FOUNDRYMAN

NSQF LEVEL – 4

SECTOR- CAPITAL GOODS & MANUFACTURING

COMPETENCY BASED CURRICULUM
CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

GOVERNMENT OF INDIA
Ministry of Skill Development & Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City, Kolkata – 700091

FOUNDRYMAN

(Engineering Trade)

SECTOR – CAPITAL GOODS & MANUFACTURING

(Revised in 2024)

Version 2.1

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Developed By

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1. COURSE OVERVIEW

The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency-based course for instructors of one-year duration. “Foundryman” CITS trade is applicable for Instructors of “Foundryman” CTS Trades.

The main objective of Craft Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus, promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

2. TRAINING SYSTEM

2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal http://www.nimionlineadmission.in. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

2.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year:

S No.	Course Element	Notional Training Hours
1.	**Trade Technology**	
	Professional Skill (Trade Practical)	480
	Professional Knowledge (Trade Theory)	270
2.	**Training Methodology**	
	TM Practical	270
	TM Theory	180
	Total	**1200**

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

3	On the Job Training (OJT)/ Group Project	150
4	Optional Course	240

Trainees can also opt for optional courses of 240 hours duration.

2.3 PROGRESSION PATHWAYS

- Can join as an Instructor in a vocational training Institute/ technical Institute.
- Can join as a supervisor in Industries.

2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. 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 Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment**.** The external examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS CRITERIA

Allotment of Marks among the subjects for Examination:
The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%.There will be no Grace marks.

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 the assessment. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary
- Assessment Sheet
- Progress chart
- Video Recording

- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

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

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an ***acceptable standard*** of crafts instructorship with ***occasional*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***fairly good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Average engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Occasional support in imparting effective training.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***reasonable standard*** of crafts instructorship with ***little*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Little support in imparting effective training.
(c) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***high standard*** of crafts instructorship with	• Demonstration of ***high*** skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Good engagement of students for learning and achievement of goals while undertaking

minimal or no support and engage students by demonstrating good attributes of a trainer.	the training on specific topic. • A high level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Minimal or no support in imparting effective training.

3. GENERAL INFORMATION

Name of the Trade	**FOUNDRYMAN-CITS**
Trade Code	**DGT/4028**
Reference NCO 2015	2356.0100, 7211.0100, 8121.4200, 8121.4600, 8121.4700, 7211.0201
NOS Covered	ISC/N9406, ISC/N9407, ISC/N9408, ISC/N9409, ISC/N9410, ISC/N9411, ISC/N9412, ISC/N9413, ISC/N9414, ISC/N9415, ISC/N9416, ISC/N9491, ASC/N9410, ASC/N9411
NSQF Level	Level- 4
Duration of Craft Instructor Training	One Year
Unit Strength (No. Of Student)	25
Entry Qualification	Degree in Mechanical/ Metallurgy/ Production Engineering/ Advanced Diploma in Foundry Technology from AICTE/UGC recognized Engineering College/ university. OR 03 years Diploma in Mechanical/ Metallurgy/ Production Engineering after class 10th from AICTE/ recognized board of technical education. OR Ex-serviceman from Indian Armed Forces with 15 years of service in related field as per equivalency through DGR. OR 10th Class with 01 year NTC/NAC passed in the trade of "Foundryman".
Minimum Age	16 years as on first day of academic session.
Space Norms	120 Sq. m
Power Norms	11 KW
Instructors Qualification for	
1. FOUNDRYMAN - CITS Trade	B.Voc./Degree in Mechanical/ Metallurgy/ Production Engineering/ Advanced Diploma in Foundry Technology from AICTE/UGC recognized University with two years' experience in relevant field. OR 03 years Diploma in Mechanical/ Metallurgy/ Production Engineering from AICTE/ recognized Board/ University with five years' experience in relevant field. OR Ex-serviceman from Indian Armed Forces with 15 years of service in related field as per equivalency through DGR. Candidate should have undergone methods of Instruction of course or minimum 02 years of experience in technical training institute of Indian Armed Forces. OR NTC/ NAC passed in Foundryman trade with seven years' experience in relevant field.

	Essential Qualification: Relevant National Craft Instructor Certificate (NCIC) in Foundryman trade or in any of the variants under DGT.
2. Workshop Calculation & Science	B.Voc./Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years' experience in relevant field. OR 03 years Diploma in any Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years' experience in relevant field. OR NTC/ NAC in any Engineering trade with seven years' experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. **OR** 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 two years' experience in relevant field. OR 03 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years' experience in the relevant field. OR NTC/ NAC in any one of the 'Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with seven years' experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. **OR** NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Training Methodology	B.Voc./Degree in any discipline from AICTE/ UGC recognized College/ university with two years experience in training/ teaching field. OR Diploma in any discipline from recognized board / University with five years experience in training/teaching field. OR NTC/ NAC passed in any trade with seven years experience in training/ teaching field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in any of the variants under DGT / B.Ed /ToT from NITTTR or equivalent.
5. Minimum age for Instructor	21 years

4. JOB ROLE

Brief description of job roles:

Manual Training Teacher/Craft Instructor; Instructs students in ITIs/Vocational Training Institutes in respective trades. Imparts theoretical instructions for the use of tools, mechanical drawings, blueprint reading and related subjects. Demonstrates processes and operations in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment & tools in stores.

