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

COMPETENCY BASED CURRICULUM

MECHANIC MINING MACHINERY

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CAPITAL GOODS AND MANUFACTURING

कौशल बलम्
Directorate General of Training

MECHANIC MINING MACHINERY

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration of Mechanic Mining Machinery trade, a candidate is trained on subjects- Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skills related to job role. In addition to this, a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task.

The content broadly covers fitting of different components by operating different hand tools conventional machines and maintenance of machineries used in Mining. The broad components covered under Professional Skill subject are as below:

FIRST YEAR: In this year, the contents covered are from safety aspect related to the trade, basic fitting operations viz., making, filing, sawing, chiseling, drilling, tapping, grinding. Making different fits viz., sliding, T-fit and square fit with an accuracy of ±0.2mm & angular tolerance of 1°. Lathe operation on different shaped job and produce components by different turning operation including thread cutting and relevant job on Shaper and Milling Machine. Also, preventive maintenance of pumps and compressors.

This year starts with practice on construction of SI engine Followed by maintenance and overhauling practice of different types of engines and their parts. Next, practice on measurement of voltage, current, power factor and other components of electrical circuits. Practical on Construction of transformer and test of transformers and rectifier circuits.

SECOND YEAR: In this year, overhauling of different types of pumps and motors are covered in the beginning followed by stator and rotor winding of induction motors, practice on different circuit breakers and relays. Basic practice on hydraulic and pneumatic parts and circuit making. Practice on assembly of tyre and inspection of puncture. Next, practice on operation and maintenance of different machines used in mining like crawler, hydraulic shovel, walking dragline, wagon drill, blast hole drill, jack hammer, tractor dozer, wheel loader, dumper etc.

The trainees will practice on operation and maintenance of Motor Grader and surface miner is covered in the beginning. In addition to this, practice on maintenance of cutting drum picks and other maintenance activities of machines working in mines. Next, practice on maintenance of conveyor belt, air compressor, hydraulic hoist and lubrication system. Also practical on overhauling of gear box, brake system and lighting system and wiper system of vehicles carried out. And practice on maintenance of different mining machineries along with measurement of insulation resistance, illumination and localization of cable fault.

2. TRAINING SYSTEM

2.1 GENERAL

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

Mechanic Mining Machinery trade under CTS is delivered nationwide through a network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Workshop Calculation & science, Engineering Drawing and (Employability Skills) imparts requisite core skill, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS:

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

- Can join various mining industries.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

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

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

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

4	On the Job Training (OJT)/ Group Project	150	150

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

2.4 ASSESSMENT & CERTIFICATION

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

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

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The

pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

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

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/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 some of the following:

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

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

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	

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

3. JOB ROLE

Mechanic, Mining Machinery; repairs services and overhauls drilling, scraping, cutting, winding, hoisting and other mining machinery for correct performance. Get, defective machine or equipment removed from surface or underground working place to repair section, using slippers, roller, hoists etc. as necessary. Examines faulty equipment to ascertain nature and location of defects. Dismantles equipment partly or completely to remove damaged and worn out parts. Repairs parts by various mechanical processes such as re-metalling, filing, chipping, scrapping, grinding etc. or obtains replacements. Assembles parts, doing supplementary tooling as necessary and ensures correct fit, movement, clearance, adjustments, functional operations etc. as specified. Tests reassembled equipment making necessary adjustments for optimum performance. Checks, adjusts and lubricates equipment periodically or gets it done and performs other tasks to keep equipment in good working order. May undertake minor repairs at working place. May weld braze or solder parts. Plan and organize assigned work, 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.

Reference NCO-2015:

a) 7233.1500 – Mechanic Mining Machinery

Reference NOS: --

a) MIN/N3211
b) MIN/N3212
c) MIN/N1702
d) MIN/N1704
e) MIN/N3208
f) MIN/N1703
g) MIN/N9401
h) MIN/N9402

4. GENERAL INFORMATION

Name of the Trade	**MECHANIC MINING MACHINERY**
Trade Code	DGT/1114
NCO - 2015	7233.1500
NOS Covered	MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704, MIN/N3208, MIN/N1703, MIN/N9401, MIN/N9402
NSQF Level	Level – 4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF
Unit Strength (No. Of Students)	24 (There is no separate provision of supernumerary seats)
Space Norms	292 Sq. m
Power Norms	20 KW
Instructors Qualification for	
1. Mechanic Mining Machinery Trade	B.Voc/Degree in Mechanical/Mining Engineering/Technology from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Mechanical/ Mining Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the trade of "Mechanic Mining Machinery" with three years' experience in the relevant field. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade ***NOTE: - Out of two Instructors required for the unit of 2(1+1), one***

	must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **<u>Essential Qualification:</u>** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical groups (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. Essential Qualification: Regular/ RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA/ D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)

	OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

FIRST YEAR:

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precaution. *[Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]. (Nos:* MIN/N3211)
2. Make simple sheet metal items as per drawing and join them by soldering, brazing and riveting. (Nos: MIN/N3211)
3. Make simple forge items as per drawing. (Nos: MIN/N3211)
4. Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper & Lathe, Different machining parameters – feed, speed & depth of cut.]. (Nos: MIN/N3211)
5. Plan & perform simple repair, overhauling of different pumps and compressors and check for functionality. (Nos: MIN/N3211, MIN/N3212)
6. Dismantle & assemble of Engine from vehicle along with other accessories. (Nos: MIN/N3211)
7. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work.
   (Nos: MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704)
8. Overhaul Engine and other parts and check functionality. (Nos: MIN/N3211)
9. Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system. (Nos: MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704)
10. Diagnose & rectify the defects in vehicle to ensure functionality of vehicle. (Nos: MIN/N3212, MIN/N3208)
11. Carryout overhauling of Alternator and Starter Motor. (Nos: MIN/N3211, MIN/N3212, MIN/N3208, MIN/N1703)
12. Read and apply engineering drawing for different application in the field of work. MIN/N9401
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. MIN/N9402

