model for finite element analysis
Professional Skill 180 Hrs Professional Knowledge 45 Hrs	Create 2D drawing of the assembly made up of individual components and perform sheet metal design for essential assembly components.	29. In the drafting window, create the 2D drawing by importing the assembly into the assembly window Plan for the proper views generation, perform design detailing, indicate all dimensions (length, width, angle), Create different cross- section views, exploded views. Bill of Material. 30. Perform sheet metal design of required parts of assembly and plan for FE modelling of such	Assembly Importing, Design detailing, 2-D Drawings, BOM, Exploded Views. Design of sheet metal parts, Geometric Parameterization Sheet Metal Design to decide the features to be used during finite element analysis.

		components. 31. Geometry editing of simple general components. 32. Drafting of machine tool assembly.	
Professional Skill 90 Hrs Professional Knowledge 15 Hrs	Demonstrate the FEM (Finite Element Model) capabilities of CAE (Computer Aided Engineering) SOFTWARE.	33. Demonstrate the CAD and FEM capabilities of CAE software (Simple cantilever beam analysis or show short videos explaining the capabilities of the software). 34. Familiarization of GUI of CAE SOFTWARE, building geometric models using Lines, points, translation, rotation, reflection etc., tools. 35. Different types of elements, 1D (Rod, beam), 2D (Shell), 3D elements (Hexa, Tetra), spring, Mass, Rigid Link. 36. Working with FE mesh using commands Translation, Rotation, Symmetry, Extrude, Scale, Sweep. 37. Materials models (Isotropic, Orthotropic), Loading and Boundary Conditions (Single Point and Multi point Constraints, Nodal forces and moments). 38. Element quality checking for connectivity, duplicates, aspect ratio, skew, warpage. 39. Familiarization with the different properties and types of inbuilt materials in library and different boundary condition options.	Introduction to engineering problems, methods to solve engineering problems, introduction to matrix theory, introduction finite element method, steps in FEM. Familiarization of GUI of CAE Software, Familiarization with geometry, finite element modules, Familiarization with the various types of materials, properties, and elements, concept of discretization.
Professional Skill 190 Hrs Professional Knowledge 50 Hrs	Create finite element model of different components like Geometry cleanup to prepare	40. Create a finite element model of cantilever beam. Create geometry using points and lines command Perform meshing with Beam/Bar element and erase	Introduction to the concept of meshing. Selection of type of the mesh /element based on the structure.

	geometry for FE modeling, concept of meshing, modelling 1D, 2D and 3D elements, creating mesh based on structures, setting element quality criteria and checking quality and updating the mesh.	the curve/geometry Select material as Isotropic and select the appropriate cross section (I-section / Rectangle/Circle). 41. FE modelling of truss structure. 42. 2D Meshing and analysis of electrical support bracket Import the geometry of the design for the meshing. Critically assess the model with regard to the type of meshing required. Modify / edit the geometry to suit the requirement of the meshing. Extract mid surfaces Create the mesh (shell) for the geometry by specified / exploring the meshing technique, associated the software. Check for free edges / free faces, element normal. If failed meet the criteria, correct the mesh. Check the element geometry check and compare it against the given specifications. Correct the geometry if required. 43. Assign the appropriate material and element properties to the components of the model. 44. 3D meshing of flywheel using tetrahedral element. Import geometry and check for discontinuities and correct the geometry. Select Tetra elements and select Auto-mesh to generate the mesh. Check element quality, if required re-mesh the model by controlling the mesh size in the failed	Importing the geometry, cleaning up the geometry for the meshing. Creating the mesh using 1D, 2D, and 3D elements, editing / modifying the mesh to meet the requirements. Geometric quality parameters, apply the correct material and properties, checking the integrity and sanity of the mesh. Introduction to the various types of available 3D elements (Hexa, Tetra, Penta) in the FEA software.

