CURRICULUM

FOR THE TRADE OF

FORGER & HEAT TREATER

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

CONTENTS

1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

1. Maruti India Ltd., Gurugram
2. Volkswagan Academy, Pune
3. OCL Ltd. (Dalmia Group), Odisha
4. Bharat Heavy Electricals Ltd., Ranipet, Tamil Nadu
5. TATA Motors, Pune
6. JBM Group, Chennai
7. MTAB Technology (P) Ltd., Chennai
8. Kirloskar Brothers Limited (KBL), Pune

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

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Remarks
1.	N. Nath, ADT	CSTARI, Kolkata	Expert
2.	R. N. Manna, T.O.	CSTARI, Kolkata	Expert
3.	Damodar Mandal, T.O.	ATI, Kolkata	Expert

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 **Forger & Heat Treater** trade)

1. It will help the Heat treatment operators oversee the machines and equipment that apply treatments to metals. They clean, harden, temper (strengthen) and anneal (soften) metals ready for use in the production of manufactured components.
2. It will enhance the ability of the trainees to forges and repairs variety of metal articles, such as tongs, edged tools, hooks, chains, machine and structural components, and agricultural implements.
3. It will enhance the ability of the trainees to hammers stock into specified size & shape on blacksmiths anvil or positions stock on anvil of power hammer and depresses pedal to hammer stock with varying force rapidity.
4. It will enhance the ability of the trainees to heats metal stock in blacksmiths forge or furnace [Heater].
5. It will help the trainees to prepare devises jigs fixtures, forges special hand tools, like hammers or chisels, and sets up form blocks
6. It will enhance the ability of the trainees to tempers or anneals forged articles [Heat treater heat treating].

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

Blacksmith; Forges metal required shape and size by processes heating, bending, hammering etc. Heats metal and furnace to required degree of temperature. Places it on anvil holding it with tongs and forges it to required shape and size by hammering either himself or by Hammerman. May use swages, sets from tools, jigs, etc. according to shape required. May weld by forging (joining two pieces with brass and borax by heating), and work by cold process is designated as ANGLESMITH OR SPRING SMITH if specialized in working on angle iron or in making springs.

Hammer Operator; Forging Machine Operator forges iron or steel to required dimensions by heating and hammering with power hammer. Heats metal red hot and adjusts it below hammer on anvil with tongs. Holds it firmly with tongs and operates hammer by paddle or signals to Leverman to operate power hammer with required force and momentum. Turns sides of metal by tongs for hammering according to requirements. May heat or get metal heated number of times according to necessity. May finish article by himself striking it with hand hammer.

Hammerman; Striker hammers iron and steel to required dimension with sledges according to direction of Blacksmith. Selects sledge according to nature of forging and strikes hot metal hard or light as per direction of Blacksmith. May also work by cold process.

Stamper; Drop Forger shapes articles from metal pieces by using dies and drop forging or stamping machine. Sets required die and punch securely in machine, heats metal to red hot and firmly places it on die holding it with long tongs. Signals Stamper, Helper to bring punch down with force. Checks formation by sight and adjusts position of material every time before strike. Applies oil, saw dust or powdered coal on die before stamping. May reheat and handle more than one set of die for completing article. May also work by cold process in case of hammer dies and metal sheets.

Blacksmiths, Hammer- smiths and Forging-press Workers, other perform variety of routine and low skilled tasks not elsewhere classified, in smithy section such as operating levers of power hammer, pulling string of drop forging machine, assisting Forging Machine Operator in placing material on anvil or carrying it off and are designated according to nature of work done.