SECOND YEAR:

14. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.] (Nos: MIN/N3211, MIN/N3212)
15. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (Nos: MIN/N3211, MIN/N3212)
16. Conduct preventive maintenance, perform dismantling and assembly of different components machine and test for accuracy of rotor, crawler etc. (Nos: MIN/N3211, MIN/N3212)
17. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. (Nos: MIN/N3211, MIN/N3212)
18. Conduct preventive maintenance, perform dismantling & assembly of different components of machine and test for accuracy. (Nos: MIN/N3211, MIN/N3212)
19. Plan, Execute commissioning and evaluate performance of AC & DC machines. (Nos: MIN/N3211, MIN/N3212)
20. Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. [Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting] (Nos: MIN/N3211, MIN/N3212)
21. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. (Nos: MIN/N3211, MIN/N3212)
22. Plan & perform basic day to day preventive maintenance, repairing and check functionality. (Nos: MIN/N3211, MIN/N3212)
23. Troubleshoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. (Nos: MIN/N3211, MIN/N3212)
24. Identify fault carryout maintenance work and break down of different machineries/ equipments viz. drilling, loaders, dozers, shovels, dumper etc., in the shop floor, using appropriate tools &equipments to ensure its functionality. (Nos: MIN/N3211, MIN/N3212)
25. Plan, execute testing, evaluate performance and carry out maintenance of cable system, measurement of insulation resistance. (Nos: MIN/N3211, MIN/N3212)
26. Read and apply engineering drawing for different application in the field of work. MIN/N9401
27. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. MIN/N9402

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precaution. *[Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] (Nos:* MIN/N3211)	Plan & Identify tools, instruments and equipments for marking and make this available for use in a timely manner.
	Select raw material and visually inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Make simple sheet metal items as per drawing and join them by soldering, brazing and riveting. (Nos: MIN/N3211)	Identify Hand Tools for Sheet Metal work, Soldering, Brazing & riveting and make these available for use in a timely manner.
	Mark and develop various forms as per drawing using sheet metals.
	Make of simple items with sheet metal as per drawing.
	Prepare the job for Soldering, Brazing &riveting.
	Identify different type of rivets and use as per requirement.
	Identify tools for drilling and use these tools.
	Mark according to drawing.
	Drill through holes on the job.
	Solder, Braze and Rivet to prepare a job as per given drawing /

	sample following standard practices.
	Observe safety procedure during riveting as per standard norms and company guidelines.
3. Make simple forge items as per drawing. (Nos: MIN/N3211)	Identify Tools and equipments for riveting and make these available for use in a timely manner.
	Prepare the forge.
	Identify different type of tools and use as per requirement.
	Hammer to prepare a job as per given drawing / sample following standard practices.
	Observe safety procedure during riveting as per standard norms and company guidelines.
4. Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper & Lathe, Different machining parameters – feed, speed & depth of cut.]. (Nos: MIN/N3211)	Ascertain basic working principles and safety aspect of lathe machine.
	Understand functional application of different levers, stoppers, adjustment etc.
	Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual.
	Identify different work and tool holding devices and collect information for functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations.
	Solve problem by applying basic methods, tools, materials and information during setting.
	Observe safety procedure during mounting as per standard norms.
	Produce components observing standard procedure.
	Check accuracy/ correctness of job using appropriate equipment/gauge.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
5. Plan & perform simple repair, overhauling of different pumps and	Ascertain basic working principles and safety aspect of lathe machine.
	Understand functional application of different levers, stoppers,

compressors and check for functionality. (Nos: MIN/N3211, MIN/N3212)	adjustment etc.
	Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual.
	Identify different work and tool holding devices and collect information for functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations.
	Solve problem by applying basic methods, tools, materials and information during setting.
	Observe safety procedure during mounting as per standard norms.
6. Dismantle & assemble of Engine from vehicle along with other accessories. (Nos: MIN/N3211)	Collect relevant information to conduct dismantling of engine from vehicle.
	Plan and identify different tools and materials required to carry out dismantling and assembling.
	Perform dismantling and assembly of different components as per stand procedure.
	Observe safety procedure while carrying out above task.
	Carryout test after assembling the engine in the vehicle.
7. Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work. (Nos: MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704)	Identify different electrical equipment viz. multi-meter, transformer, relays, solenoids, motor & generator.
	Identify different sensors viz., proximity & ultrasonic.
	Examine functioning of different electrical equipment, sensors and their utilization in industrial application.
	Observe safety precautions during examination of electrical equipment and sensors.
8. Overhaul Engine and check functionality. (Nos: MIN/N3211)	Select and ascertain tools for the job and make this available for use in a timely manner.
	Identify different components of the engine.
	Plan to dismantle and replace parts as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components

