

OPTICAL WORKER

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – PRODUCTION AND MANUFACTURING



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

OPTICAL WORKER

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)



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Developed By

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1.1 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.

1.2 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.

1.3 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.



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2.1 GENERAL

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

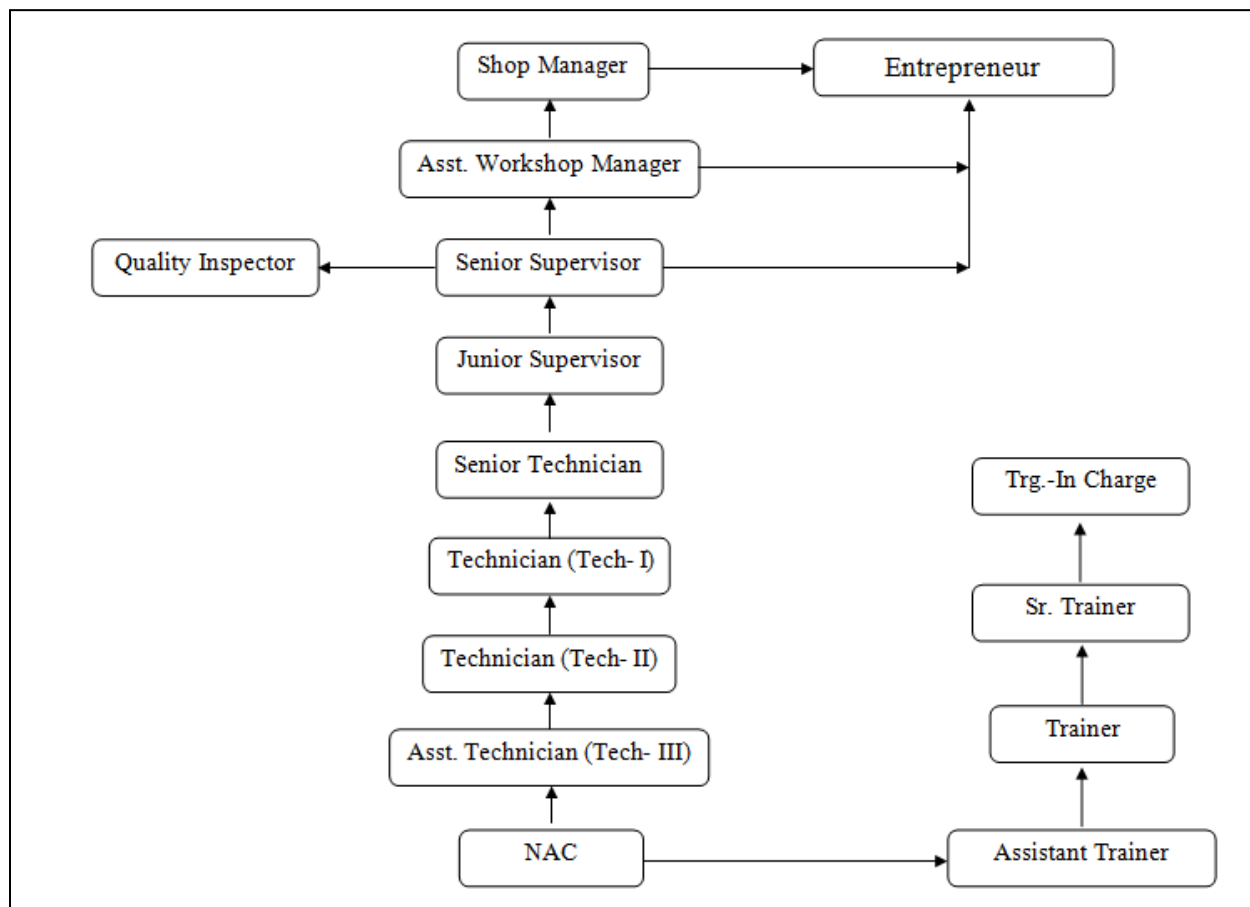
Optical Worker trade under ATS is one of the courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:-

- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*): -

Total 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

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A. Basic Training

For 02 yrs. course (Engg.) :-(**Total 06 months:** 03 months in 1st yr. + 03 months in 2nd yr.)