Heat Treater controls heat-treating furnaces, baths and quenching equipment to alter physical and chemical properties of metal objects, using specifications and methods of controlled heating and cooling, such as hardening, tempering, annealing, case-hardening, and normalizing: Determines temperature and time of heating cycle, and type and temperature of baths and quenching medium to attain specified hardness, toughness, and ductility of parts, using standard heat-treating charts, and utilizing knowledge of heat-treating methods, equipment, and properties of metals. Adjusts furnace controls and observes pyrometer to bring furnace to prescribed temperature. Loads parts into furnace. Removes parts after prescribed time and quenches parts in water, oil, brine, or other bath, or allows parts to cool in air. May test hardness of parts. May set up and operate die-quenching machine to prevent parts from warping. May set up and operate electronic induction equipment to heat objects.

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-2004: 7221.50, 7223.30, 8152.90, 8152.75**

5. GENERAL INFORMATION

1. **Name of the Trade** **: FORGER & HEAT TREATER**

2. **N.C.O. Code No.** : **NCO-2004:** 7221.50, 7223.30, 8152.90, 8152.75

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):**2years

3.1 **For Freshers: -** Duration of Basic Training: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: **6 months**

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: **18 months**

3.2 **For ITI Passed: -** Duration of Basic Training: - **NIL**

Duration of Practical Training (On -job Training): **12 months**

4. **Entry Qualification** : Passed in 10th class examination under 10+2 system of education or its equivalent

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

6. **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	4-12	13-15	16-24
Basic Training	**Block– I**	**-----**	**Block – II**	**------**
Practical Training (On - job training)	**----**	**Block – I**	**------**	**Block – II**

Components of Training	Duration of Training in Months																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

7. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I & II)
DURATION: 06 MONTHS

GENERAL INFORMATION

1) **Name of the Trade** : **FORGER & HEAT TREATER**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 11 KW for Workshop
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/Metallurgy Engineering/Advanced Diploma in Foundry Technology** 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 Forger **& Heat Treater** 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)
1.	Engineering Drawing: Introduction and its importance Different types of standards used in engineering drawing. Drawing Instruments: their uses Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.	**30**	**Units & Measurements-** FPS, CGS, MKS/SI unit, unit of length, Mass and time. Fundamentals and derived units Conversion of units and applied problems.	**20**
2.	Lines : types and applications in Drawing as per BIS SP:46-2003 Drawing geometrical object using all types of lines. **Drawing of Geometrical Figures:** Angle, Triangle, Square, Rectangle and Circle. **Letters: -** Lettering styles, Single stroke letters and numbers as per IS standard. Lettering practice		**Material Science** : properties - Physical & Mechanical, Types - Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals	
3.	**Dimensioning-** Types of dimension, elements of dimensions, Methods of indicating Values, Arrangement, Alignment and indication of dimensions. **Scales**:-Types use and construction. Representative factor of scale.		**Mass .Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density,	
4.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view		**Speed and Velocity:** Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. Average Velocity, Acceleration & Retardation. Related problems. Circular Motion: Relation between circular motion and Linear motion, Centrifugal	

			force, Centripetal force	
5.	**Constructions: -** Draw proportionate free hand sketches of plane figures. Sketch horizontal, vertical and inclined line by free hand, Draw circles by free hand using square and radial line method, Draw arcs and ellipse by free hand		**Ratio & Proportion** : Simple calculation on related problems. **Percentage:** Introduction, Simple calculation.	
6.	Projections: Concept of axes plane and quadrant. Orthographic projections Method of first angle and third angle projections (definition and difference) Symbol of 1^{st} angle and 3^{rd} angle projection as per IS specification. Free hand Drawing of Orthographic projection from isometric/3D view of geometrical blocks		**Work, Power and Energy:** work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy. Meaning of H.P., I.H.P., B.H.P., and F.H.P. and CC and Torque.	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1.	**Screw :-** Its Types and Sizes, Screw thread, their standard forms as per BIS, external and internal thread.	**30**	**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	**20**
2.	**Rivets and Joints:-** Prepare a drawing sheet on rivets nomenclature and Joints.		**Heat & Temperature:** Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	
3.	Free hand Sketches for simple pipe line with general fittings.		**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids - cube, cuboid, cylinder and Sphere. Surface area of solids -cube, cuboid, cylinder and Sphere. Volume of cut-out solids: hollow cylinders, frustum of cone, block section. Volume of simple solid blocks.	
4.	Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries.		**Basic Electricity:** Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections - series, parallel, electric power, Horse power, energy, unit of electrical energy. Concept of earthling.	
5.	Simple exercises related to trade related symbols. Basic electrical and electronic symbols		**Simple machines** **Transmission of power:** - Transmission of power by belt, pulleys & gear drive. **Heat treatment process:** - Heat treatment and advantages.	