Moulder, General prepares mould from foundry sand using pattern for casting metal parts. Places pattern on mould plate (Wooden plate with arrangements to hold pattern). Makes mould in two halves (top and bottom) by ramming foundry sand around the pattern. Removes pattern carefully and mends two halves of mould by trowel and smoothers. Makes vent holes by wire for escape of gas and other holes on top box for pouring metal into mould and for escape of excess molten metal (runners and risers). Fixes dried cores in proper position to have designed holes in casting. May prepare bottom half of mould in floor instead of in bottom box. May dry moulds by fire in case of heavy castings. May do additions and alternations in mould from drawing, using foot rule, knife and trowel. May be known as PIPE MOULDER if engaged in pipe moulding.

Die Casting Machine Operator operates die-casting machine to make zinc, aluminium and alloy castings for gears, carburettor bodies, machinery parts, equipment, etc. Charges furnace with slabs of metal and adds specified quantity of alloy. Transfers molten alloy to heated reservoir of machine with crane or hand ladle. Removes metal fragments from die surfaces and brushes cavities with compound to prevent casting from adhering to die. Regulates valves to heat furnace, circulate water through die and to force hot metal in to die. Move levers to open and close to halves of water-cooled die. Hooks completed casting from die with steel wire and cools it in water.

Core Maker, Machine makes cores, using machine, for placing in mould to have designed holes in metal castings. Selects die and spiral conveyor screw and fastens them to machine. Mixes sand and binding material and packs mixture into feed box of machine. Starts motor or turns crank by hand to rotate screw and to take mixture from box and press it through die to form core. Cuts off core as required, repairs damaged surfaces and passes it on for baking or drying in oven or heated chambers. May perform some tasks involved in making cores by hand.

Annealer, Metal anneals (softens) metals by heating and cooling, for easy machining, rolling, bending, etc., and for relieving internal stresses caused by working or by unequal contraction in casting. Starts furnace and heats material in it up to required temperature for specified time depending upon type and size of material. Stops furnace and allows material to cool down inside it. Anneals copper by heating and immediately quenching in water. May do pack annealing by putting material in sealed box and by heating and cooling it in furnace. May cool material in sand, lime or ash if working on open furnace. May be designated as NORMALISER, if engaged in normalizing (removing stresses) fatigued metal parts by process of repeated heating and cooling in air.

Casting Technician-Sand Moulding manages the specifications of the sand and molten metal, setting up and operating the casting equipment and forming and finishing the final output.

Reference NCO-2015:

i) 2356.0100 - Manual Training Teacher/Craft Instructor.
ii) 7211.0100 - Moulder, General
iii) 8121.4200 - Die Casting Machine Operator
iv) 8121.4600 - Core Maker, Machine
v) 8121.4700 - Annealer, Metal
vi) 7211.0201 - Casting Technician, Sand Moulding - Casting Supervisor

Reference NOS:

i) ISC/N9406
ii) ISC/N9407
iii) ISC/N9408
iv) ISC/N9409
v) ISC/N9410
vi) ISC/N9411
vii) ISC/N9412
viii) ISC/N9413
ix) ISC/N9414
x) ISC/N9415
xi) ISC/N9416
xii) ISC/N9491
xiii) ASC/N9410
xiv) ASC/N9411

5. LEARNING OUTCOMES

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

5.1 TRADE TECHNOLOGY

1. Demonstrate workshop safety measures and different types of tools, equipment & raw material used in foundry. (NOS: ISC/N9406)
2. Monitor different patterns, allowances of pattern, colouring & core made and repair defective pattern and boxes. (NOS: ISC/N9407)
3. Evaluate Sand tempering for different types of mould making. (NOS: ISC/9408)
4. Assess different casting components by different metal with different moulding process. (NOS: ISC/9409)
5. Demonstrate heat treatment operations. (NOS: ISC/N9410)
6. Evaluate metal working such as marking, sawing, filling, grinding, drilling, charging of cupola etc. (NOS: ISC/N9411)
7. Plan and prepare Die casting machine to produce casting, moulds by moulding process, make cast iron castings and check defects. (NOS: ISC/N9412)
8. Evaluate casting, fettle of casting & calculation of yield percentage. (NOS: ISC/N9413)
9. Demonstrate complete core by joining half cores and mould by various types of gate to produce different types of metal casting. (NOS: ISC/N9414)
10. Evaluate extra thick casting & finish it, reline & prepare different types of furnaces for melting cast metals and make Core using linseed oil & IVP oils. (NOS: ISC/N9415)
11. Assess mould made without pattern & with sweep pattern and casting by investment casting process & binder less process. (NOS: ISC/N9416)
12. Explain dust problem in Foundry Shop adhering to TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system. (NOS: ISC/N9491)
13. Read and apply engineering drawing for different application in the field of work. (NOS: ASC/N9410)
14. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: ASC/N9411)