For 01 yr. course (Engg.) :-(**Total 03 months:** 03 months in 1st yr.)

S No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	For 01 Yr. course
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	1000	500

B. On-Job Training:-

For 02 yrs. Course(Engg.):-(**Total 18 months:** 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. course (Engg.):-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course(Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course(Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training

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institute have to maintain individual trainee portfolio as detailed in assessment guideline (section-2.4.2). The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline (section-2.4.2) before giving marks for practical examination.**

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to 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 the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination 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	

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

Brief description of Job roles:

Optical Worker cuts and grinds optical components. Coats them by vacuum deposition. Cements optical glass lenses; etches, engraves and prints metals/nonmetals using photographic or ruling techniques. Applies chemical and spray techniques in assembly of optical instruments. Cuts blanks from slabs/moulds and smoothes and polishes on machine or by hand operation. Centres and edges the lenses. Carries out on line stage and interline stage inspection of components. May make test plates, master and articulates by photographic techniques, thin film multilayer vacuum deposition for wide band anti-reflection and laser mirror coating.

NCO Code 2015: 7315.1100 - Optical Worker



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4. NSQF LEVEL COMPLIANCE

NSQF level for Optical Worker trade under ATS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a) Process
- b) Professional knowledge,
- c) Professional skill,
- d) Core skill and
- e) Responsibility.



The Broad Learning outcome of Optical Worker trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and Learning and some responsibility for other's works and learning.

5. GENERAL INFORMATION

Name of the Trade	Optical Worker
NCO-2015	7315.1100-Optical Worker
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months Total duration of Basic Training: 6 months
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months Total duration of Practical Training: 18 months
Entry Qualification	Passed 10th class examination under 10+2 system of education or its equivalent.
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related trade of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	One year
CTS trades eligible for Optical Worker Apprenticeship	i. Machinist ii. Machinist (Grinder) iii. Turner iv. Fitter v. Millwright Maintenance Mechanic

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.
- For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Optical Worker course of 02 years duration under ATS.

Block I & II

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain principles and operational features of machine tools
7. Explain property and characteristics of optical
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

Block – I

1. Practice on tool Grinding- chisel, twist drills etc.
2. Shape a tongue and groove to dimensions.
3. Shape a Vee block with slots on the side and check the dimension with measuring instruments and tools.
4. Practice steps of drilling and boring in lathe reaming the bores to correct sizes.
5. Tapping and Die Threading in Lathe-knurling in lathe.
6. Taper turning by (i) Swiveling hand slide and (ii) by the taper attachment.
7. Cutt V-Threads in lathe (External and Internal) & check with screw pitch gauge.
8. Mill V- block using double end mill cutter checking up with bevel protractor.
9. Radius grooving – both concave and convex milling. Check the depth of groove.

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10. Barking out and milling slots, dovetails and grooves to dimensions use of side face cutter and dovetail cutter.
11. Select suitable Grinding wheels to grind different types of work using jigs, fixtures, angel plates, V-Blocks vice chuck, etc.

Block – II

1. Perform Trepanning process on Glass blanks with help of trepanning machine
2. Work on curve generating machine and obtain radius on glass blanks with help of setting of angles of the curve generator.
3. Determine radius of curvature.
4. Milling of glass on milling machine.
5. Obtain glass blanks for manufacture of prisms from moulds and the glass
6. Grind the lenses and flats to correct dimensions.
7. Make Test plates.
8. Polish lenses, prisms, other flat surfaces for window graticules and mirrors.
9. Cement optical parts
10. High vacuum apparatus and coating of optics
11. Practice on Chemical silvering of glass
12. Graticule engraving, by dry and wet methods.
13. Practice on Process Camera.

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

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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to avoidance of same.
	1.13 Take opportunities to use energy and materials in an environmentally friendly manner
	1.14 Avoid waste and dispose waste as per procedure
	1.15 Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic electrical and	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.