			Annealing, Normalizing, Hardening, Tempering.	
6.	Free hand sketch of trade related components / parts /cutting tool indicating angles.		**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding the value of unknown sides and angles of a triangle by Trigonometrical method. Finding height and distance by trigonometry. Application of trigonometry in shop problems. (viz. taper angle calculation). Calculate the area of triangle by using trigonometry and application of Pythagoras theorem.	
7.			**Concept of pressure** - **Definition**:-Force, Pressure, and their units, atmospheric pressure, gauges used for measuring pressure, problems. Introduction to pneumatics & hydraulics systems.	
8.	**Simple exercises related to trade related Test Papers. Solution of NCVT test papers.**			

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.	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 eg; 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. Global warming its causes and remedies. Industrial Waste its types, sources and waste Management.
2.	Method of heating iron, use of various Fire Zones in a forge while heating.	Fuels used in forge shop. Anvil, swage block, tongs, hammers, chisels, Description, their uses and maintenance. Importance of sawing, method of sawing, frames and blade-centre punches and dot punch.
3.	Method of Hand Hammer practice, Forging various cross sections.	Measuring and marking tools used in forging. Description their uses and maintenance.
4.	Use of Tongs, Hammers and Anvil etc. Reading of Brass Rule, use of caliper for measurement.	Metals –Ferrous Metals and Nonferrous; their physical and Mechanical properties. Forgeable Non-forgeable metals. Pig iron, cast-iron, wrought iron, steel properties and uses. Advantages of forging over other manufacturing process.
5.	Sledge Hammer practice, Drawing out, Jumping operations, method of various sledge-hammer, Fuller, Swages, and swage Block etc.	Hand forging operations, drawing out, jumping, cutting, Finishing, spreading, tapering.
6.	Forge flat taper, Round taper, Square and Hexagon tapers with correct size.	Steels and their classification, composition, properties uses. Punching-Method of punching, defects, remedies, effect of hot working and cold

		working changes in properties of steel on heating.
7.	Drawing out various cross sections of square, Round, Hexagon Octagon etc.	Process of the steel for forging-Oxidation and De carbonization. Defect in for and Remedies.
8.	Forging of various chisels, Flat, crosscut, Diamond point and, Round Nose etc.	Files classification, Selection of Files, for proper work. Equipment and tools used in Fitting shop. (Vice, Hammers, Chisels, marking Tools)
9.	Forging of Bolts & Rivets by using Bolster.	Need of heat-treatment for cutting tools, hardening and tempering of cutting tools by single heating and double heating method. Definition of Annealing and Normalizing Different between the above.
10.	Forging of Spanners, Box spanners and Ring spanners, use of punches and drifts.	Importance of power forging. Advantages and application in industry-importance of oil fired furnace-construction working principle.
11.	Bending of solid Bars in different cross sections. Cold and Hot method.	Various types of power hammer. Spring power hammer-pneumatic power hammer-working Principle-uses-operations and safety.
12.	Hardening and tempering of chisels and other cutting tools. Use of colour chart. Practice of annealing & Normalising of steel, by using open fire test by hammer.	Principle of drop hammer types-operations controlling the hammer blows-maintenance and Safety rules.
13.	**Revision & Internal Assessment**	