		location. Assign the material properties and element properties. 45. 3D meshing of typical lug fitting. 46. FE modelling of automotive chassis frame.	
Professional Skill 170 Hrs Professional Knowledge 40 Hrs	Prepare components for the simple analysis by applying appropriate loads and boundary conditions. [Simple Analysis: - Linear static analysis]	47. Find out the deflection, stress, strain, shear force and bending moment diagram of cantilever beam. Import the finite element model of the cantilever beam from the previous steps of meshing. Assign appropriate loading (point load/ pressure) and boundary condition (constrain one of the end node for all 6 DOFs to depict cantilever beam). Run the static stress analysis. Perform post processing activities by plotting Deflection, Stress, Strain, bending moment diagram. 48. Perform linear static analysis of Plate with hole. 49. Perform linear static analysis of typical lug. 50. Perform static analysis of bracket 51. Perform linear static analysis of automotive chassis frame.	Apply the appropriate loads and boundary conditions. Prepare the FE model for the analysis, submit the FE model to the solver. Checking the correctness of the analysis, post processing of results, result interpretation of the analysis.
ENGINEERING DRAWING: 30 Hrs.			
Professional Knowledge; ED- 30 hrs	Read and apply engineering drawing for different application in the field of work.)	Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free	

		hand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definition and difference) Reading of Job drawing of related trades.
WORKSHOP CALCULATION & SCIENCE: 15 Hrs.		
Professional Knowledge; WCS -15 hrs	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Unit, Fractions** • Classification of unit system • Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units • Measurement units and conversion • Factors, HCF, LCM and problems • Fractions - Addition, substraction, multiplication & division • Decimal fractions - Addition, subtraction, multiplication & division • Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** • Square and square root • Simple problems using calculator • Applications of Pythagoras theorem and related problems • Ratio and proportion • Ratio and proportion - Direct and indirect proportions • Percentage • Percentage - Changing percentage to decimal and fraction **Mass, Weight, Volume and Density** • Mass, volume, density, weight and specific gravity **Mensuration** • Area and perimeter of square, rectangle and parallelogram • Area and perimeter of Triangles • Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse • Surface area and volume of solids - cube, cuboid, cylinder,

		sphere and hollow cylinder • Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Trigonometry** • Measurement of angles • Trigonometrical ratios • Trigonometrical tables
In-plant training/ Project work **Broad area:** a) Visit industry and learn the advanced way of doing the analysis. b) Project work involving 3D modelling in the live industry components such as simple gear, connecting rod, piston or any other components etc., with QC reports with focus on functional prototypes.		

SYLLABUS FOR VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD) TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 170 Hrs Professional Knowledge 40 Hrs	Analyze component by inertial relief method and by non- linear analysis.	52. Gather geometric details of the component using the detailed drawing such as dimensions, shapes, legacy data etc. 53. Create the geometry using the curve surface, extrude, revolve, fillets champers etc., tools from software. 54. Assign the cross sectional details of the component wherever necessary and clean up the model to carry out the finite element model. 55. Gather the physical and material properties of the component. 56. Create the finite element model of the component and assign the applicable material and physical properties. 57. Check the elemental orientation, normal, free edges, and elemental quality check. 58. Apply the loads and consider the inertial relief instead of constrains from the solver package. 59. Request the results as deflection, stresses and strains etc. as desired. 60. Run the analysis to get the reactions. 61. Review the results, forces	Advanced structural Analysis Introduction to element such as mass element, rigid elements, spring element. introduction to linear static analysis using inertial loads Introduction to inertial relief method and analyzing the component using inertial relief method (static analysis). Introduction to concept of non-linearity. Geometric, material and topology non linearity.

		and reactions must be 0 and compare with result with the calculated results data. 62. For non-linear analysis, add non- linear material instead of the standard material. 63. The analysis steps are increased by adding steps and add time steps. Large deflection is switched on. For non-linearity check.	
Professional Skill 150 Hrs Professional Knowledge 45 Hrs	Perform modal analysis of component, brackets and assemblies and apply the concept about the mode shapes (rigid and local body) and frequencies.	64. Gather geometric details of the components. Such as length, width, height, cross sectional details and detailed drawing of component under test (bracket, angles, simple assemblies and any other components). 65. Create the detailed geometry of the component using the geometric details and geometric tool like lines surface, extrude, fillets, champers etc. 66. Create the finite element model of the component using geometric details using 1d and 2D elements for surface panels and 3D elements for solids and establish connection at the required junctions. 67. Collect the material properties and strength properties of the material used for the component. Density of the material is must. 68. Assign the material properties to finite element model of the component. 69. Collect the physical properties of component	Why modal analysis and need for modal analysis Concept of natural frequency and equation of natural frequency Concept of mass and stiffness in the calculation of natural frequencies. Concept of resonance and methods to arrest resonance. Concept of rigid body modes and mode shapes occurring in the component. Difference between rigid body modes and local modes and its mode shapes.

