CURRICULUM

FOR THE TRADE OF

FURNACE OPERATOR
(STEEL INDUSTRY)

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

CONTENTS

1. ACKNOWLEDGEMENT

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1. TATA Steel, Jamshedpur

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

Co-ordinator for the course: Sh. Nirmalya Nath., ADT

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2. BACKGROUND

2. 1. Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

2. 2. Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

2. 3. Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.

- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.

- Scope has been extended also to non-engineering occupations.

- Establishments have been permitted to outsource basic training in an institute of their choice.

- The burden of compliance on industry has been reduced significantly.

3. RATIONALE

[Need for Apprenticeship in **Furnace Operator (Steel Industry)** trade]

1. Able to weigh or measures specified amounts of ingredients or materials for processing, using devices such as scales and calipers.
2. Able to press and adjust controls in order to activate, set, and regulate equipment according to specifications.
3. Able to monitor equipment operations, gauges, and panel lights in order to detect deviations from standards.
4. Able to read and interpret work orders and instructions in order to determine work assignments, process specifications, and production schedules.
5. Knowledge to keep record gauges readings, test results, and shift production in log books.
6. Confers with supervisors or other equipment operators in order to report equipment malfunctions or to resolve productions problems.
7. Able to examine or test samples of processed substances, or collect samples for laboratory testing, in order to ensure conformance to specifications.
8. Able to maintain, clean, lubricate, and adjust equipment, using scrapers, solvents, air hoses, and oil and hand tools.
9. Able to transport materials and products to and from work areas, manually or using carts, hand trucks, or hoists.
10. Ensure to stop equipment and clear blockages or jams, using fingers, wire, or hand tools.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Furnace Operator, Open Hearth; Furnace Operator First Hand, Open Hearth (Steel Manufacture) operates open hearth furnace for making steel from blown metal (iron). Charges furnace with scrap, blown and molten metal received from convertor and blast furnace, chemicals etc., according to type of steel required. Controls fuel intake and flow of air in furnace to suit furnace condition. Takes care not to damage refractory work of furnace. Gets furnace ready for tapping and directs Furnace Operator Second Hand to open tapping hole of furnace closed for ascertaining suitability of further operation. May spray furnace sides with dolomite for maintaining proper furnace condition.

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.

Perform TPM (Total Production Management), TQM (Total Quality Management) and record keeping system.

Reference NCO:

i) **NCO-2015: --** 3135.1100

5. GENERAL INFORMATION

1. **Name of the Trade** **: FURNACE OPERATOR (STEEL INDUSTRY)**

2. **N.C.O. Code No.** : **NCO-2015:** --3135.1100

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 15 Months

4. **Duration of Basic Training**: -

a) Block –I : 3 months

Total duration of Basic Training: 3 months

5. **Duration of Practical Training (On -job Training): -**

a) Block–I: 12 months

Total duration of Practical Training: 12 months

6. **Entry Qualification** : Passed 10^{th} class examination under 10+2 system of education or its equivalent.

7. **Selection of Apprentices:** The apprentices will be selected as per Apprenticeship Act amended time to time.

8. **Rebate for ITI passed trainees** : NIL

Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.

6. COURSE STRUCTURE

Training duration details: -

Time (in months)	1-3	4-15
Basic Training	Block– I	-----
Practical Training (On - job training)	----	Block – I

Components of Training ↓	Duration of Training in Months →														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Basic Training Block - I															
Practical Training Block - I															

7. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I)
DURATION: 03 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **FURNACE OPERATOR (STEEL INDUSTRY)**
2) **Hours of Instruction** : 500 Hrs.
3) **Batch size** : 20
4) **Power Norms** : 11 KW
5) **Space Norms** : 128 Sq. m.
6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of **Furnace Operator (Steel Industry)** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