6. COURSE CONTENT

SYLLABUS FOR FOUNDRYMAN - CITS TRADE			
TRADE TECHNOLOGY			
Duration	**Reference Learning Outcome**	**Trade Practical**	**Trade Theory**
Practical 53 Hrs Theory 22 Hrs	Demonstrate workshop safety measures and different types of tools, equipment & raw material used in foundry.	**Occupational Safety & Health** **Importance of housekeeping & good shop floor practices.** Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipment's (PPE). Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Use of Fire extinguishers **Technical English.** Prepare different types of documentation as per industrial need by different methods of recording information. **Basic Life support training: -** Be able to perform DRSABCD: D: Check for Danger R: Check for a Response S: Send for help A: Open the Airway B: Check for normal Breathing C: Perform CPR (Cardio Pulmonary Resuscitation) D: Attach Defibrillator / Monitor as soon as available. Importance of trade training. Machinery used in the trade	Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure **Soft Skills:** its importance and Job area after completion of training. **Introduction to 5S** concept & its application. Importance of 5S implementation throughout CITS course-workplace cleaning, machine cleaning, signage, proper storage of equipment etc. **Importance of Technical English** terms used in industry -(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards. **Basic Life support (BLS): -** Basic Life Support (BLS) techniques for drowning, choking, electrocution, neck and spinal injury, including CPR (cardiopulmonary resuscitation). Safety Precaution to be Followed While Under gone Through Various foundry operations. Foundry materials: Classification, Application,

		as well as Industries. Demonstrate open sand mold by trammeling method, Apply facing & backing sand for C.I casting. Demonstrate closed mold with Green molding sand, Melting of Al. Alloys in Crucible furnace and pouring the same in to the molds. Carry all types of sand tests. Demonstrate mold with different Joints (plain, Build up, Cutting, Floating). Demonstrate mold with Top Run gating system.	& I.S.I Specification for all Raw Materials used in Foundry. Refractory sand, Refractories, Binder, Fuels, Fluxes, Facing materials, Parting agents. Engineering metals. Classification of Metals. (Ferrous, Non-Ferrous & Its Alloys. Ore to Metal Mfg. Of Ferrous Metals, Properties, Application I.S.I Specification. Effects Of elements normally Presents in Ferrous Metals. Effects of alloying elements in Cast Iron alloys and Steel Alloys.
Practical 53 Hrs Theory 22 Hrs	Monitor different patterns, allowances of pattern, colouring & core made and repair defective pattern and boxes.	Monitor mold with odd side pattern, mould with setting of Vertical core and Horizontal cores in a mold. Demonstrate mold with balanced core & Hanging Core, setting with Chaplet into a mold, along with suitable gating system.	Gating system: Introduction, Parts & Function, Types, Pre-Requisites, Ferro static Pressure. Pattern materials, types of pattern, colouring of pattern allowances, maintenances of patterns and types of core. Fettling: Fettle the all types of Casting, Mould Shake out-removal of runner & Riser, Surface cleaning, Finishing &Trimming. Inspection of Casting: Destructive and Non-Destructive methods, Casting Defects: Internal & External Defects. Salvaging of Castings: Foundry method, By welding methods.
Practical 42 Hrs	Evaluate Sand tempering for different types of mould making.	Evaluate mold with Bottom Run gating System. Demonstrate mold with	Molding Sand & core sand. Composition, Types, Ingredients, additives.

Theory 18Hrs		Parting Line run gating system. Evaluate sand tempering, different types of mould making by using appropriate hand tools. Mould with parting line gate, top gate and bottom gate. Evaluate different types of Core by using different types of Core Boxes and making of core by different types of Core Binder and also baking then in Oven and other Methods.	Properties of sand. Sand reclamation and Sand Preparation.
Practical 42Hrs Theory 18Hrs	Assess different casting components by different metal with different moulding process.	Demonstrate mold with core; by using of self cored pattern and split pattern having Horizontal & Vertical Core print. Demonstrate core sand, preparation of core, Reinforcement and Venting of core. Backing & Baking of core, trimming of core & dressing of core.	Design of casting Introduction Sand casting, Pattern: Types, materials, Allowance, Color coding, Care & maintenance. Core Boxes: Types, Materials, coloring. Core: Classification of core. Venting & Reinforcing, Backing & Baking of core.
Practical 20Hrs Theory 10Hrs	Demonstrate heat treatment operations.	Evaluate heat treatment in different metals and its alloy.	Introduction of heat treatment. Different type of heat treatment. Heat Treatment in different metals and its alloy. Difference type of heat chamber
Practical 53Hrs Theory 22Hrs	Evaluate metal working such as marking, sawing, filling, grinding, drilling, charging of cupola etc.	Evaluate Mold with Chill or Denseners, setting the core into a mold, along with suitable gating system (use chill, denseners, Exo- thermic materials). Demonstrate induction furnace for charging, demonstrate charges for charging, operate and melt aluminium/ magnesium and pour aluminium/ magnesium into the mould and identify	Different type of coolant. Iron-carbon diagram, TTT, CCT diagram. Furnace. Brief Information about the Construction, operation, Maintenance of Melting Furnace (Solid-Liquid-Gas-Electrical Fuel). I. Cast Iron Melting- Cupola, Rotary Furnace, Electrical Arc Furnace.