	with accuracy applying range of skills and standard operating procedure.
	Assemble different components.
	Check functionality of the components.
9. Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system. (Nos: MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704)	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half &full wave rectifier with and without filter circuits.
	Construct circuit by using transistor as a switch.
	Construct and test a UJT as relaxation oscillator & electronic timer.
	Construct amplifier circuit using Transistor, FET and JFET and test.
	Construct and test lamp dimmer using TRIAC/DIAC.
	Test IGBT and use in circuit for suitable operation.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test logic gate circuits.
10. Diagnose & rectify the defects in vehicle to ensure functionality of vehicle. (Nos: MIN/N3212, MIN/N3208)	Acquaint the safety practices related to the diagnose of vehicle.
	Understand & identify various defects in vehicle.
	Demonstrate the faults arised in the vehicle.
	Conduct the rectification of faulty parts.
	Carry out the performance test.
11. Carryout overhauling of Alternator and Starter Motor. (Nos: MIN/N3211, MIN/N3212, MIN/N3208, MIN/N1703)	Plan work in compliance with standard safety norms related with Alternator &Starter motor.
	Connect start and run an alternator and build up the voltage.
	Determine the load performance of a alternator.
	Start and load a starter motor and build up the voltage.
12. Demonstrate basic mathematical concept and principles to perform	Solve different mathematical problems
	Explain concept of basic science related to the field of study

practical operations. Understand and explain basic science in the field of study.	
13. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
SECOND YEAR	
14. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.] (Nos: MIN/N3211, MIN/N3212)	Select and ascertain tools for the job and make this available for use in a timely manner.
	Identify different pneumatics and hydraulics components.
	Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure.
	Assemble different components.
	Check functionality of the components.
15. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (Nos: MIN/N3211, MIN/N3212)	Select and ascertain tools for the job and make this available for use in a timely manner.
	Identify different pneumatics and hydraulics components.
	Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure.
	Assemble different components.
	Check functionality of the components.
16. Conduct preventive	Select and ascertain tools for the job and make this available for

maintenance, perform dismantling and assembly of different components machine and test for accuracy of rotor, crawler etc. (Nos: MIN/N3211, MIN/N3212)	use in a timely manner.
	Identify different components.
	Plan to dismantle and replace faulty parts as per drawing and collecting necessary information.
	Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure.
	Assemble different components and check for accuracy.
17. Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. (Nos: MIN/N3211, MIN/N3212)	Understand safety aspects while working with power transmission system.
	Explain the functions and constructional features of various mechanical power transmission elements and drives.
	Drain out lubrication oil from the power transmission system.
	Select proper tools for the required task.
	Dismantle the shaft, coupling, gears, belt, clutch, pulley, chain & sprockets. keys, bearing from the power transmission system.
	Clean and check for damage of all dismantled parts.
	Repair / replace damaged parts.
	Assemble the power transmission system in sequence.
	Fill lubrication oil and check functionality.
18. Conduct preventive maintenance, perform dismantling & assembly of different components of machine and test for accuracy. (Nos: MIN/N3211, MIN/N3212)	Collect relevant information to conduct preventive maintenance of grinding.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components of grinding machine as per stand procedure.
	Observe safety procedure while carrying out above task.
	Test for accuracy of grinding machine by conducting machining.
19. Plan, execute commissioning and evaluate performance of AC & DC machines. (Nos: MIN/N3211, MIN/N3212)	Collect relevant information to conduct preventive maintenance of grinding.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components of grinding machine as per stand procedure.
	Observe safety procedure while carrying out above task.

	Test for accuracy of grinding machine by conducting machining.
	Collect relevant information to conduct preventive maintenance of grinding.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components of grinding machine as per stand procedure.
	Observe safety procedure while carrying out above task.
	Test for accuracy of grinding machine by conducting machining.
20. Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. [Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting]. (Nos: MIN/N3211, MIN/N3212)	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components as per stand procedure.
	Observe safety procedure while carrying out above task.
21. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. (Nos: MIN/N3211, MIN/N3212)	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components i.e. head stock, tail stock etc. as per stand procedure.
	Observe safety procedure while carrying out above task.
	Carryout advance lathe operation viz., taper turning, thread cutting to check functionality and accuracy.
	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components i.e.

	head stock, tail stock etc. as per stand procedure.
22. Plan & perform basic day to day preventive maintenance, repairing and check functionality. (Nos: MIN/N3211, MIN/N3212)	Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job.
	Interpret construction, alignment and assembly of different parts of machine.
	Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team.
	Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of simple machine as per layout plan and standard procedure.
	Put the machine in operation complying Standard operating procedure.
	Check for proper functioning of repaired machine and other parameters of simple machine as per manual after erection.
	Dispose unsalvageable materials as per standard procedures.
23. Troubleshoot& Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. (Nos: MIN/N3211, MIN/N3212)	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components i.e. head stock, tail stock etc. as per stand procedure.
	Observe safety procedure while carrying out above task.
	Carryout advance lathe operation viz., taper turning, thread cutting to check functionality and accuracy.
24. Identify fault carryout maintenance work and break down of different machineries/ equipments viz., drilling, loaders, dozers, shovels, dumper etc., in the shop floor, using appropriate	Collect relevant information to conduct preventive maintenance of lathe.
	Plan and identify different tools and materials required to carry out preventive and dismantling assembling.
	Perform dismantling and assembly of different components i.e. head stock, tail stock etc. as per stand procedure.
	Observe safety procedure while carrying out above task.

tools &equipments to ensure its functionality. (Nos: MIN/N3211, MIN/N3212)	Carryout advance lathe operation viz., taper turning, thread cutting to check functionality and accuracy.
25. Plan, execute testing, evaluate performance and carry out maintenance of cable system, measurement of insulation resistance. (Nos: MIN/N3211, MIN/N3212)	Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job.
	Interpret construction, alignment and assembly of different parts of machine.
	Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information.
	Demonstrate possible solutions and agree tasks within the team.
	Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of cable system as per layout plan and standard procedure.
	Check for proper functioning and measure the insulation resistance and other parameters as per manual.
25. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems
	Explain concept of basic science related to the field of study
26. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