B. Block –II
Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Hardening and tempering of chisels and other cutting tools. Use of colour chart. Practice of annealing & Normalising of steel, by using open fire test by hammer.	Annealing-Normalizing- Hardening and tempering process for plain carbon steel.
2.	Method of operating Oil Fired Furnace and power Hammer practice. Forging various cross section by using power Hammer. (a) Round to Square. (b) Square to Round.	Allowance for various seems bending, swaging, plainshing and flattening of sheet. Different development method of elbow, cones, bucket. Safety rules to be followed in sheet metal workshop.
3.	Drawing out and setting out operation using power hammer. Forging a cube using a power hammer.	Safety while working in heat treatment shops. Types of furnaces. Electrical oil fired, salt bath furnaces, Induction heater etc. Description and use.
4.	Forging different types of forgings such as Die casts the help of power Familiarization of tools and equipment used in sheet-metal: Practice on marking and cutting of sheets	Principle of Heat Treatment. Method of hardness Measurements, Rock well, Brinell and Vickers test. Iron carbon phase diagram for plain carbon steels, critical temperature, Structure of Ferrite, pearlite.
5.	Practice on Forming different shapes in sheets Forming Funnel, Rectangular Boxes, Riveting and Grooving by using stakes. Fabrication of sheet metal container by soldering and Brazing.	Forging High speed steel tools temperature-used. Tools used- precaution to be followed. Allowance for forging,
6.	Safety precaution observed while using Electrical Furnace and construction detail of Heat-Treating Furnace. Operating of Furnace and their controls. (a) Oil Fired Furnace. (b) Electric Furnace (Direct and Indirect)	Importance of forge welding and its principle-welding fire scarfing, Types of welding joints-Lap-Butt joints cleft 'V' welding
7.	Observation of Temperature, distribution of Muffle Furnace and heating methods for various jobs. Practice by using Rock well Hardness Tester. Identification of steel. By Spark test and sound test.	Punching and drifting methods, different types of punches and drifts. Precaution should be observed while working on high carbon steel. Method of equalizing temperature to avoid burning of steel. Surface Hardening method, Pack carburising, Gas carburising Nitriding, carbontriding,
8.	Effect of different Quenching Medias on Henders steel, Brine cold water, oil, air and Warm water. Annealing, Normalizing, Hardening and Tempering operations by using Electrical oil Fired Furnace.	Heat Treatment of Nonferrous metals.
9.	Forge Butt welding practice on thicker section,	Heat-Treatment of Low Alloy, Steel-medium Alloy

	welding practice on Low and High carbon steel bar.	Steel and High Alloy steel.
10.	Forging and Eye-Bolt. Forging a Crane Hook. Forging spanners. Forging Carpentry Tools. (Firmer Chisel-Mortise chisel claw Hammer).	Working principle of Forging presses. Types, Safety rules forging operations Handling mechanisms etc.
11.	Forming of Lathe Tools. a. Screw cutting tool. b. Parting tool. c. Boring tool. d. From tool.	Time-Temperature and transformation diagram and cooling curves for different steels.
12.	Hardening and tempering of-high speed steel and aprong steel. Heat treatment of stainless steel. Forging an Adze by Forge welding, Grinding and Heat treatment.	General information on automatic Forging and stamping machine. Estimation of cost of forged and Heat-Treatment. Study of Forging defects, Fabrication defects, Heat Treatment Defects etc.
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	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	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 & II)
DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) **Name of the Trade** : **FORGER & HEAT TREATER**

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/Metallurgy Engineering/Advanced Diploma in Foundry Technology** 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 **Forger & Heat Treater** 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 (09 months)