8) **Tools, Equipments & Machinery required**: - As per Annexure – I

7.1.1 DETAIL SYLLABUS OF CORE SKILL

A. Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
		30		**20**
1	Advance blue print reading.		**Elementary Mathematics:** Percentage and its application to shop problems appropriate to the trade like air fuel ratio, capacity of the furnace, capacity of the cooling bed, area of the shop, furnace etc.	
2	Freehand sketching of details from assembly drawings and vice versa.		**Mensuration:** Areas of rectangles, square, triangle **Trigonometry:** Trigonometrical functions. Use of Trigonometrical tables. Applied problems- Principle of sine bar, calculation of areas, triangles, polygons etc. **Slide rule:** Use of slide rule for multiplication and division.	
3	Code of practice for general engg. drawings according to I.S.I specification as relevant to the trade.		**Mensuration:** Area of circle, volume and weight of regular cones and spheres. Calculation of area, volume and weight of simple hollow solids applied problems.	
4	Free hand sketching of isometric views of different parts related to the trade.		**Graphs:** Plotting of graphs for given dates and equations, reading of graphs. Further problems as applicable to the trade- Calculation on capacity of the furnace, cooling bed, volume of furnace volume of stock, weight of stock, simple calculation of amount of fuel required per ton of metal heated etc. Calculation of opening carbon from a given charge, addition after a given composition to adjust the batch composition to the desired specifications, calculation of ladle additions, calculation of basicity.	
5	**….**		**A. PHYSICS.** Different states of matter. Different units of measurement- fundamental and derived units-	

			R.P.S.C.G.S., M.K.S. systems, conversion from one system to another. Newton's law of motion. Force- units of force. Work, energy and power. Equation of motion. Resolution of forces- parallogram, triangles and polygon law of forces. Density and specific gravity. Archimede's principle. Properties of liquids- viz. Surface tension, viscosity, etc Gas Laws- Boyle's law, Charles law. Pressure- atmospheric pressure- measurement of pressure. Frictio- laws of friction, co-efficient of friction, method of reducing friction. Lubricants and their uses. Machines- Mechanical advantage, velocity ratio, efficiency, industrial applications of simple machines. Heat & temperature- effects of heating. Measurement of temperatures, thermometers, resistance thermometers pyrometer, thermocouples etc. Thermal expansion of solid liquid and gases. Conduction convection and radiation. Natural and artificial magnets, theory of magnetization. Application of magnet in steel Industry. Ohm's law, current potential difference, Resistance- their units, resistance in series and parallel, electrical power. Principle of generation of electricity. Electrical motors (AC & DC)- Principle of working.	
6	**…..**		**<u>B-CHEMISTRY:</u>** Chemical symbols, valency, formulas and equations. Elements compounds, mixtures.	

			Periodical classification of elements (Periodical table). Acid, Basic and salts. Atoms, molecules, atomic and molecular weights, equivalent weight. Law of chemical combinations-law of conservation of mass. Law of constant proportions, law of multiple proportions. Law of reciprocal proportions, gay Lucca's law of gaseous volumes.	

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Safety: - its importance, classification, personal, general, workshop and job safety. Occupational health and safety. 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. Importance of housekeeping & good shop floor practices. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Fire& safety: Use of Fire extinguishers. Safety regarding working with different types of steam and its First-Aid.	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Institute system including stores procedures. Introduction of First aid. Safety attitude development of the trainee by educating him to use Personal Protective Equipment (PPE). Response to emergencies e.g.; power failure, fire, and system failure. Accidents- Definition types and causes. First-Aid, nature and causes of injury and utilization of first-aid. Introduction to 5S concept & its application. Fire: - Types, causes and prevention methods. Fire Extinguisher, its types. Define environment, environment Pollution, Pollutants, type of Pollution (Air pollution, water pollution, soil pollution noise pollution, thermal pollution, radiation. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.
2.	Mock drill on fire and first aid. <u>Basic Fitting:</u> 1. Using simple measuring instruments, use of foot scale tape, calipers in measuring lengths. 2. Flat chipping of cast iron and mild steel. 3. Making of keyways and slots and chipping. 4. Hacksawing of cast Iron and mild Steal. 5. Sharpening of chisel.	**<u>Safety Hazardous. First Aid.</u>** 1. Definition of first aid. 2. Classification of wound, their types, causes and its treatment. 3. Fractures- causes, symptoms and its treatment. 4. Burn injuries- fire burn, treatment. 5. Shock treatment. **<u>Fire fighting:</u>** 1. Classification of fire- fire , triangle. 2. Types of fire extinguishers-