		such as thickness. 70. Assign the physical properties to the finite element model. 71. Check the elemental orientation and normal, free edges, and elemental quality check. 72. Select the solution type to Modal analysis. Requesting the rigid and local modes (at least 10 mode shapes) for the component. 73. Review the results and compare with test data available. The first 6 most to be rigid body modes i.e., deflection in translation and rotation w.r.t. axes and natural frequencies less than 0 hurts. Local modes natural frequencies to be more than 0 hurts.	
Professional Skill 260 Hrs Professional Knowledge 70 Hrs	Execute basic thermal analysis of Simple components like plate, beam for conduction and convection in variable temperature.	74. Gather geometric details of the components by detailed drawing of component under test (plate, beam, angles and other simple components). 75. Create the detailed geometry or import the geometry if readily available. Perform geometry cleanup. 76. Create the finite element model of the component using geometric details using 1d and 2D and 3D elements and establish connection at the required junctions. 77. Collect the material properties and strength properties of the material used for the component.	Heat transfer Heat transfer analysis, its requirements significance and its types i.e., conduction, convection and radiation Symbols and mathematical, Expressions for conduction, Convection and radiation. Basic requirements for heat transfer analysis such as temperature, heat flux, heat flow, temperature gradient and its application on to the component such as nodal, on surface etc. Material data collection and physical data collection to check the condition of heat transfer. Study the output of the analysis such as heat flux and temperature distribution etc.

		Density, thermal coefficient of expansion is must. Collect the physical properties for FE modelling. 78. Assign the material properties and physical properties to finite element model of the component. 79. Check the elemental orientation and normal, free edges and elemental quality check. 80. Assign boundary condition and loads such as initial temperature and final temperature. Requesting the heat flux and temperature distribution. 81. Select the solution as Thermal analysis and run for results. 82. Review the results and check for Temperature distribution across the component and heat flux.	
Professional Skill 130 Hrs Professional Knowledge 35 Hrs	Perform frequency response analysis of beam and any suspension components.	83. Gather geometric details of the components. Such as length, width, height, cross sectional details and detailed drawing of component under test. 84. Create the detailed geometry of the component using the geometric details and geometric tool like lines surface, extrude, fillets, champers etc. 85. Create the finite element model of the component using geometric details using 1d and 2D elements for surface panels and 3D elements for solids and establish connection at the required junctions.	Advanced Analysis Introduction to dynamic loading. Introduction to dynamic stiffness Introduction to frequency response analysis, input as sinusoidal frequencies. Introduction to time dependent loading such as sinusoidal load, impulse load.

		86. Collect the material properties and strength properties of the material used for the component. Density of the material is must. Assign the material properties to finite element model of the component. 87. Collect the physical properties of component such as thickness. Assign the physical properties to the finite element model. 88. Check the elemental orientation and normal, free edges, and elemental quality check. 89. Assign sinusoidal load at the free end of component using the parametric equation and support at desired location depending on model with required boundary condition. 90. Select the solution type to transient analysis. Update time steps and end time as load step and request the displacement, velocity and strains. Run the model. 91. Review the results and displacement to have proper displacement velocity, strains etc.	
Professional Skill 130 Hrs Professional Knowledge 35 Hrs	Perform Thermo-mechanical analysis of engine components, welded joints etc.	Thermo-mechanical analysis 92. Gather geometric details of the components. Such as length, width, height, cross sectional details and detailed drawing of component under test (engine component, welded joints, component exposed to thermal loads). 93. Create the detailed	Introduction to Thermo-mechanical analysis. Any Loading type is converted applied on the component as a mechanical load along with and thermal loads and analyzed.