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apply in day to day work. <i>[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure</i>	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. <i>[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]</i>	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts
6. Explain principles and operational features of	6.1 Explain the working principles of different machine tools

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machine tools	6.2 Assign suitable machine for suitable job.
7. Explain property and characteristics of optical	7.1 Explain the procedure for handling the different glasses
	7.2 Recognise the use of glasses for desired usage
	7.3 Choose the suitable machines for suitable operation of glasses.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
<u>Block- I &II (Section:10)</u>	
<i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under block – I &II(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of Planning (Identify, ascertain, estimate etc.); Execution (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and Checking/ Testing to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.</i>	

BASIC TRAINING (Block – I)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Familiarisation with the institute. Importance of trade training, Machinery used in the trade. Instructions in Safety Precautions as applicable to the trade including firefighting equipment and their uses.	Importance of safety and general precautions observed in the institute and in the section. Importance of the trade in the development of industrial economy of the country. What is related instruction – subjects to be taught- achievement to made – Recreational, medical facilities and other extra-curricular.
2-3	Identification of tools & equipment as per desired specifications for marking & sawing(Hand tools , Fitting tools & Measuring tools). Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc. Uses of marking tools, Punch, Try square & basic measuring tools, caliper, steel rule. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions, sawing different types of metals of different sections. Chipping flat surfaces and grinding various angles to chisels, filing flat surface. Grooving with Hammer and chisel. Filing Flat surfaces, Tee shape job, flat type polygon, checking with steel rule and Try square. Marking and Drilling holes on flat pieces. Tapping as per simple drawing.	Hand tools and its importance, steel rule, Try square, chisel, surface gauge and care & maintenance, Hacksaw frame, blades. Classification and types of chisels, files & uses, vices - its constructions and uses. Hammers and its types. Related safety. Marking block, Steel rule, and calipers- different types and uses. Hacksaw blade, Hacksaw frame and its types. Drill bits- parts, Types & uses. Introduction to Hand Taps & Dies and their types, applications, care and maintenance. Familiar with tap and drill size, Thread Terminology. Use of vernier caliper and its parts, construction, principle & reading, use & care. Outside micrometer, its types and construction, parts, reading use, care and maintenance. Study about Depth gauge, micrometers and dial test indicator - their parts and construction. Limits, fits, tolerances and allowances, Engineering fits-force, driving and push fits definition and explanation of the terms- unilateral and bilateral system-explanation and examples –standardisation and interchange ability
4-5	Drilling open and blind holes according to the diagram	Drills kinds of drill nomenclature, sockets and drill chucks. Specification of the drills

	Practice tapping and threading with tap & dies.	– cutting speed and feed. Grinding of twist with correct cutting angle and clearance- safety precautions, Drilling machines – different types – bench, pillar, radial and multiple spindle specification and special feature of each constructional details and safety. Taps and Dies – definition, use care and maintenance, Thread terminology – determining the drill size for tapping a standard size of thread. Tap wrenches, construction and standard dimensions. Threading lubricants.
6	Practice fitting of mating parts to close limits-checking the finished job using instruments like vernier caliper, micro meter, dial indicator, etc.	Micrometer principle and construction- various parts, reading of micro-meter both English and metric. Use of micro-meter with job held in machine- their care maintenance Micrometer depth gauge, Vernier Caliper , inside micrometer and Dial Test Indicator –construction principle, Use, care and maintenance
7	Introduction to Shaping machine and its construction. Setting of strokes, tools, job on table. Safety points to be observed while working on a shaper. Setting of vice, setting of block on vice checking accuracy. Machining of Rectangular, Hexagonal block, steps, with the use of Basic tools as per sketch checking with caliper & steel rule, angle protractor.	Introduction of shaper, types, classification, General principles of power transmission on shaping mechanism. Shaping parts, construction use of parts, quick return mechanism ratio etc. Various tools of shaping machine and their angles and importance of angles.
8	Holding of round job in an independent chuck and truing it. Holding the tool in a tool post, centering the job with the tool. Facing & drilling. Parallel turning between centers, parting off, chamfering using roughing, finishing and parting off tools.	Introduction to lathe. Its types, engine lathe construction, detail function of parts size and specification. Safety points to be observed while working on a lathe. Lathe tools their angles & uses. Driving mechanism, speed and feed mechanism & lathe accessories.
9	Holding the job in three jaw chuck truing, centering facing. Step turning undercutting, knurling drilling and boring. Taper turning by swiveling compound	Chucks-different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks. Taper introduction, types and uses.