SYLLABUS FOR MECHANIC MINING MACHINERY TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 85Hrs.; Professional Knowledge 18Hrs.	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precaution. *[Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]* *(Mapped NOS:* MIN/N3211)	1. Importance of trade training, List of tools& Machinery used in the trade. (2 hrs.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (2 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Identification of safety signs for Danger, Warning, caution & personal safety message. (2 hrs.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs.) 8. Use of fire extinguishers. (2 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (2 hrs.) 10. Safe use of tools and equipments used in the trade.	All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures. Soft skills, its importance and job area after completion of training. Importance of safety and general precautions observed in the industry/shop floor. Introduction of first aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application. Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment.

		(3 hrs.)	
		11. Familiarization with the Institute, Importance of trade training, Machinery used in the trade, types of work to be done by trainees in the trade, introduction to safety equipment and their uses. Practice on Description of Safety Equipment; their uses; Safety Rules to be observed in workshops. (10 hrs.) 12. Accidents & their causes; upkeep of fire Extinguishers; Familiarization of the Tools & Machinery available in the shop their uses and up keep; Importance of maintenance and cleanliness of Workshop, Tools, Jacks; Trays and Houses. (10 hrs.)	General Introduction to the Course-Duration of the Course and Course Content. Study of the Syllabus-general Rules pertaining to the Institute-Facilities Available-Hostel, Recreation and Medical Facilities - Library-working Hours, Timetable. Importance of Safety and General Precautions to be observed in the workshop and the laboratory; Storing and Handling of Inflammable Materials; Elementary first aid.
		13. Practice on use of fitters' hand tools; Marking off with steel rule; Callipers and Dividers, Scriber Prick and Centre Punch; Chipping in marked line on a given piece; sharpening of chisel; Center punch and Dot punch to correct angle. (12 hrs.) 14. Practice on Identification of simple types of screw, nuts & bolts, clamps, rivets etc. (10 hrs.)	Systems of measurements; Conversion of English into Metric measurements and vice-versa; Marking media chalk, Mechanic Blue-Red lead and tools used for marking, Marking steel rule; Try Square, callipers and Dividers, Scriber Prick and Centre Punch Hammer and Chisel-uses and Maintenance-Safety Use, care and maintenance of scribing block. Different types of forces, graphical representation of forces, addition, subtraction and resultant of coplanar forces, moment, couple and torque; Definition and example

			of stress, strain, modulus of elasticity, ultimate strength. Matter, atoms-structure, Importance of Physics-Basic principles-work, power, energy.
		15. Practice on Measurement by Micro-meter (outside and Inside), Vernier Calliper and Protector. Practice on Marking and Drilling of Clear and Blind Holes; Sharpening of Twist Drills; Safety precautions to be observed while using a drilling machine. (12 hrs.) 16. Practice on Tapping a clear and blind hole; selection of Tap Drill Size; Use of Lubricant for Cutting threads on a Bolt/Stud. Scraping a given machined surface. (10 hrs.)	Construction and Method of reading Micro- meter (Internal and External); Vernier Calliper; Correct handling of Micrometer and Vernier Callipers; Reading of Vernier Scale; Description and use of combination set; Care and maintenance of Vernier calliper, Micrometer, Combination set etc. Calculation of Tap Drill Sizes. Care and maintenance of files, drills, hacksaws. Taps & Dies-Description, use of different types of Taps & Dies-Different types of threads and their uses; Precautions while using Taps & Dies; Description and use of different types of scrapers, reamers and emery papers. Drill holding devices: material, construction and their uses. Drill processes: Common type (bench type, pillar type) gang and multiple drilling machine. (18 hrs.)
Professional Skill 85Hrs.; Professional Knowledge 15Hrs.	Make simple sheet metal items as per drawing and join them by soldering, brazing and riveting. (Mapped Nos: MIN/N3211)	17. Practice on Sheet metal work, Joining of metal sheet by soldering; Simple marking out on sheet metal, cutting, bending and folding; Practice of silver soldering; Pipe bending; Fitting nipples and unions on pipes; Soldering and	Sheet metal workers' hand tools-their description and uses; Description of simple soldering and brazing; Fluxes used for common joints; Types of sheet metal joints and uses; Sheet and Wire Gauges, Blow lamp and its uses; Pipe fitting; Explanation of various common

		Brazing of pipes. Practice on Identification of different types of bolts, nuts and their threads, rivets, joints etc. (20 hrs.)	metal sheets used in sheet metal shop. Engg. Drawing: Different types of nuts, bolts and their threads, rivets, keys, different joints; e.g. cotter joint, knuckle joint etc.
		18. Practice on Measurement of viscosity. (4 hrs.) 19. Practice on Measurement of pressure using manometers, pitot tube; Pressure gauge calibration. (6 hrs.) 20. Study of the construction of Non-return valve, gate valve and globe valve. (5 hrs.) 21. Practice on Series & Parallel connection of resistors, Connection of ammeter and voltmeter Measurement of resistance by (i) Wheatstone bridge (ii) Ammeter voltmeter method. (10 hrs.)	Fundamentals of Fluid mechanics; Viscosity and its measurement. Pressure and its measurement: manometers and mechanical gauges. Operation, construction and uses of valves: Non-return valve, gate valve and globe valve An electrical system, Electric charge, Movement of electron, Current flow in a circuit, Electromotive force and potential difference, Electrical units, Ohm's law, Resistors, Resistor coding, Conductors and insulators.
		22. Practice on Determination of Reynold's number; Determination of Cd, Cv of orifices, discharge coefficient of notches, determination of jet forces. (10 hrs.) 23. Study of colour code of resistor, Use of multimeter for measurement of voltage and resistance. (08 hrs.)	Flow through orifices and notches: introduction, classification of orifices, notches; concept of Cd, C_v etc. Determination of jet forces Simple DC Circuits:-Series circuits, Parallel networks, Series circuits versus parallel networks, Kirchhoff s laws, Power and energy, Resistivity, Temperature coefficient of resistance, Temperature rise.
		24. Practice on marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. Marking out of simple	Safety - importance of safety & general precaution observed in a welding shop, precaution in electric & gas welding (before, during and later) introduction to safety