1. Safety and best practices/Basic Industrial Culture (5S, KAIZEN, etc.) emphasizing more on housekeeping.
2. Prepare different types of documentation as per industrial need by different methods of recording information.
3. Familiarization, Introduction to the trade importance, machinery used in the trade.
4. Introduction of safety including fire fighting Equipments and their use.
5. Method of heating iron, use of various Fire Zones in a forge while heating.
6. Using of hammers and cold chisels.
7. Jumping operations- Full, Middle and End.
8. Forging of various chisels, flat, crosscut, Diamond point, flat taper, Round taper, Square and Hexagon tapers with correct size and Round Nose etc.
9. Forging of Bolts & Rivets by using Bolster, Spanners, use of punches and drifts.
10. Bending of solid Bars in different cross sections. Cold and Hot method.
11. Filing Practice. Uses of various Files. Grinding practice.
12. Marking, Punching, Chipping, Drilling, Taping, Threading and Hack sawing.
13. Hardening and tempering of chisels and other cutting tools. Use of colour chart. Practice of annealing & Normalizing.
14. Different types of forgings such as Cube, Die casts, Using of power Hammer.
15. Riveting practice (Cold and hot).
16. Learning different types of furnaces.
17. Drop forging of machines parts.
18. Non-conventional heat treatment process
19. Hardness testing methods & scales

B. BLOCK – II (09 months)

1. Forge welding practice on rounds, Square and Flat Bars. Lap Welding on Links & ring.

   Forge Butt welding practice on thicker section, welding practice on Low and High carbon steel bars.
2. Hand forging of items of agricultural implements and hand tools.
3. Fabricating small cylindrical cans, buckets, rectangular containers from sheet metal.
4. Soldering and joining of ferrous and non-ferrous components (Soft & Hard).
5. Brazing the tool tips with holder.
6. Making of coil spring and tempering.
7. Bending of steel pipes and strips to different radius and angles.
8. Making set of leaf spring and tempering.
9. Assembling:

(a) Male and female fitting.

(b) Parts by riveting so as to make complete unit according to drawing.

10. Operations of Pneumatic power hammer, Steam hammer, Hydraulic Presses.
11. Forge the Lever double eyes, Bell crank lever Double ended spanner (stamping).
12. Heat treatment of forged components. Case hardening in steel, Carburising, Cyaniding and nitriding, Flame hardening, Induction hardening, Studying of hardness of case hardening parts at different places in its cross section (case and depth).
13. Tempering of hardened steel at different temperatures for varying carbon to be checked after every exercises.
14. Hardening of steel at different temperatures, different carbon contents and hardness to be checked after every exercise.
15. Annealing of steel of various carbon content. Exercises to be carried out at their corresponding annealing temperatures. Hardness of part to be checked before and after annealing.
16. Allowances for forged components-shrinkage allowances for different steels and non ferrous metals. A chart is to be prepared; it is to be verified by actually measuring the components dimensions.
17. Ergonomics - Handling methods of heavy parts
18. Pollution control standards - Forging & Heat treatment
19. Inspection and acceptance, methods of forged and heat treated material-detection of micro cracks, internal cracks, surface cracks, ISO standards.
20. Perform TPM (Total Productive Maintenance), TQM (Total Quality Management) and record keeping system.

8. 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:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

b) 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 the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) 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 the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST

(SUMMATIVE ASSESSMENT FOR TWO YEARS TRADE)

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.

9. FURTHER LEARNING PATHWAYS

- On successful completion of the course trainees can opt for Diploma course (Lateral entry). [Applicable for candidates only who undergone ATS after CTS]
- On successful completion of the course trainees can opt for CITS course.

Employment opportunities:

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

1. Production & Manufacturing industries.
2. Structural Fabrication like bridges, Roof structures, Building & construction.
3. Automobile and allied industries
4. Service industries like road transportation and Railways.
5. Ship building and repair
6. Infrastructure and defence organisations
7. In public sector industries (Central and State) and private industries in India & abroad.
8. Self employment

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: FORGER & HEAT TREATER

LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A: TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (Indicative)
1	Goggles	16 pairs.
2	Gloves	16 pairs.
3	Apron leather 106 cm	16 pairs.
4	Blacksmiths safety boots	16 pairs.