	6. Filling of flat surface.	construction and uses.
3.	**Video demo of fuel classification process.** 1. Chamfering and making round edges. 2. Marking out positions of holes and drilling. 3. Drilling of different metals: Countersinking operation using drill bit. 4. Internal and External threading.	Fuels- classification of fuels- Indian reserves of coal, petroleum and natural gas, primary and secondary fuels, solids, liquid and gaseous fuels, their composition and uses. Testing of fuels. Proximate and ultimate analysis, physical and chemical properties of coal colorific value, density and wobs index for fuels. Flash point fire point and viscosity for liquid fuels. Washing of coal and its principle, Central washeries in India, Name and location. **Idea of tolerance and allowances.**
4.	**Video demo/showing combustion of fuel.** 1. Lighting up the forge fire. 2. Handing up the different smithy tools. 3. Identify the temperature of mild steel during heating process. 4. Elementary forging operations like using hand hammers and sledge hammers. 5. Drawing out operation tapering, jumping upsetting.	Principles of combustion. Combustible and inert constituent of fuel. Atomic weights of elements occurring in fuel. Simple combustion equations and their use. Primary and secondary air excess air and its requirement and its necessity. Efficient use of fuel-waste heat recovery re-cooperators and regenerators. Furnace efficiency steam lagging of oil pipe lines and its use. **Idea of the forge: different parts of the forge.**
5.	**Video demo of combustion devices.** 1. Trimming and other finishing operations. 2. Use of tools required to measure the dimensions of forged objects. 3. Safety precautions in forge shop. 4. Annealing of copper or steel tube. Change in properties before and after annealing.	Combustion devices- Burners different types constructional features of burners for pulverized coal, liquid and gaseous fuels, burning of coal on grates. Control of furnace temperature. Functions of recuperators and Regenerators. **Heating for heat treatment. Different temperatures required for annealing, normalizing, tempering and pack carburizing for steel objects.**

	5. Normalizing of a forged hammer. Study of change in properties.	
6.	**Video demo of different types of furnaces.** 1. Hardening and tempering of a chisel. 2. Case hardening of a cam by pack carburizing. Study in change of properties. 3. Use of hardness testing machine. 4. Quenching media and importance of rate of cooling on heat treatment technique. 5. Tempering temperatures. Temper colours, temper finishes.	Furnace, meaning of furnace, oven and kiln. Different types of furnace and their classification. Melting furnaces, refining furnaces, heating furnaces different types. Roller hearth, walking beam, pusher type, car type, rotary type multi-zone continuous type reheating furnaces. Different zones, of a furnace. Temperature in different zones, main part of a furnace. Cooling members of a furnace cooling members of a furnace cooling systems adopted. Meaning of furnace atmosphere oxidizing, reducing and neutral atmosphere and their use. Furnace pressure and its effect on furnace operation. Control of furnace pressure. Safe working of a furnace.
7.	**Video demo of furnace hazards.** 1. Identifying different types of refractory bricks by visual observations. 2. Cutting of bricks to required size and shape. Brick cutting tools. 3. Mortars: preparation methods- proportion of different ingredients of a mortar. 4. Different joining method of bricks. 5. Laying of bricks for straight walls arches, checker works etc.	Furnace hazards and safety precaution to be adopted. Safety precautions for reheating furnaces, chimney, function of a chimney, different types of chimneys, maintenance of chimney F.D. & I.D. fanes. **Different shapes and sizes of refractory bricks.**
8.	**Video demo of refractories and its use.** 1. Use of common masonary tools like plumb bob, square, straight edge etc. 2. Ability to craw free hand sketches of masonry work such as walls, arches etc. 3. Ability to read and interpret simple drawing relating to masonry work. 4. Judging the straightness and squareness of a brick.	Refractories-Meaning of the term refractory, acid basic and neutral refractories uses and properties of refractories. Testing of refractories. Raw material required for the manufacture of refractories. Manufacturing process for refractories. Manufacturing for at least one type of refractory. Cost of refractories. Proper furnace operation to held longer refractory life.