		development marking out for flaps for soldering and sweating. (07hrs.) 25. Practice on various joints, wiring, hemming, soldering and brazing from locked, grooved and knocked up single hem straight and curved edges from double hemming; Punch holes-using hollow and solid punches; making of lap and butt joints. (05hrs.) 26. Practice on Making of square butt joint and "F fillet joint-gas and arc. (05hrs.) 27. Practice on gas cutting. (05hrs.)	equipment and their uses. Hand tools: hammers, Welding description, types and uses, machine and accessories welding transformer, welding generators, description principle, and method of operating. HP welding equipment description, principle method of operating L.P welding equipment, description, principle, method of operating types: joints-Butt and fillet as per BIS specifications. Oxygen -Acetylene cutting machine: description, parts, uses, method of handling cutting torch-description, parts function and uses. Gases and gas cylinder description, main difference and uses. Isometric projections. (15 hrs)
Professional Skill 20 Hrs.; Professional Knowledge 06Hrs.	Make simple forge items as per drawing. (Mapped NOS: MIN/N3211)	28. Practice on Prepare forge; Fire for heating metals; Forge a square rod from round stock; Judge the forging temperature of various metals. (6 hrs.) 29. Forge M.S. bar to square, Octagon and hexagon. (5 hrs.) 30. Practice on Forge punches, screw drivers, chisels; grind them to shape and heat treat to requirement, bending metals to angles; curves & twisting; Preparation of brackets. (9 hrs.)	Smithy shop description and uses. Anvil and swage blocks-Description and uses; Forging tools- hammers- band and sledge; description and uses. Chisels, set hammers, flatters, hardier, fuller swage & uses. Heat treatment necessary various heat treatment methods such as normalizing annealing, hardening and tempering. Power hammer construction feature, method of operating and uses. (06 hrs.)
Professional Skill 160 Hrs.; Professional	Set the different parameters to produce components involving basic	31. Practice on verification of Bernoulli's theorem; Determination of losses in pipelines due to sudden enlargement, contraction etc.	Flow through pipes: losses of energy in friction, Bernoulli's theorem, Pascal's law, hydraulic gradient, pipes in series and parallel.

Knowledge 18 Hrs.	operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper &Lathe, Different machining parameters – feed, speed & depth of cut.]. (Mapped NOS: MIN/N3211)	(20 hrs.) 32. Practice on True job on four jaw chuck using knife tool face both the ends for holding in centre; Measure the diameter using outside caliper and steel rule. (6 hrs.) 33. Practice on Grind the facing, parting and form tools, plain turn, step turn, holding job in three jaw chuck- debur, chamfer-corner round the ends, shoulder turn: square filleted bevelled undercut shoulders. (10 hrs.) 34. Practice on Cut groves square, round, V, groove. Make a mandrel- turn diameter to sizes. Knurl the job. (10 hrs.) 35. Practice on Bore holes-spot face, pilot drill, enlarge hole, using boring tools make a bush; Step bore-cut recess; turn hole diameter to sizes. (8 hrs.) 36. Practice on Turn taper (internal and external.) Turn taper pins. Turn standard tapers to suit with Gauge. (6 hrs.) 37. Practice on Cutting of threads using taps & dies, and on lathe. Prepare a nut and match with the bolt. (8 hrs.)	Safety precautions to be observed while working on a lathe; Lathe specifications and constructional features; Lathe main parts-descriptions, bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms. Work between centers, catch plate, dog, simple description of a facing and single point cutting tools and their applications. Lathe cutting tools; Brier study of the nomenclature of lathe cutting tools and necessity of correct grinding, solid and tipped, throw away type tools; cutting speed and feed and comparison for HSS carbide tools. Use of coolants and lubricants. Chucks and chucking the independent four jaw chuck; Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting chucks chucking true face plate drilling in method of holding drills in the tail stock, Boring tools and enlargement of holes. General turning operations-parallel or straight turning; Stepped turning; grooving, shape of tools for the above operations. Appropriate method of holding the tool on tool post or tool rest; Knurling tools description, grade, uses, speed and feed coolant for

			knurling. Taper-definition use and method of expressing tapers. Standard tapers-taper calculations. Screw threads- definition-uses and application; Terminology of screw threads, square worm buttress (nonstandard-screw threads), Principle of cutting screw thread in centre lathe; principle of chasing screw thread-use of centre gauge setting tool for cutting internal and external thread cutting; use of screw pitch gauge; checking the screw thread.
		38. Relevant jobs on milling machine Identification and Study of the operation of brakes and clutches. (20 hrs.)	Safety precautions to be observed while working on milling machine, main parts of milling machine and its constructional features, specifications Classification, construction, selection and application of brakes and clutches.
		39. Practice on Relevant jobs on shaping machine. (15 hrs.) 40. Study of common mechanisms used in industrial equipment.(10 hrs.)	Safety precautions to be observed while working on shaping machine, main parts of shaping machine and its constructional features, specifications Common mechanisms used in industrial equipment: universal coupling, ratchet and pawl, slider-crank, quick-return mechanism etc.
		41. Verification of ohms law, Kirchhoff s laws. (12 hrs.) 42. Practice on measurement of current voltage and power of a resistive circuit. (13 hrs.)	Capacitance and Capacitors: - Capacitors, Charge and voltage, Capacitance, Capacitors in parallel, Capacitors in series, Distribution of voltage across capacitors in series, Capacitance and the capacitor, Electric fields.