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	rest, setting the compound rest to correct degree, checking the tool height, clamping the saddle for no longitudinal movement, checking up with precision instruments.	Calculations of tapers. Measurement of taper by sine bar and slip gauges. Different thread forms their related dimensions and calculations screw cutting in a lathe.
10	Demonstration on horizontal and vertical milling machines, Setting of vice parallel and square to the table setting the work in the vice. Milling the rectangular block to dimension taking gradual cuts with slab cutter and registering the depth of cut taken each time with machine dial.	Milling machines. Importance of Milling machines, types of mills machine – Horizontal milling machine, Vertical milling machine and Universal milling machine, special features of each milling machine.
11	Performing simple operations on horizontal and vertical milling machines up to an accuracy of $\pm 0.075\text{mm}$. Practice on Grooving operation	Horizontal Milling machine constructional details and function of apart -columns arbor, support , spindle Table size and specification. Main difference between plain and universal Milling machine Collant pump and cutting fluid. Milling cutters- classification of milling cutters-cylindrical, side and face shell and cutter, angular- cutter sloting cutter, slitting saw, Gear cutter and their uses
12	Demonstration on grinding machines Practice on rough and finish grinding on surface grinding machines according to drawing slot grinding practice.	Grinding machines-types-working-principles construction size and specifications driving mechanism – speed and feed control safety precautions, Bench, Pedestals, surface, cylindrical, controllers, tools and cutter and universal grinding machines their description and uses.
13	Internal Assessment/Examination (03days)	

Note: - More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.

BASIC TRAINING (Block – II)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Practice on Wheel balancing & truing. Grinding of parallel and stepped jobs. Dressing of grinding wheels.	Grinding wheel-types of abrasive-structure of grinding wheel, grain grade, bond, standard shapes and designation of grinding wheels, Bond their classification and use. Selection of grinding wheels – mounding turning, dressing, care and maintenance of grinding wheel. Speed of grinding wheels for different operations.
2-3	Dry and wet grinding or different metals such as steel, C.I., Brass, Aluminum etc.	Dry and wet grinding defects in grinding and their remedies – use of coolants in grinding their composition and selection- grinding methods external and internal grinding- operational procedures- rough and finish grinding- grinding allowances and tolerances according to JST standards.
4	Milling of glass on milling machine. Obtain glass blanks for manufacture of prisms from moulds and the glass.	Glass, its classification and properties of different types of glasses, clear and tinted Glass. Refractive index, value method of manufacture of moulds. Characteristics optical Glass, its inspection. Defects in optical Glass. Concepts in optics, geometric axis and optical axis, measurement of refractive index, relation of radii on focal length of lenses. Tracing in optical systems. Determination of focal length.
5 -6	Trepanning of Glass blanks with help of trepanning machine.	Methods of cutting glass tepanning, grinding. Obtaining correct shape, principle of curve generators, tools used for operations. Blocking of glass components on methods of blocking reason of difference with mechanical components. Determination of size of mounting tools and polishing tools number of components to be mounded.
7	Slicing of Glass with the help of glass slicing machine, manual slicing and machine slicing.	Cutting tools, absasives and materials, their classification selection for different operations. Other chemical/process

Optical Worker

		material used in optics production and their requirements and characteristics. Care custody and maintenance of correct shaping tools.
8	Inspection of Glass for bubbles and Inspection of polished glass surface for its defects.	Reason for maintenance of atmospheric control for optics production. Smoothing, grinding and roughing machines used for operation their characteristics and determination of surface quality of jobs dimension for further operation. Polishing process its difference with other process. Similarity of process with mechanical process. Rocker arm mechanism, control of speed, length of stroke, weight, cutting of polisher.
9	Demonstration on Spherometers, Interferometers and measurements.	Centering and edging of the lenses, types of machines used, checking centering of lenses. Bell clamp and moving image method. Inspection of optical parts. Surface equality types of instruments used for inspection collimator, autocollimator sperometer, interferometer. Defects of optical components, reasons and remedial measures. Progress towards quantisations of defects. Cleaning of optical components.
10	Inspection of Glass for bubbles and Inspection of polished glass surface for its defects.	Modern methods of mass manufacture of quality Optics manufacture of higher quality optics, testplates, recesstools, optical contact methods, diamond fines milling. Theory of manufacture of a spheric surfaces, their use in Optical technology. Methods of coating on glass like chemical, spray, vacuum, coating electro depositer. Reasons for coating. Reflecting, anti-reflecting antifrugal coating chemical silvering.
11	Practice construction of vacuum coating plant, operate and upkeep	Theory of reflection, anti-reflection vacuum coating plant construction,