		defects. Evaluate Furnace operation. Relining and Patching of Tilting / Pit furnace, demonstrate Ladle lining by Fire clay mixture and Carbon Die oxide sand.	II. Steel Melting- Electric Arc & Induction Furnace - Types, construction, operation, and maintenance, Converter. II. Non-ferrous metal melting. Crucible Furnace, Pot furnace, Reverberatory furnace, Rotary furnace, Induction furnace Charging the Metals & Chemical analysis. Measure Molten Metal Temperature by Using Of Pyrometers: Introduction, Necessity, Thermocouple, Pyrometer, Optical Pyrometer, Radiation Pyrometer, Infrared Thermograph Cupola construction, operation zones in cupola. Lining of cupola. Cupola specification.
Practical 20Hrs Theory 10Hrs	Plan and prepare Die casting machine to produce casting, moulds by different moulding process, make cast iron castings and check defects.	Demonstrate Core by Preparation of mold by molding Machine. Hand molding machine & use of Special tools. Core Shooters.	Brief Information about Modern /All types of Moulding and Core Making Machines. Molding Machines, Introduction, Functions, Advantages, Disadvantages, Types. Core Making Machines, Introduction, Functions, Advantages, Disadvantages, Types.
Practical 42Hrs Theory 18Hrs	Evaluate casting, fettle of casting & calculation of yield percentage.	Demonstrate mold with Stack molding methods. Evaluate Special mold by Full mold process. Use of expanded polystyrene / Thermo Cole pattern.	Special Casting Process: Detailed information about the Special Casting Process. Including all types of DIE Casting. Introduction-Classification-Advantages-Disadvantages - Application. (Metal Mould Casting, Gravity Die casting, Pressure Die Casting, Centrifugal casting, Slush casting) Non-Metal Mould casting.

			Carbon dioxide molding, Shell Molding, Lost Wax Process, Plaster Mould, Binder less dry sand process. Etc. Detailed Information about Lay-out of different Foundries. Foundry Mechanization, Construction, Merit of Modernization, Application. (Materials Handling Equipment-Industrial Trucks- Cranes- Hoists- Conveyors- Slides and Chutes -Tractors and Trailers-Robots).
Practical 95 Hrs Theory 40Hrs	Demonstrate complete core by joining half cores and mould by various types of gate to produce different types of metal casting.	Demonstrate mold and core by air setting binders. Demonstrate mold and core flask less system, No-bake system. Demonstrate mould & core by Carbon Die oxide Process. Demonstrate mold & core by Shell molding Process. Demonstrate mold with Special molding Process like INVESTMENT CASTING process.	Introduction to Inspection and Testing Procedures - Visual Inspection, Dimensional Inspection, Examination of Surface. Sound Test, Pressure Testing \ Leak Testing, Testing Of Mechanical Properties: Tensile Testing Hardness Testing The brinell Test or The Rockwell Test, Fracture Test, Impact Test, Creep Testing. Heat-Treated all Types of Metal Casting and Salvaging of Metallurgical Problems NON- DESTRUCTIVE TEST: Introduction, Radiography, (X-ray & y- ray) Magnetic Particle Inspection, Fluorescent -Penetrate Inspection. Ultrasonic Inspection. SOME ADVANCEMENTS IN INSPECTION AND TESTING Instrumented Impact Testing, Thermal Inspection, X-Ray Diffraction Analysis, Materials Characterization Automation of Surface

			Defect Detection, Image Analysis, Industrial Computed Tomography, Computerized Testing.
Practical 20Hrs Theory 10Hrs	Evaluate extra thick casting & finish it, reline & prepare different types of furnaces for melting cast metals and make Core using linseed oil & IVP oils.	Demonstrate a solid casting & Hollow Casting by using of Gravity Die casting Machine.	THE USE OF STATISTICAL METHODS IN QUALITY CONTROL OF CASTING. (a)Sampling Inspection, (b)Control Charts. Design of new casting Software package for the design and production of casting. Program Structure the knowledge-base-Parting line analysis Feeder head design Gating design-Pattern plate layout concluding.
Practical 20Hrs Theory 10Hrs	Assess mould made without pattern & with sweep pattern and casting by investment casting process & binder less process.	Assess preparation of a Solid Casting & Hollow casting by using of Pressure Die Casting Machine. Fore Moulding.	Energy Conservation and Environment Control. Energy conservation in Melting, & Casting, Heat-Treatment. Energy saving, Environmental pollution in foundries and its control. Cost and Estimation of Casting. Casting weight calculation
Practical 20Hrs Theory 10Hrs	Explain dust problem in Foundry Shop adhering to TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system.	Explain preparation of Casting by Centrifugal casting Machine.	QUALITY CONTRAL IN FOUNDRIES: Introduction, Quality Control In Pattern And Mold Making, QUALITY Control In Melting, Quality Control in Heat-treatment, Quality Control in Fettling and Cleaning, Quality Control in Final Inspection, Dust control in foundries.
Engineering Drawing: 30 Hrs.			
Professional Knowledge ED- 30 Hrs.	Read and apply engineering drawing for different application in the field of work.	**CIRCLES, TANGENTS AND ELLIPSE:** Practical applications procedure for constructing tangent to given circle-lines-loop pattern-- tangential circles- external tangents- internal tangents ellipse **PARABOLIC CURVES, HYPERBOLA:** Involutes - Properties and their application. Procedure for constructing parabolic curve-hyperbolic curve-in volute curve. epicycloids, hypocycloid, Involutes, spiral & Archimedes spiral	