			Inductance in a DC Circuit: - Inductive and non-inductive circuits, inductance, Inductance in terms of flux-linkages, Factors determining the inductance of a coil, Ferromagnetic-cored inductor in a D.C. circuit, Energy stored in an inductor, Mutual inductance, Coils connected in series.
		43. Demonstration of chain pulley block, powered winch, screw jack. Practice on Identification of bearings, bushes, springs. (22 hrs.)	Construction and use of simple machine and machine elements; e.g.- chain pulley block, screw jack, mechanical winch, springs, bearings, coupling, cam and follower. (18 hrs.)
Professional Skill 85Hrs.; Professional Knowledge 16 Hrs.	Plan & perform simple repair, overhauling of different pumps and compressors and check for functionality. (Mapped NOS: MIN/N3211, MIN/N3212)	44. Practice on disassembly and assembly of old, unserviceable turbine pump; mono pump, identification of its critical components: bearing, seals, impeller, casing etc. (15 hrs.) 45. Performance test of centrifugal pump. (8 hrs.)	Construction and operation of Multi-stage centrifugal pump need of multistage pump; submersible pump, air lift pump, mono pump.
		46. Study of the operation of mechanical drives, assembly, disassembly and maintenance of mechanical drives Study of the construction of reciprocating and centrifugal pumps. (10 hrs.) 47. Practice on Disassembly and assembly of old, unserviceable pumps; identification of its critical components: bearing, seals, impeller, casing etc. (12 hrs.)	Mechanical drives: Classification, construction, selection and application of mechanical drives; e.g. gear, gear train, chain, belt and rope. Classification and field of application of fluid machines.
		48. Practice on Study of the constructional feature of	Classification and application of air compressor and blowers:

		reciprocating and screw compressor; Performance test of reciprocating compressor. Practice on tracing of magnetic field setup by current carrying conductor and a loop. Tracing of magnetic field of an electromagnet & study the variation of field strength by varying current, number of turns etc. (40 hrs.)	reciprocating compressor, screw compressor and other rotary compressor. Electromagnetism: - Magnetic field, Direction of magnetic field, Characteristics of lines of magnetic flux, Magnetic field due to an electric current, Magnetic field of a solenoid, Force on a current-carrying conductor, Force determination, Electromagnetic induction, Direction of induced E.M.F., Magnitude of the generated or induced E.M.F., Magnitude of E.M.F. induced in a coil. (16 hrs.)
Professional Skill 50Hrs.; Professional Knowledge 18Hrs.	Dismantle & assemble of Engine from vehicle along with other accessories. (Mapped NOS: MIN/N3211)	49. Practice on construction of single and multi-cylinder SI Engine in laboratory; their combustion processes in working models. (08 hrs.) 50. Practice on the construction of combustion process, ignition system, MPFI system, cooling system, lubrication system through wall chart / posters. (10 hrs.) 51. Practice on Steps to follow assembly and disassembly of two-wheeler and four-wheeler SI engine. (08 hrs.) 52. Practice of unserviceable petrol engines: removing jammed nuts and broken studs; reconditioning damaged threaded holes; removing cylinder head, pistons, connecting rod, crank shaft and cylinders; carburetor, cleaning	History and development of IC engines: Spark Ignition (SI) and Compression Ignition (CI) engines; Advantages and disadvantages of SI and CI engines; Thermodynamic cycles; Two stroke and Four stroke IC engines; Constructional details of single and multi-cylinder SI engines; Fuels and lubricants of SI and CI engines, fuel ratings and alternative fuels. Turbocharger and its advantages. Single / multi-cylinder SI engine: specification; combustion process, Principle of carburetion, Ignition system, MPFI system, Cooling system, Lubrication system Construction of typical two-wheeler and four-wheeler SI engine.

		and refitting them. (08 hrs.)	
		53. Practice on Identification of typical problems and possible remedies of two-wheeler and four-wheeler SI engine. (16 hrs.)	Case studies on trouble shooting of two-wheeler and four-wheeler SI engine. (18 hrs.)
Professional Skill 50Hrs.; Professional Knowledge 18Hrs.	Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work. (Mapped NOS: MIN/N3211, MIN/N3212, MIN/N1702, MIN/N1704)	54. Practice on Measurement of voltage & current in RLC series and parallel circuit. (16hrs.)	Alternating Voltage and Current: - Alternating system, Generation of an alternating E.M.F., Waveform terms and definitions, Relationship between frequency, speed and number of pole pairs, Average and r.m.s. values of an alternating current, Average and r.m.s. values of sinusoidal currents and voltage. Single-Phase Series Circuits: -Basic A.C. circuits, Alternating current in a resistive circuit, Alternating current in an inductive circuit, Current and voltage in an inductive circuit, Resistance and inductance in series, Alternating current in a capacitive circuit, Current and voltage in a capacitive circuit, Resistance and capacitance in series, Alternating current in an RLC circuit. Single-Phase Parallel Networks: - Basic A.C. parallel circuits, Simple parallel circuits, Parallel impedance circuits.
		55. Practice on the connection of half wave & full wave rectifier circuit. (10 hrs.) 56. Practice on construction of three-phase transformer. (14 hrs.) 57. Open circuit & short circuit test	Semiconductor Materials: - Introduction, Atomic structure, n-type semiconductor, p-type semiconductor, Junction diode. Rectifiers: -Rectifier circuits, Half-wave rectifier, Full-wave rectifier network, Bridge rectifier networks,