	5. Leveling, joining and plastering operations. 6. Expansion joints in bricks walls.	
9.	**Video demo of repair & maintenance of furnace.** 1. Maintenance of refractory construction. 2. Temporary repairs of refractory work like patching, gunning fetting etc. 3. Simple tests for refractory bricks, Testing for hardness, specific gravity, porocity PCE etc. 4. Salvaging of used up bricks, refractory grog. 5. Study of mixers used for making Mortar.	Meaning of the terms life of a furnace. Temporary and major repairs for refractory lining of a furnace. Instruments and indicators for furnace control. Their necessity, Thermocouples and pyrometers working principles. Flow measuring instruments, orifice meter, venturimeter pilot tube etc.
10.	Demonstration of different pressure measuring instruments. 1. Determination of calorific value of a fuel. 2. Determination of flash and fire point of a liquid. 3. Measurement of viscosity of a fuel oil. 4. Study of equipment for Orsat analysis for gaseous fuels. 5. Study of different samples of coals, steam coals and metallurgical coals. Samples of peet, lignite, Bituminous coal and Anthracite. 6. Proximate and ultimate analysis of fuels. 7. Determination of calorific value of a fuel.	Pressure measuring instruments. Manometers and pressure gauges. Instruments for measuring density and viscosity of liquid fuels. Oxygen- Manufacture by limes process- properties and industrial uses oxidation and reduction reactions. Study of different samples of coals, steam coals and metallurgical coals. Samples of peet, lignite, Bituminous coal and Anthracite. Proximate and ultimate analysis of fuels.
11	**Video demo of gaseous fuels & their properties.** 1. Determination of flash and fire point of a liquid. 2. Measurement of viscosity of a fuel oil. 3. Study of equipment for Orsat analysis for gaseous fuels.	Acetylene- Properties, uses. Fuels- Solid, liquid and gaseous fuels, coal, coking coal, carbonization of coal into coke, by products and their uses. Industrial gaseous fuels, e.g. Blast furnace gas, coke oven gas- properties, industrial uses, alloys etc.

	4. Study of thermo couples. Use of Thermo couples to measure the furnace temperature. 5. Study of optical and radiation pyrometers. Measurement of furnace temperature by these instruments.	
12	**Video demo of water treatment system.** **<u>Process Instrumentation Laboratory</u>** 1. Study of manometers and pressure gauges. 2. Reading and recording furnace temperature and pressures and temperatures, from the recording instruments. 3. Use of graphs for recording furnace temperature and pressure continuously. 4. Study & use of ventury and orifice meters.	Water- hard and soft water, water treatment, industrial uses. Scine Industrially important compounds and their natural deposits, viz. lime stone, dolomite, quartz. Feldspar, manganese ore etc. Four link accident chain.
13	**Revision & Internal Assessment**	

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only
3)	**Hours of Instruction**	**:**	**110 Hrs. (55 hrs. in each block)**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
3	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
4.	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page	

	and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** **Organizational Behavior** Problem Solving Confidence Building Attitude Decision making Case study/Exercise	
	Entrepreneurship skill	**15**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	

2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**Institutions Support** Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**15**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	
3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	

9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**10**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)
(BLOCK – I)
DURATION: 12 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **FURNACE OPERATOR (STEEL INDUSTRY)**

2) **Batch size** : a) Apprentice selection as per Apprenticeship guidelines.
b) Maximum 20 candidates in a group.

3) **Examination** : i) The internal assessment will be held on completion of each block
ii) NCVT exam will be conducted at the end of 2nd year.

4) **Instructor Qualification** :

i) Degree/Diploma in **Mechanical** Engg. from recognized university/Board with one/two year post qualification experience in the relevant field.

OR

ii) NTC/NAC in the trade of **Furnace Operator (Steel Industry)** with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

5) **Infrastructure for On-Job Training** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. BLOCK – I
DURATION: 12 MONTHS

- Different furnace parts and their constructional features like hearth, roof side walls and back walls furnace sub-structures charging and discharging doors.
- Arrangements and facilities for storing the material to be heated in the furnace.
- Charging arrangements and operations.
- Discharging arrangements and operations.
- Starting up the furnace after relating new furnace..
- Heating schedule for starting the new or relined furnace.
- Judging and noting the temperature of the material inside the furnace.