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	vacuum coating plants, deposition in high vacuum & different types of coating. Construction of process camera; make graticules through photographic method.	operation and upkeep of vacuum coating plants, deposition in high vacuum, reflecting, anti-reflecting, partly reflecting coating. Photographic techniques, process camera construction and use. Photographic method of manufacture of graticules masters, scale etc. vacuum deposition method etching of manufactures of graticule. Pantograph its principle. Types of filters and their use. Types of lamps and light sources.
12	Practice cementing techniques of various optical glasses; Jigs fixtures for cementing Optical cements; operating equipment required for cementing and centering.	Cementing of lenses, prisms, case and qualities of cemented jobs. Jigs fixtures for cementing Optical cements and their characteristics equipment required for cementing and centering. Demonstration of various operations.
13	Revision & Internal Assessment(03days)	

Note: - More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.

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9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration: - 30 hrs.)
1.	Workshop calculation and science, Properties and uses of C.I and W.I	Engg. Drawing introduction to Engg. Drawing. Its importance
2.	Properties and uses of plain carbon steel and alloy steel	Simple conventional symbols for metering and part as per IS-696
3.	Fraction decimals conversion of fraction to decimals and vice-versa	Use of drawing instruments in the construction of geometrical drawings angles, triangles. Geometrical construction of rectangles, square, circles
4.	Simplification of Arithmetical Problems of fraction and decimal fractions.	Geometrical construction of polygons and ellipse, parabola and hyper-bola Geometrical construction of involutes, oval and helix. Free hand sketching of st. lines rectangles, circles, square polygon ellipse.
5.	Units of temperature force, work power and energy. Applied problems.	Free hand sketching of simple geometrical solid-cube, cone prism, cylinder, sphere pyramids
6.	Rest and motion velocity acceleration. Applied problems	Standard printing style for letters and numbers as per I.S.-696
7.	Newton's law of motion.	Free hand practice of printing style for standard letters and numbers.
8.	Mass, volume, density, weight CGS, MKS, and FPS units of force, weight etc. their conversion. Applied problems.	Scales construction of plain scale representing fraction
9.	Meaning of tenacity, elasticity malleability, brittleness, hardness, ductility, with examples.	Construction of diagonal scale
10.	Power and Roots Factor, Power base exponent.	Simple dimensioning technique size and location dimension for parts, holes angles, taper, screw etc. As per IS -696
11.	Multiplication and division of power of root of a number.	Transferring measurements for linear angular, circular dimensions from the given object to the related free hand sketches using different measuring instruments.
12.	Square root and problem related to trade.	Pictorial drawing isometric drgs of simple geometrical solids.

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13.	Work energy and power, their units and applied problems.	-do-
14.	Work energy and power their units and applied problems and meaning of H.P. and B.H.P. applied problems.	Oblique projection of simple geometrical solids.
15.	Percentage changing percent to decimal and fraction and vice-versa	-do-
16.	Problems on percentage related to trade	Isometric drawing of simple machined and casting blocks
17.	Meaning of stress, strain modulus of elasticity.	-do-
18.	Ultimate strength different types of stress, factor of safety, examples.	-do-