		TECHNICAL DRAWING/ SKETCHING OF COMPONENTS' **PARTS:** Views of object Importance of technical sketching- types of sketches-Isometric drawing sketching- Oblique drawing sketching. **PROJECTIONS**: Theory of projections (Elaborate theoretical instructions), Reference planes, orthographic projections concept 1st Angle and 3rd Angle, Projections of points, Projections of Lines–determination of true lengths & inclinations. Projections of plane, determination of true shape. Exercises on missing surfaces and views. Orthographic drawing or interpretation of views. Introduction to first angle projections of solids. **ISOMETRIC VIEWS**: Fundamentals of isometric projections (Theoretical Projections) Isometric views from 2 to 3 given orthographic views. Preparation of simple working drawing of Furniture items like table, stool and any job prepared in the workshop. **SECTIONAL VIEWS:** Importance and salient features, Methods of representing sections, conventional sections of various materials, classification of sections, conventional in sectioning. Drawing of full section, half section, partial or broken out sections, offset sections, revolved sections and removed sections. Drawing of different conventions for materials in section, conventional breaks for shafts, pipes, Rectangular, square angle, channel, rolled sections. Exercises on sectional views of different objects. - **DEVELOPMENT AND INTERSECTIONS:** Development of surfaces-Types of surface- Methods of development- Intersection- Methods of drawing intersection lines-critical point or key point. **FASTENERS**: Sketches of elements of screw threads, Sketches of studs, cap screws machine screws, set screws, Locking devices, bolts, Hexagonal & square nuts & nut bolt & washer assembly. Sketches of plain spring lock, toothed lock, washers, cap nut, check nut, slotted nut, cassel nut, sawn nut, wing nut, eye blot, tee bolt & foundation bolt. Sketches of various types of rivet heads (snap–pan–conical–countersunk) Sketches of keys (sunk, flat, saddle, gib head, woodruff) Sketches of hole & shaft assembly. **DETAIL DRAWING AND ASSEMBLY DRAWING:** Details of machine drawing- Assembly drawing- surface quality- surface finish standard- Method of indicating surface roughness for general engineering drawing-symbols used for indication of surface roughness-symbols for direction of lay. Geometrical tolerance. Detail drawing of the following with complete dimensioning, tolerances, material and Surface finish specifications

		1. Universal couplings 2. Ball bearing and roller bearing. 3. Fast and loose pulley. 4. Stepped and V belt pulley. 5. Flanged Pipe joints, right angle bend. 6. Tool Post of Lathe Machine. 7. Tail Stock of Lathe Machine 8. Stepped and V belt pulley. 9. Flanged Pipe joints, right angle bend. 10. Tool Post of Lathe Machine. 11. Tail Stock of Lathe Machine Practice of blue print reading on limit, size, fits, tolerance, machining symbols, and reading out of assembly drawing etc., ISO Standards. **READING OF ENGINEERING DRAWING:** Blue print and machine drawing reading exercises. **GRAPHS & CHARTS**: Types (Bar, Pie, Percentage bar, Logarithmic), Preparation & interpretation of the graphs and charts. **AUTO CAD:** Familiarization with AutoCAD application in engineering drawing. Practice on AutoCAD using Draw & Modify commands. Practice on AutoCAD with Rectangular snap using Draw, Modify, Inquiry commands. Practice on AutoCAD using text dimensioning& dimensioning styles Practice on AutoCAD to draw nuts, bolts & washers. Isometric views-isometric views with square, taper and radial surface-simple & complex views. Perspective views. Practice on AutoCAD using isometric snap to make isometric drawings Practice on AutoCAD using Hatch command and application. Practice on AutoCAD using 3D primitives with UCS (User Co-ordinate system).
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.	**<u>WORKSHOP CALCULATION:</u>** **Fraction:** Concept of Fraction, Numbers, Variable, Constant, **Ratio & Proportion**: - Trade related problems **Percentage:** Definition, changing percentage to decimal and fraction and vice versa. Applied problems related to trade. Estimation and cost of product. **Algebra:** Fundamental Algebraic formulae for multiplication and factorization. Algebraic equations, simple & simultaneous equations, quadratic equations and their applications. **Mensuration 2D:** Concept on basic geometrical definitions, basic geometrical theorems. Determination of areas, perimeters of triangles, quadrilaterals, polygons, circle, sector etc. **Mensuration 3D:** Determination of volumes, surface areas