1. Filling up the furnace log sheet.
2. Operation of stoves provided with blast Furnaces.
3. Locating the various valves and instruments in:-
   a) Air passage line.
   b) Fuel passage line (liquid fuel or gaseous fuel or both)
   c) Combustion products (fuel gas) line.
4. Positioning and operation of the various valves.
5. Knowledge of the temperatures to be used for different sticks.
6. Controlling the air fuel ratio to attain and maintain the required temperature. Identifying the burner location. Number of burners used. Specification and capacity of the burners. Sketch of the burners.
7. Arrangement of the different part of the burner.
8. Control of the air and fuel input to the burner.
9. Cleaning of the burners.
10. Judging the flame characteristics through burner inspection holes.
11. Gas shutting off for furnace cold repair.
12. Reading the different furnace instruments provided in the control panel or control room.

- Cleaning of the ID or FD fan in the chimney.
- Cleaning of furnace frame scale accumulation.
- Handling of different tools and tackles used for cleaning the furnace from scale accumulation.
- Cleaning of the heat recovery system recuperators or regenerators.
- Regulation and control of furnace atmosphere and furnace pressure.
- Identification of furnace irregularities and measure taken to rectify them.

- Emergency services and measures taken to rectify.
- Defects in the material heated developed due to bad hitting practices.
- Identification of these defects and their rectification.
- Effect of bad heating on further rolling or shaping of the heated material.
- Use of furnace control instruments such as optical and radiation pyrometer, furnace pressure regulator etc.

ASSESSMENT STANDARD

8.1 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 scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For 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.

In this work there is evidence of:

- demonstration of good operational skills while executing the assigned job.
- different accuracy achieved while undertaking different skills demanded by the job.
- a fairly good level of neatness and consistency in handling controls.
- occasional support in completing the project/job.

b) Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

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.

In this work there is evidence of:

- good skill levels in operation while executing the assigned job.
- the majority of the accuracy achieved while undertaking different skills demanded by the job.
- a good level of neatness and consistency in handling controls.
- little support in completing the job.

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

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.

In this work there is evidence of:

- high skill levels in operation while executing the assigned job.
- accuracy while undertaking different work being substantially in line with those demanded by the job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST FOR APPRENTICE

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	08 hrs.
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50	-	50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under all India trade test.

8. FURTHER LEARNING PATHWAYS

Employment opportunities:

On successful completion of this course, the candidates may be gainfully employed in the following industries:

1. Manufacturing & Process industries like steel, and other related industries where casting work is executed.

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: FURNACE OPERATOR (STEEL INDUSTRY)

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A. Trainees tool kit: -

Sl. No.	Item	Quantity
1	Tool tray steel 145 x 145 x 5 cm	21
2	Taper trowel 18 cm round	21
3	Heart and square trowels 3 x 1.2 x 1.2 cm	21
4	Trowel heart and scoop	21
5	Trowel square and scoop	21
6	Trowel double scoop	21
7	Trowel double square	21
8	Tools Spoon 32 x 16 mm - 25 x 6 m	21
9	Cleaner 6 x 300 m	21
10	Cleaner 9 x 300 m	21
11	Vent wire 3 mm	21
12	Peg rammer	21
13	Flat rammer 75mm x 25mm height	21
14	Rapping spike forged and hardened	21
15	Hand bellows - 25 cm	21
16	Safety goggles (with clear glass)	21
17	Goggles (antiglau heat proof)	21
18	Cleaner flange	21
19	Egg smoother	21
20	Smoother round corner	21
21	Smoother square corner	21
22	Steel rule 300mm	21
23	Apron leather or asbestos	21
24	Legging pad	21
25	Hand gloves (Leather or asbestos)	21

B: Tools, Measuring Instruments and Shop Outfit

Sl. No.	Item	Quantity
1	Hammers Ball Peen 0.45 kg	11
2	Ball peen hammers 650 to 700 gms	11