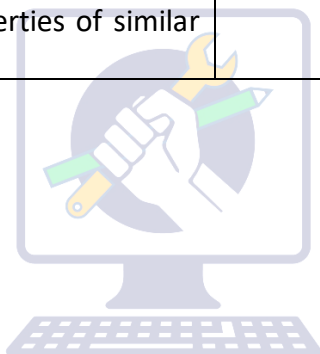


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Block – II		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration: - 30 hrs.)
1	Ratio and proportion, Ratio finding, forms of ratio proportions. Direct proportions and indirect proportions.	Free hand sketches of trade related hand tools measuring tools.
2	Mixed direct and indirect proportion problems.	-do-
3	Machine- basic principles velocity- ratio mechanical advantage, efficiency, simple problems.	-do-
4	Algebraic symbols fundamental algebra operations. Sign and symbols. Use in algebra co-efficient terms, like terms and unlike terms.	Orthographic drawings, application of both the first angle and third angle. Method in representing the drawings for simple and complex machine blocks given for exercises with dimensions.
5	Algebraic addition, subtraction, multiplication and division.	-do-
6	Power and exponent Law of exponent.	-do-
7	Algebraic simplification problems.	-do-
8	Simple machines like winch pulley and compound axle etc.	Standard method of sectioning as per IS: 696. Exercises for different sectional view on the given orthographic drawing of machine parts, casting etc.
9	Factors and equations Algebraic formula.	-do-
10	Factors and different types of factorization.	-do-
11	Heat treatment of steel hardening, annealing, tempering normalizing, case-hardening standards and measurements, equations simple simultaneous quadratic.	-do-
12	Application, constructional and solution of problems by equations.	Inter conversion of isometric , oblique drawings to orthographic drawings and vice versa Related problem such as 'V' Block oriented by various machining operations etc.
13	Atmospheric pressure, pressure gauge, gauge pressure and absolute pressure.	-do-
14	Logarithms and use of logarithm tables; logarithms and exponent.	-do-
15	Use of logarithms and anti logarithms tables.	-do-
16	Arithmetical operations involving logarithm in the computations.	-do-

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17	Problem related to the trade using logarithms tables.	-do-
18	Density of solids and liquids simple experimental determination.	Surface development of simple geometrical solids like cube, rectangular block, cone, pyramid, cylinder prism etc.
19	Specific gravity Principles of Archimedes.	-do-
20	Relation between specific gravity and density simple experimental determination.	-do-
21	Geometry; Fundamental geometrical definitions angles and properties of angles, triangles and properties of triangles.	Interpenetration of solids and conventional application of intersectional curves on drawings.
22	Pythagoras theorem Properties of similar triangles.	-do-



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9.2 EMPLOYABILITY SKILLS**(DURATION: - 110 HRS.)**

Block – I (Duration – 55 hrs.)	
1. English Literacy Duration: 20 Hrs. Marks : 09	
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
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.
2. I.T. Literacy Duration: 20 Hrs. Marks : 09	
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
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.
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.
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.

3. Communication Skills	
Duration : 15 Hrs. Marks : 07	
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.
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.
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.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude
Block – II Duration – 55 hrs.	
4. Entrepreneurship Skills	
Duration : 15 Hrs. Marks : 06	
Concept of Entrepreneurship	Entrepreneur - 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.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
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.

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Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity Duration : 10 Hrs. Marks : 05	
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
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.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education Duration : 15 Hrs. Marks : 06	
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. Safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
7. Labour Welfare Legislation Duration: 05 Hrs. Marks : 03	
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.

8. Quality Tools	
Duration : 10 Hrs. Marks : 05	
Quality Consciousness	Meaning of quality, Quality characteristic.
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.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.



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10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR OPTICAL WORKER TRADE:

Note: Actual training will depend on the existing facilities available in the establishments.

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

Block – I

1. Practice on tool Grinding- chisel, twist drills etc.
2. Shape a tongue and groove to dimensions.
3. Shape a Vee block with slots on the side and check the dimension with measuring instruments and tools.
4. Practice steps of drilling and boring in lathe reaming the bores to correct sizes.
5. Tapping and Die Threading in Lathe-knurling in lathe.
6. Taper turning by (i) Swiveling hand slide and (ii) by the taper attachment.
7. Cutt V-Threads in lathe (External and Internal) & check with screw pitch gauge.
8. Mill V- block using double end mill cutter checking up with bevel protractor.
9. Radius grooving – both concave and convex milling. Check the depth of groove.
10. Barking out and milling slots, dovetails and grooves to dimensions use of side face cutter and dovetail cutter.
11. Select suitable Grinding wheels to grind different types of work using jigs, fixtures, angel plates, V-Blocks vice chuck, etc.