		of cube, cuboids cylinders, hollow cylinder, sphere prisms, pyramids cone spheres, frustums etc. Mass, Weight, Volume, Density, Viscosity, Specific gravity and related problems. **Trigonometry:** Concept of angles, measurement of angles in degrees, grades and radians and their conversions. Trigonometrical ratios and their relations. Review of ratios of some standard angles (0, 30,45,60,90 degrees), Height & Distances, Simple problems. **Graphs:** basic concept, importance. Plotting of graphs of simple linear equation. Related problems on ohm's law, series-parallel combination. **Statistics:** Frequency tables, normal distribution, measure of central tendency – Mean, Median & Mode. Concept of probability. Charts like pie chart, bar chart, line diagram, Histogram and frequency polygon. **WORKSHOP SCIENCE:** **Units and Dimensions:** Conversions between British & Metric system of Units. Fundamental and derived units in SI System, Dimensions of Physical Quantities (MLT)-Fundamental & Derived. **Engineering Materials:** Classification properties and uses of ferrous metals, non-ferrous metals, alloys etc. Properties and uses of non-metals such as wood, plastic, rubber, ceramics industrial adhesives. **Heat & Temperature:** Concepts, differences, effects of heat, different units, relation, specific heat, thermal capacity, latent heat, water equivalent, mechanical equivalent of heat. Different Temperature measuring scales and their relation. Transference of heat, conduction, convection and radiation. Thermal Expansion related calculations. **Force and Motion**: Newton's laws of motion, displacement, velocity, acceleration, retardation, rest & motion such as linear, angular. Force – units, different laws for composition and resolution of forces. Concept on centre of gravity and equilibrium of forces in plane. Concept of moment of inertia and torque. **Work, power & energy**: Definitions, units, calculation & application. Concept of HP, IHP, BHP and FHP – related calculations with

		mechanical efficiency. S.I. unit of power and their relations. **Friction:** Concept of friction, laws of friction, limiting friction, coefficient of friction and angle of friction. Rolling friction & sliding friction with examples. Friction on inclined surfaces **Stress & Strain:** Concepts of stress, strain, modulus of elasticity. Stress-strain curve. Hook's law, different module of elasticity like Young's modulus, modulus of rigidity, bulk modulus and their relations. Poisson's ratio. **Simple machines:** Concept of Mechanical Advantage, Velocity Ratio, Efficiency and their relations. Working principles of inclined plane, lever, screw jack, wheel and axle, differential wheel and axle, worm and worm wheel, rack and pinion. Gear train. **Electricity:** Basic definitions like emf, current, resistance, potential difference, etc. Uses of electricity. Difference between ac and dc. Safety devices. Difference between conductors and semiconductors and resistors, Materials used for conductors, semiconductors and resistors. Ohm's Law. Series, parallel and series-parallel combination of resistances. Concept, definitions and units of electrical work, power and energy with related problems. **Fluid Mechanics:** Properties of fluid (density, viscosity, specific weight, specific volume, specific gravity) with their units. Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure.

SYLLABUS FOR CORE SKILLS
1. Training Methodology (Common for all CITS trades) (270Hrs + 180Hrs)

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

7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
TRADE TECHNOLOGY	
1. Demonstrate workshop safety measures and different types of tools, equipment & raw material used in foundry. (NOS: ISC/N9406)	Demonstrate selection of appropriate foundry tools & equipment.
	Demonstrate raw materials used in foundry.
	Demonstrate function of every raw material.
	Explain proper use of every tools and equipment.
	Demonstrate wrong use of tools & defective tools & equipment.
	Demonstrate workshop safety & discipline.
2. Monitor different patterns, allowances of pattern, colouring & core made and repair defective pattern and boxes. (NOS: ISC/N9407)	Monitor selection of pattern for the mould.
	Demonstrate making of the floor & level it and level checked with spirit level & straight edge.
	Demonstrate making of the core with the help of core box and assemble the mould with core.
	Assess selection of all charging materials for casting.
	Demonstrate furnace preparation for melting the metal as per type of metal.
	Demonstrate pouring of melting metal into the mould cavity with special care, maintaining all safety measures.
	Demonstrate mould making with loose piece pattern.
	Demonstrate mould making and assemble it.
	Explain all step of operation during working.
	Ensure safety procedure during above operations.
	Check dimensional accuracy as per standard procedure.
	Avoid waste and use raw materials economically.
3. Evaluate Sand tempering for different types of mould making. (NOS: ISC/9408)	Check the correct proportion of the mixing of sand.
	Check the moisture content of the mixing sand.
	Evaluate selection of raw material for sand mixer.
	Demonstrate mixing of sand with right quantity.
	Analyse Sand tested with different testing equipment and check accuracy of the equipment.
	Demonstrate tools & equipment required for producing green sand mould.
	Assess making of green sand moulds by using appropriate hand tools.
	Demonstrate repairing of mould, if necessary.
4. Assess different casting components by different metal with different moulding process. (NOS: ISC/9409)	Evaluate proper tools and equipment for making specific mould.
	Assess selection of all raw materials and prepare mould.
	Evaluate selection of pattern required for the job.
	Demonstrate selection of core box for making cover core.
	Demonstrate making of mould and insert core carefully.