B : SHOP OUTFITS PER UNIT:-

Sl. No.	Name of the items	Quantity (indicative)
1	Brass Rule 300 mm	8 nos.
2	Calipers outside 20 cm	8 nos.
3	Calipers inside 20 cm	8 nos.
4	Compass wing 20 cm	8 nos.
5	Smith square 45cm x 30 cm	8 nos.
6	File flat rough 35 cm double cut	8 nos.
7	File half round rough 25 cm	8 nos.
8	File square rough 25 cm	8 nos.
9	File triangular rough 20 cm	8 nos.
10	Hardia or bottom sit for anvil 5 cm	4 nos.
11	Tong bolt 300, 500, 1000, 1500 mm	6 each
12	Tong side 300, 500, 1000, 1500 mm	6 each
13	Tong flat 300, 500, 1000, 1500 mm	6 each
14	Tong round 300, 500, 1000, 1500 mm	6 each
14	Tong hollow bit 300, 500, 1000, 1500 mm	6 each
16	Set cold roded	16 nos.
17	Chisel cold flat 2.5 x 20 cm	16 nos.
18	Chisel cold flat 6 mm	16 nos.

19	Flatter rodded 63 mm square	4 nos.
20	Swage top 12 mm rodded	4 nos.
21	Swage top 19 mm rodded	4 nos.
22	Swage top 25 mm rodded	4 nos.
23	Fuller top rodded 6 mm	4 nos.
24	Fuller top rodded 12 mm	4 nos.
25	Fuller top rodded 19 mm	4 nos.
26	Fuller bottom 6 mm	4 nos.
27	Fuller bottom 12 mm	4 nos.
28	Fuller bottom 19 mm	4 nos.
29	Swage bolster 12 x 15 x 19 mm in set of 3	2 sets.
30	Centre punch 10 cm	2 nos.
31	Punch round 19 to 38 mm x 6 mm raising by 6 mm	2 sets.
32	Punch round 6 to 15 mm x 3 mm raising by 6 mm	2 sets.
33	Punch oval 25 x 12 mm	4 nos.
34	Punch oval 25 x 38 mm	4 nos.
35	Punch oval 38 x 19 mm	4 nos.
36	Hammer smith 1.8 kg. handled	4 nos.
37	Hammer smith 0.9 kg. handled	4 nos.
38	Swage bottom 5 mm	4 nos.
39	Swage bottom 12 mm	4 nos.
40	Swage bottom 14 mm	4 nos.
41	Square mouth tong	4 nos.
42	Blacksmith’s bending link	4 nos.
43	Blacksmith fork	4 nos.
44	Blacksmith’s levelling block with holes and accessories for bending	1 no.
45	Steel rule 30 cm	8 nos.
46	Try square engineers 15 cm	4 nos.
47	Hacksaw frame adjustable 30 cm	4 nos.
48	Hammer sledge 3.2 kg. double faced handled	4 nos.
49	Hammer sledge 6.3 kg. double faced handled	2 nos.
50	Hammer set 0.9 kg. handled	4 nos.
51	Hammer set 1.8 kg. handled	2 nos.
52	Rivet snap 9 and 12 mm set of two	2 sets.
53	Goggles	1 pair
54	Poker	1 pair
55	Shovel	4 nos.
56	B.S.W. taps and dies 6 to 12 mm by 1.5 mm witha set of suitable tap size drills	1 set.
57	Rake hand	4 nos.
58	Hot set rodded	2 nos.
59	Drill twist 3 to 12 mm by 1.5 mm set	1 set.
60	Tank, water 15 x 75 x 4 cm	8 nos.
61	Block swage 35 cm x 35 cm x 12	2 nos.