		of single-phase transformer. (10 hrs.)	Smoothing, Zener diode. Transformer Construction of transformer: -Core Material, Core Construction, Transformer Windings, Insulation, Leads and Terminals, Bushings, Tap Changes, Transformer Tank, Transformer Oil, Breather, Buchholz relay. Operation of Transformer: -Principle of action of a transformer, EMF equation of a transformer, Useful and leakage fluxes in a transformer, Leakage flux responsible for the inductive reactance of a transformer, Voltage regulation of a transformer, Efficiency of a transformer, Condition for maximum efficiency of a transformer, Open-circuit and short-circuit tests on a transformer, Calculation of efficiency from the open-circuit and short-circuit tests, calculation of the voltage regulation from the short-circuit test. (18 hrs.)
Professional Skill 195Hrs.; Professional Knowledge 30 Hrs.	Overhaul Engine and other parts and check functionality. (Mapped NOS: MIN/N3211)	58. Practice on Determination of the thermodynamic and overall efficiencies of SI engine. (12 hrs.) 59. Practice on construction and operation of single and multi-cylinder CI engine in working models. (13 hrs.)	Testing and performance of SI engines. Construction and operation of single and multi-cylinder CI engine, compression ratio, clearance volume etc. specification of diesel engine.
		60. Practice on dismantle rocker arm, assembly clean & check shaft-bushes, posts and rocker arm for wear and Cracks and reassemble. Check valve	Description and function of valve parts-maintenance materials used-Necessity of valve, clearance prescribed by makers of engine-effect of incorrect clearances-

		springs, tappets, pushrods, tappet screws and valve stem cap. (22 hrs.) 61. Reassembling valve parts in sequence; refit cylinder head and manifold and rock arm assembly; adjust valve clearances; starting engine after decarburizing.(22 hrs.)	common troubles and remedy-reason for warping of cylinder head.
		62. Practice on Maintenance checks-daily weekly, monthly for deferent types of engines writing up of inspection schedules Maintenance of log sheets-details of maintenance. (10 hrs.) 63. Practice of starting stationary and a transport vehicle engine. (12 hrs.) 64. Practice on Measurement of power &power factor of single-phase A.C. series &parallel RLC circuit. (8 hrs.) 65. Practice on using Unserviceable engine remove rockers arm, assembly, manifolds-and cylinder head - removing valves and its parts, cleaning & decarburizing, checking valve seats and valve guide, reconditioning valves seats and prefacing valves - lapping valves on its seats - testing leaks of valve seats for leakage - inspection of cylinder head and manifold surfaces for warping and cracks. (16 hrs.)	Engine details -cylinder materials, cylinder arrangements, cylinder liners and their advantages, cylinder heads, description, function, care and maintenance - Location of combustion chamber in cylinder heads and also heater plugs and post & valve arrangements. Combustion chambers pumps open and closed types, advantages and disadvantages, compression ratio & compression pressures compression testing of cylinders and analysis of results & its importance. Power in AC Circuits: - Power in a resistive circuit, Power in a purely inductive circuit, Power in a purely capacitive circuit, Power in a circuit with resistance and reactance, Power factor, Active and reactive currents, The practical importance of power factor, Measurement of power in a single-phase circuit. Resonance in AC Circuits: -Frequency variation, Frequency variation in an RLC circuit, Resonance in a circuit having R, L and C in series,

			Resonance in RLC parallel networks. Valves, valve operations-Mechanism- parts, and function of each valve timing diagram-camshaft and timing gears-types of drives used in engines, chain tension and its importance, cylinder head and manifold construction and function-water jackets passages.
		66. Practice on Removing piston and connecting rod from engine - examine -piston ring heads for wear; examine piston skirt for cracks & distortions, clear oil holes -check connecting rod for bend and twist and parent bore for taper, ovality, and gudgeon pin bushes for wear check elongation of cap fixing bolts. (16 hrs.) 67. Practice on Removing crankshaft and camshaft from engine-checking oil retainer and trust surface for wear-measure crank shaft journal for wear-checking flywheel and mounting flanges, spigot, bearing-check vibration damper for defects - check cam shaft for bend & crank. (16 hrs.) 68. Measurement of voltage & current of line and phase of Star & Delta connected system. Measurement of three-phase power and power factor by two-watt meter method. (08 hrs.)	Piston and piston rings; function, types and materials used, recommended clearances for the rings and its necessity; precautions while fitting rings; connecting rods; types; function and material used; methods of fixing gudgeon pin on small end; method bearing failure & its causes; care & maintenance. Crankshaft - construction & ructions -materials used - arrangement of crank pins and journals - balancing methods-Flywheel-construction & its functions and material used; Rim marks and balancing; Construction of flywheel and its attachment with crank shaft. Multi-phase System: - Disadvantages of the single-phase system, Generation of three-phase E.M.F., Delta connection of three-phase windings, Star connection of three-phase windings, Voltages and currents in a star-connected system, Voltages and currents in a delta-connected system, Power in a three-phase system with a balanced load, Measurement of