	Demonstrate pouring of molten metal carefully.
	Ensure safety during handling and pouring of molten metal.
	Analyse Fettling of the job.
	Evaluate the finished job as per specification.
5. Demonstrate heat treatment operations. (NOS: ISC/N9410)	Demonstrate safe working of furnace for melting metal and its alloy.
	Demonstrate selection of raw materials for charging of furnace.
	Demonstrate making of mould & pour molten metal to the mould.
	Demonstrate all safety & precaution maintained during heat treatment operations.
6. Evaluate metal working such as marking, sawing, filling, grinding, drilling, charging of cupola etc. (NOS: ISC/N9411)	Demonstrate tools & equipment for making sawing, chipping, filling, grinding & drilling.
	Evaluate cupola construction, operation and charging.
	Demonstrate performing of above operation carefully in pit furnace.
	Observe safety & precaution during operation.
	Check the accuracy of the job.
7. Plan and prepare Die casting machine to produce casting, moulds by moulding process, make cast iron castings and check defects. (NOS: ISC/N9412)	Demonstrate the machine required for gravity die casting.
	Ensure that the quality of the machine is useable.
	Demonstrate releasing agent in applied in the metallic dies.
	Analyse pouring temperature of molten metal.
	Check the quality of the castings.
	Demonstrate steps of making the mould.
	Demonstrate maintaining of heating temperature for removal of wax from the mould.
	Demonstrate extra care for handing the investment mould.
	Check the quality of the casting.
8. Evaluate casting, fettle of casting & calculation of yield percentage. (NOS: ISC/N9413)	Demonstrate the tools and equipment required for making casting.
	Demonstrate chills &denser.
	Locate position for chills.
	Demonstrate pouring of molten metal by observing safety.
	Assess Fettling of the casting carefully.
	Check the accuracy and quality of the job.
	Calculate percentage of yield of casting.
9. Demonstrate complete core by joining half cores and mould by various types of gate to produce different types of metal casting. (NOS: ISC/N9414)	Demonstrate and check core box for making jobs.
	Demonstrate maintaining heating temperature of core baking oven.
	Demonstrate controlling of mixed sand composition.
	Check accuracy of dimensions and hardness of the core.
	Demonstrate all hand tools, equipment and raw materials required for this job.
	Demonstrate mixing of sand with correct proportion.
	Demonstrate maintaining of Core during meeting.
	Demonstrate maintaining of correct actions during working.
	Demonstrate repairing the mould, if necessary.

10. Evaluate extra thick casting & finish it, reline & prepare different types of furnaces for melting cast metals and make Core using linseed oil & IVP oils. (NOS: ISC/N9415)	Demonstrate tools and equipment required.
	Select raw material required for the job.
	Demonstrate raw materials required for reline and repair.
	Evaluate maintaining of correct proportion of charge materials.
	Assess maintaining of relining thickness.
	Evaluate maintaining of preheating temperature and heating time.
	Ensure maintaining of all safety and precaution during melting practice.
	Check quality of casting.
	Check hardness of cores after curing.
	Check quality and finishing of the core.
11. Assess mould made without pattern & with sweep pattern and casting by investment casting process & binder less process. (NOS: ISC/N9416)	Select suitable sweep pattern for sweep moulding.
	Demonstrate raw materials for the mould.
	Mix the sand properly.
	Check dimensions of mould cavity after mould making without pattern.
	Check the dimension of the mould cavity after mould making by sweep pattern.
12. Explain dust problem in Foundry Shop adhering to TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system. (NOS: ISC/N9491)	Demonstrate equipment maintenance.
	Ensure that equipments achieve perfect production.
	Demonstrate strategic tool to grow and sustain.
	Illustrate continuous improvement in continuous manner.
	Maintain record keeping system for all the process work.
13. Read and apply engineering drawing for different application in the field of work. (NOS: ASC/N9410)	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.
14. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: ASC/N9411)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR FOUNDRYMAN (CITS)			
(For batch of 25 candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Tool tray steel	145x145x5 cm	26 nos.
2.	Taper trowel	18cm round	26 nos.
3.	Heart and square trowels	3xl.2xl.2cm	26 nos.
4.	Trowel heart and scoop		26 nos.
5.	Trowel square and scoop		26 nos.
6.	Trowel double scoop		26 nos.
7.	Trowel double square		26 nos.
8.	Tool Spoon	32x16cm -25x6cm	26 nos.
9.	Cleaner	6x300m	26 nos.
10.	Cleaner	9x300m	26 nos.
11.	Vent wire	3 mm	26 nos.
12.	Peg Rammer		26 nos.
13.	Flat rammer	75mmx25mm height	26 nos.
14.	Rapping spike forged and hardened		26 nos.
15.	Hand bellow	25 cm	26 nos.
16.	Safety goggles	With clear glass	26 nos.
17.	Goggles	antiglau heat proof	26 nos.
18.	Cleaner flange		26 nos.
19.	Egg smoother		26 nos.
20.	Smoother rounder corner		26 nos.
21.	Smoother square corner		26 nos.
22.	Steel rule	300mm	26 nos.
23.	Apron leather or asbestos		26 nos.
24.	Legging pad		26 nos.
25.	Hand gloves	Leather or asbestos	26 nos.
B. INSTRUMENT AND GENERAL SHOP OUTFIT			
26.	Hammers Ball Peen.	0.45kg	13 nos.
27.	Ball Peen Hammers	650 to 700 grams	13 nos.
28.	Sledge Hammers	8kg	5 nos.
29.	Claw Hammers	0.75kg	2 nos.