62	Leg vice 10 cm jaw	2 nos.
63	Work bench 182 cm x 91 cm x 6 cm	4 nos.
64	Almirah 182 cm x 12 cm x 45 cm cast iron or stainless steel	1 no.
65	Wheel barrow	1 no.
66	Annealing box 25 x 10 x 25 cm	1 no.
67	Metal rack 182 x 152 x 45 cm	2 nos.
68	Steel lockers with drawers (standard size)	2 nos.
69	Black board with easel	1 no.
70	Fire extinguisher	2 nos.
71	Fire buckets	4 nos.
72	Safety blanket	1 no.
73	Anvil london pattern 150 kg.	3 nos.
74	Bench vice 15 cm jaw	4 nos.
75	Mallet wooden 0.66 kg	4 nos.
76	Soldering copper 0.27 kg	4 nos.
77	Protractor with blade	2 nos.
78	Tinman's square 45 cm x 60 cm	4 nos.
79	Standard sheet metal gauge	1 no.
80	Stake ratchet	4 nos.
81	Stake round & bottom	4 nos.
82	Stake half moon	4 nos.
83	Funnel	4 nos.
84	Bick iron	4 nos.
85	Horse	2 nos.
86	Hammer greasing	4 nos.
87	Hammer plasting	4 nos.
88	Shear tinman's 30 cm	8 nos.
89	Snip straight	8 nos.
90	Snip bend	8 nos.
91	Hand shear universal	2 nos.
92	Punch round 4 mm	4 nos.
93	Revit sets and combined 4 mm	4 nos.
94	Revit sets and combined 6 mm	4 nos.
95	Groover 6 mm	4 nos.

96	Groover 4 mm	4 nos.
97	Blow lamp 4 pint	1 no.
98	Blow lamp 1 pint	1 no.
99	Drill hand 0 to 6 mm, 8 mm, 10 mm and 12 mm	2 nos.
100	Hammer raising 0.45 kg.	2 nos.
101	Soldering iron 425 mm	4 nos.
102	Rawl punch holder and bits	2 nos.
103	Hand vice 5 cm No. 1	2 nos.
104	Brush steel wire 5 cm x 15 cm No. 1	4 nos.
105	Gloves pairs for welding No. 1	4 nos.
106	Trammel medium	1 no.
107	Portable forge	2 nos.
108	Welding plant oxy-acetylene complete (High pressure) (To be provided where no welding trade exists)	1 no.

C : GENERAL MACHINERY INSTALLATIONS:-

Sl. No.	Name & Description of Machines	Quantity (indicative)
1.	Forge with hood and chimney blowers forge capacity 1000 cft/main 15 cm water gauge pressure complete with electric motors, starter and switch with air pipe linecocks etc. complete set.	8 nos.
2	Blacksmith's cones 25 to 38 mm and 76 to 254 mm	2 nos.
3	Lever shear hand operated blade 30 cm	1 no.
4	Pipe bending machine manually operated	1 no.
5	Pneumatic hammer 50 kg. with accessories capacity 30 cm stroke motorised	1 no.
6	Pneumatic hammer 100 kg. with accessories capacity 50 cm stroke motorised	2 nos.
7	Pillar type drilling machine 12 mm capacity.	2 nos.
8	Pedestal grinder with 20 cm wheels.	1 nos.
9	Oil fired furnace for forging 3 ft. x 3 ft. x 2 ½ heating range upto 1350 C	1 nos.

10	Electric furnace rating about 12 kW., 440 volt, 3 phase upto 1000 C, 50 cycles chamber size 300 x 200 x 500 mm with automatic temperature pyrometers	1 no.
11	Oil Quenching tank 50 litres capacity	1 no.
12	Water tank for quenching capacity about 50 litres.	1 no.
13	ckwell hardness testing machine with ABC scale load 60, 100 and 150 kgs.	1 no.
14	Alloy steel test pieces of known composition of atleast 15 different steel pieces	1 no.
15	Shearing machine for cutting flat, square round bars and planes hand operated (any smaller make)	1 no.

Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: FORGER & HEAT TREATER

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: FORGER & HEAT TREATER

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. 9 months + 9 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.