		geometry of the component using the geometric details and geometric tool like lines surface, extrude, fillets, champers etc. 94. Create the finite element model of the component using geometric details using 1d and 2D elements for surface panels and 3D elements for solids and establish connection at the required junctions. 95. Collect the material properties and strength properties of the material used for the component. Density of the material is must. Assign the material properties to finite element model of the component. 96. Collect the physical properties of component such as thickness. Assign the physical properties to the finite element model. 97. Check the elemental orientation and normal, free edges, and elemental quality check. 98. Convert any load in terms mechanical loads such that it can applied as point load or pressure etc., and include temperature loads as well. 99. Select the solution type to static analysis and request the displacement, velocity and strains. Run the model. 100. Review the results and displacement to have proper displacement velocity, strains etc.	
ENGINEERING DRAWING: 45 Hrs.			

Professional Knowledge ED- 45 Hrs.	Read and apply engineering drawing for different application in the field of work.	• Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints • Reading of drawing of pipes and pipe joints • Reading of Job Drawing, Sectional View & Assembly view
WORKSHOP CALCULATION & SCIENCE: 30 Hrs.		
Professional Knowledge WCS- 30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Friction** - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing**.**

Project work / Industrial visit

Broad areas:

a) Visit to industry to have a greater knowledge of how the analysis is performed on the actual components and get to know the processes of developing actual analysis types & do work on the similar components.
b) Based on the analysis performed drawing conclusion to recommend design updates if any.
c) Know more about writing technical documentation.

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs + 60 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in / dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
VIRTUAL ANALYSIS AND DESIGNER FEM (FINITE ELEMENT METHOD) (for batch of 24 candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. GENERAL MACHINERY / SOFTWARE INSTALLATIONS			
1.	UPS (Common to other trades)	3 KVA With Battery & Trolley	1 No.
2.	Industrial Workstation (Common to other trades)	32 GB RAM, NVIDIA Qdr 4GB, Intel XeonW-2123 3.6 4C, 1TB HDD, USB Keyboard & USB Optical Mouse	20 Nos.
3.	Monitor (Common to other trades)	IPS Display, Narrow Bezel	20 Nos.
4.	Server with rack (Common to other trades)	Intel Xeon Silver 4114 2.2G, 10C/20T, 9.6GT/s, 14M Cache, Turbo, HT (85W) DDR4-2400, 600GB x 5nos. 10K RPM SAS, 12Gbps 512n 2.5in Hot plug Hard Drive	1 No.
5.	CAD/ CAE SOFTWARE - ANSYS	CAD Static Structural Analysis, Modal Analysis, Topology Optimization, Topology Optimization, Steady State Thermal, Transient Thermal, Conduction, Convection	20 Nos.

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members participated for finalizing the course curriculum of Virtual Analysis and Designer FEM (Finite Element Method) trade			
S No.	**Name & Designation Shri/Mr./Ms.**	**Organization**	**Remarks**
1.	Ajoy Bhagat, Jt. Director	RDSDE, Chennai	Chairman
2.	P. Govindraj, AD	NSTI, Chennai	Coordinator
3.	M.J. Vijaya Raju, AD	CSTARI, Kolkata	Member
4.	KVS Narayana, TO	CSTARI, Kolkata	Member
5.	Satheeshkumar N, AD	Govt. ITI, Bodi	Industry Expert
6.	W. Jamson, JTO	Govt. ITI, Dindigul	Industry Expert
7.	M. Raja, ATO	Govt. ITI, Sivagangai	Industry Expert
8.	V. Muthusamy,	Govt. ITI, Nagercoil	Industry Expert
9.	Pradeep S, Sr. Engineer	TATA Technologies	Industry Expert
10.	Venkatakrishnan, PRL/AD	Govt. ITI Gundalam	Industry Expert
11.	Dr. Ishtiaq Khan, Program Director	TATA Technologies	Industry Expert
12.	Prashant Handigund, Program Director	TATA Technologies	Industry Expert
13.	G. Rajan, Sr. D'man	NSTI, Chennai	Industry Expert
14.	M. Ganaesh, VI	NSTI, Chennai	Industry Expert

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्