30.	Chisel Cold Flat	2 x 22 cm	13 nos.
31.	Chisel	200 x 15 mm	13 nos.
32.	File flat	30 cm Bastared	13 nos.
33.	File flat	30 cm second cut	13 nos.
34.	File flat round	30cm Bastard	13 nos.
35.	Folding rule	60 cm	5 nos.
36.	Steel rule	600 mm	5 nos.
37.	Caliper odd leg		3 nos.
38.	Caliper inside	15cm	5 nos.
39.	Scriber		5 nos.
40.	Centre Punch	15 cm	5 nos.
41.	Hacksaw	30cm adjustable	13 nos.
42.	C Clamps	20 cm	13 nos.
43.	C Clamps light duty steel	30 cm	13 nos.
44.	Screw Drivers	25 cm with 15mm blade	5 nos.
45.	Screw Drivers	15 cm	5 nos.
46.	Screw Drivers	18 cm	5 nos.
47.	Pliers	20 cm 5	5 nos.
48.	Try Square	for wood work	5 nos.
49.	Brick layers hammer	20cm	5 nos.
50.	Hand lamp wandering lead		2 nos.
51.	Degassing bale	10 cm Perforated hood	2 nos.
52.	Bench Vice	12 cm jaw	5 nos.
53.	Work bench for bench vice	245 x 125x 75	1 nos.
54.	Blow lamp		5 nos.
55.	Hand saw		5 nos.
56.	Steel measuring	tap 3 mts.	1 no
57.	Trammel		2 nos.
58.	Shovel Hand		13 nos.
59.	Engineers Try Square	15 cm	5 nos.
60.	Lockers Steel	with 8 drawers each	3 nos.
61.	Black board with easel		1 no
62.	Fire Extinguishers foam chemical type		2 nos.
63.	Fire Extinguishers soda Ash, etc type Co2 gas type		1 each
64.	Fire buckets	2 for water and 3 for sand	5 nos.

65.	Stand for Fire buckets		1 no
66.	Face shield clear		13 pairs
67.	Helmet (engineers)		13 pairs
68.	Gauntlets leather Fettling		13 pairs
69.	Gauntlets leather or asbestos for Furnace		13 pairs
70.	Footwear asbestos over shoes		13 pairs
71.	First aid Box based on burn Treatment		1 set
72.	Dividers Firm joint	20 cm	5 nos
73.	Moulding Boxes	30 x 40 x 15 cm RSDL	25 pairs
74.	Moulding Boxes	75 x75 x 25cm RSDL	13 pairs
75.	Snap Flask	40 x 35 x 12 cm RSDL	2 Pairs
76.	Slip Flask	40 x 35 x 12 cm RSDL	2 pairs
77.	Sprit level		5 nos.
78.	Wheel barrows		2 nos.
79.	Plane grooving 6mm cutter		2 nos.
80.	Cutting Pliers		2 nos.
81.	Set of Spanners , and Alegen keys		2 set each
82.	Venire calipers		1no.
83.	Set of Tongs For Melting & Charging.		2sets
84.	Equipment for conducting BLS (Basic Life Saving) training.		1 set
85.	Air Compressor with maximum working pressure of	17.5kg/sq.cm	1 no.
86.	Pneumatic Rammer with Rubber head		2 nos.
87.	Pneumatic Chisel (with suitable Chisel)		1 no.
88.	Molding Sand Muller	100 Kg, Core Sand Muller 50kg capacity	Each one unit
89.	Mould Green Hardness tester - dial type -Risdale dials standard		1 Unit
90.	Core hardness tester		1 Unit
91.	L.P.G Cylinder With heating torch (Industrial Purpose)		1 Unit
92.	Heating and Plumbing Unit to suit with Heating Pressure Gauge etc. Oil tank Motorized Rotary pump-Pre heater.	oil Fired Tilting type Crucible Furnace	1 Unit
93.	Sand testing Equipments - Permeability meter, Universal Strength tester, Sieve Shaker, Standard Sand Rammer, Shutter Index Tester, Clay Content Tester,		Each One Set

	Speedy Moisture tester. Electric Hot Air oven.		
94.	Molding Machine Hand squeeze With Stripping device pin lift type. With Suitable Compressor &Lifting Device.	latest version	1 Unit
95.	CO2 Gas cylinder with nozel		1 Unit
96.	Testing Of Mechanical Properties: Tensile Tester, Hardness Tester, The brinell Tester, The Rockwell Tester, Fracture Tester, Impact Tester, Creep tester. Specification: Equipments suitable for Training Purposes.		1 Unit
97.	Electrical Melting Furnace: With all accessories.	Induction 100 kg. melting of C.I or Steel or Brass.	1 Unit
98.	Metal Chemical Composition Analyzers or spectrometer		1 Unit
99.	Heat -Treated Furnace (Electrical Furnace)		1 Unit
100.	Centrifugal Casting Machine		1 Unit
101.	Equipment for conducting BLS (BASIC Life support) training.	Optional	1 set
102.	Air conditioner		As required


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