3	Sledge hammer 8 kg	5
4	Claw hammers 0.75 kg	3
5	Chisel cold flat 2x22 cm	11
6	Chisel 200x15 mm	11
7	File Flat 30 cm Bastard	11
8	File Flat 30 cm Second cut	11
9	File half round 30 cm bastard	8
10	File half round 30 cm second cut	11
11	Folding rule 60 cm	5
12	Steel rule 600 mm	5
13	Caliper odd leg	3
14	Caliper inside 15 cm	5
15	Scriber	5
16	Centre punch 15 cm	5
17	Hacksaw 30 cm adjustable	11
18	C Clamps 20 cm	11
19	C Clamps 30 cm light duty steel	11
20	Screw drivers 25cm with 15mm blade	11
21	Screw drivers 15 cm	11
22	Screw drivers 18 cm	11
23	Pliers 20cm	5
24	Plane grooving 6mm cutter	3
25	Cutting Pliers	3
26	Try Square (for wood work)	11
27	Brick layers hammer 20cm	11
28	Hand lamp wandering lead	3
29	Degasing bale 10cm perforted hood	3
30	Bench vice 12cm jaw	5
31	Work bench for bench vice (245x125x75cm)	11
32	Blow lamp (Kerosene)	5
33	Hand saw	3
34	Steel measuring tape - 3 meter	2
35	Trammel	3
36	Shovel hand	11
37	Engineers try square 15 cm	5
38	Lockers steel with 8 drawers each	5
39	Black board with easel	2
40	Fire buckets (2 for water and 3 for sand)	5
41	Stand for fire buckets	2
42	Fire extinguisher foam chemical type	3
43	Fire extinguisher soda ash, etc type CO2 gas type	1 each
44	Face shield clear	11
45	Helmet (engineers)	11
46	Guantlets leather fettling	11pairs
47	Guantlets leather fettling	11pairs
48	Footware asbestos over shoes	11pairs
49	First Aid Box based on burn treatment	1
50	Lividers firm joint 20cm	5
51	Moulding boxes 30 x 40 x 15 cm RSDL	40 pairs

52	Moulding boxes 75 x 75 x 25 cm RSDL	21 pairs
53	Snap flast 40 x 35 x 12 cm RSDL	1 pair
54	Snap flast 30 x 30 x 10 cm RSDL	1 pair
55	Spirit level	5
56	Wheel Barrows	2
57	Weighing machine (cap: 0.001 to 150gm)	1 no.

C: List of Equipments & General Installations

Sl. No.	Item	Quantity
1	Air Compressor with maximum working pressure of 17.5 kg/cm^2	1 no.
2	Pneumatic Rammer with Rubber Rammer head	1 no.
3	Pneumatic Chisel (with suitable chisel)	1 no.
4	Moulding Sand mixmuller 35 kg capacity with motor impeller 30 RPM	1 no.
5	Mould Green Hardness Tester dial type Risdale diels st.	1 no.
6	Core hardness tester	1 no.
7	CO_2 cylinder with CO_2 probe and Rubber Hoses with nozzle 12 mm wheel valve.	1 no.
8	LPG Cylinder with heating torch	1 no.
9	Cylinder trolly suitable to CO_2 cylinder and Indane Gas Cylinder	1 no.
10	Heating and pumping unit to suit to oil fired tilting type crucible furnace with Heating pressure gauge etc. Wesman model SPM Simplex model motorized Rotary gear oil pump pre-heater.	1 no.
11	Sand Testing Equipment- permeability meter, Universal Strength tester, Sieve shake, standard sand rammer, Shatter Index Tester, Clay content Tester, Speedy Moisture teller.	1each
12	Moulding Machine hand squeeze with stripping device pin lift type.	1 no.
13	Weighing machine 300 kg by 100 gms	1 no.
14	Pedestal grinder DE 35 cm power operated	1 no.
15	Core oven 180 x 90 x 90 cm electric hot air circulated with maximum temperature 350^oC adjustable	1 no.
16	Cupola capacity 1.5 tons/hours. Motorised blower and pipe line volume gauge, pressure gauge, charging platform, blast control valve spark arrester.	1 no.
17	Sand Sampler	1 no.
18	Auto Sand riddle with 3 tons/hors. ridding capacity	1 no.
19	Sand Erator	1 no.
20	Oil Fired tilting type crucible furnace furnace to fit no. 100 crucible	1 no.
21	Induction furnace (Cap:50Kg) suitable for non-ferrous metals	1 no.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: FURNACE OPERATOR (STEEL INDUSTRY)

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20 Nos.
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20 Nos.
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20 Nos.
4.	Mini drafter	20 Nos.
5.	Drawing board (700mm x500 mm) IS: 1444	20 Nos.

B : FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
1	Drawing Board	20 Nos.
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01
6	White Board (size: 8ft. x 4ft.)	01
7	Trainer's Table	01
8	Trainer's Chair	01

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: FURNACE OPERATOR (STEEL INDUSTRY)

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (*i.e. 12 months*) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.