Block – II

1. Perform Trepanning process on Glass blanks with help of trepanning machine
2. Work on curve generating machine and obtain radius on glass blanks with help of setting of angles of the curve generator.
3. Determine radius of curvature.
4. Milling of glass on milling machine.
5. Obtain glass blanks for manufacture of prisms from moulds and the glass
6. Grind the lenses and flats to correct dimensions.
7. Make Test plates.
8. Polish lenses, prisms, other flat surfaces for window graticules and mirrors.
9. Cement optical parts
10. High vacuum apparatus and coating of optics
11. Practice on Chemical silvering of glass
12. Graticule engraving, by dry and wet methods.
13. Practice on Process Camera.

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Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.



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INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

OPTICAL WORKER		
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)		
Sl. No.	Item	Qty.
A : TRAINEES TOOL KIT:-		
1.	Drawing Instrument box	03
2.	Scale	03
3.	Vernier Calipers	03
4.	Micrometer	02
5.	Bevel Protector	02
6.	Engineers Square	02
7.	Straight Edge	03
8.	Angle Dekkor	02
9.	Spherometer	03
10.	Focometer	03
11.	Interferometer	02
12.	Proof Place	02
13.	Strain Viewer	03
14.	Collimators	02
15.	Instrument Testing Scales	02
16.	Tripod Testing Scale	01
17.	Binocular Adjusting and Testing Collimator	02
18.	G.P Collimator	01
19.	Glass Slitting Machine	02
20.	Glass Trepaning Machine	02
21.	Grinding Spindle Small	01
22.	Grinding Spindle Large	02
23.	Optical Smoothing Machine Small	02
24.	Optical Smoothing Machine Large	02
25.	Optical Polishing Machine Small	02
26.	Optical Polishing Machine Large	01
27.	Lens curve generator	01
28.	Glass Milling Machine	01
29.	Lens Centering Machine	01
30.	Lens Edging Machine	01
31.	High Pressure Mercury Lamp	01
32.	Table Lamps	01
33.	Centrifugal Machine	01
34.	Graticule Dividing Machine	01

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35.	Stereoscopic Microscopes	01
36.	Process Camera	01
37.	Drilling Machine	01
38.	Centre Lathe	01
39.	Vacuum Coating Plant	01
40.	Photometer for Measuring Transmission Of Light	01
41.	Electric Oven	01
42.	Hot Plates	01
43.	Dynamometer	01
44.	General Shop Tools Optical Tools Template Gauges	01



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Optical Worker

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: Optical Worker

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

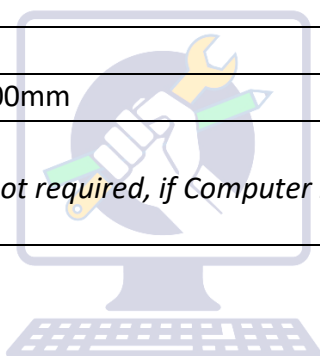
1) Space Norms : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

Sl. No.	Name of the items	Quantity
1.	Draughtsman drawing instrument box	20+1 set
2.	Set square celluloid 45° (250 X 1.5 mm)	20+1 set
3.	Set square celluloid 30°-60° (250 X 1.5 mm)	20+1 set
4.	Mini drafter	20+1 set
5.	Drawing board (700mm x500 mm) IS: 1444	20+1 set
B : Furniture Required		
Sl. No.	Name of the items	Quantity
1	Drawing Board	20
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

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TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
<i>Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.</i>		



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FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :						Year of Enrollment :							
Name & Address of ITI (Govt./Pvt.) :						Date of Assessment :							
Name & Address of the Industry :						Assessment location: Industry / ITI							
Trade Name :			Semester:			Duration of the Trade/course:							
Learning Outcome:													
Sl. No	Maximum Marks (Total 100 Marks)	15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
	Candidate Name	Father's/Mother's Name	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA	
1													
2													