			active power in a three-phase three-wire system, Power factor measurement by means of two watt meters.
		69. Practice on checking cylinder blocks surface -measure cylinder bore for taper & ovality-check main bearing parent bore for taper & ovality clean oil pipe line- check main bearing cap; bolt holes check cam shaft, bearing and tappet bore-rescale water passages and examine plugs check cylinder head for warping. (16 hrs.) 70. Study of construction and operation of Fuel system, lubrication system, of multi-cylinder CI engine. (12 hrs.) 71. Practice on Overhauling oil pump, oil filters, oil coolers, air cleaners check and adjust oil pressure relief values - changing oil in the sump, repair of oil flow pipelines and unions. (12 hrs.)	Description & function of cylinder block-material used-cylinder liners-& details-crank case and oil pan and their construction water jacket passages & wail thickness-bolt hole dimension; cylinder fixing provision for mounting accessories-like oil pump, water pump filters-oil flow passages and cleaning plugs. Fuel system, lubrication system and their components (e.g.:- fuel injection pump, PT pump etc.) used in multi-cylinder CI engine Friction-its meaning and importance, methods to reduce friction in engines use of lubricants-oil for diesel engine lubrication - properties of lubricants. (30 hrs.)
Professional Skill 20 Hrs.; Professional Knowledge 07 Hrs.	Trace and Test all Electrical & Electronic components & circuits and assemble circuit to ensure functionality of system. (Mapped NOS: MIN/N3211,	72. Construction of D C. machine & identification of various components of D.C. machine. (3 hrs.) 73. Study the armature winding of D.C. machine / visit to electrical workshop to study armature winding of dc machines. (4 hrs.) 74. Practice on bleeding of air from fuel line; servicing primary and secondary filters; oil filters;	Construction Features and Armature Windings of D.C. Machines: -Poles and Yoke, Armature core, Magnetic circuit, Commutator, Brushes, Brush Holders and Rocker Ring, Armature Winding, Action of a Commutator. Operating Principle and Characteristics and D. C. Generator: - E. M.F. induced in Armature,

	MIN/N3212, MIN/N1702, MIN/N1704)	removing and fixing filter elements. (3 hrs.) 75. Maintenance of filter elements. Practice on Assembly, disassembly of radiators, filters, water pump, radiators, thermostat valve and other components of cooling system; maintenance of cooling system. (5 hrs.) 76. Practice on the connections of three-phase transformer. (3 hrs.) 77. Study of auto transformer. (2 hrs.)	Type of D.C. Generators, Classification of D.C. Generators, Characteristic Curves and Regulation, Characteristic curves of Separately Excited Generator, Characteristics Curves of Shunt Generator Construction of Air filters, Fuel filters, Oil filters of CI engine; reasons for using no. of filters elements; importance of diesel and lubricating oil cleanliness; types of diesel fuel and oil used. Construction and operation of cooling system of multi-cylinder CI engine; construction of radiators, cooling fan, thermostat valve etc. Three-phase Transformers: -Three-phase core-type transformers, Connection of three-phase two windings transformers, Autotransformers, Current transformers, Potential Transformers, Air-cored transformer, Three windings transformers, Parallel Operation of transformers. (07 hrs.)
Professional Skill 45Hrs.; Professional Knowledge 10Hrs.	Diagnose & rectify the defects in vehicle to ensure functionality of vehicle. (Mapped NOS: MIN/N3212, MIN/N3208)	78. Practice on Dismantling of unserviceable fuel injection pump, PT pump, governor; studying their parts and reassemble; testing of fuel pump and PT pump; general maintenance of fuel pumps and governor. (4 hrs.) 79. Checking performance for missing cylinder by isolating	Constructional details of fuel injection pumps, feed pumps, governors, PT pumps; explanation of function and operation. Fuel injection nozzles description & operation- of each type; spray angle orifices and their characteristics-injector tester-construction & function; types of tests & their purpose; effects of

		defective injectors & test. (2 hrs.) 80. Dismantle and replace defective parts & reassemble and refit back to engine; importance of correct tuning while assembling the unit and fitting on the engine. (4 hrs.) 81. Practice on Measurement of diameter of the crank shaft, cam shaft for regrinding / replacement. (3 hrs.) 82. Inspection of cylinder liner, cylinder head for repairing / replacement; Inspection of valve seats on cylinder head and valves. (4 hrs.) 83. Checking of cylinder head and crank case for possible crack; Inspection of seals and packing of the exhaust and inlet manifolds. (4 hrs.)	incorrect setting of nozzles on engine performance. Construction of crank case, exhaust manifold, inlet manifold, crank shaft, cam shaft, piston, cylinder liner and cylinder head.
		84. Construction of turbocharger used in high powered diesel engine; Inspection of old turbocharger, seal, bearing for replacement / repair. (5 hrs.) 85. Practice on study of the construction of alternator and starter used in turbo-charged diesel engine; their trouble shooting; removing and repairing of alternator and starter. (4 hrs.) 86. Precautions while connecting battery in alternator circuit. (2 hrs.) 87. Practice of D.C. motor starter	Construction and operation of turbocharger, reasons for probable failures and remedies. Construction and operation of Engine accessories: Basic function of Alternator, starter, batteries; Testing and maintenance of batteries; Description of battery charging circuit of an automobile; Operating Characteristics of D.C. Motors: -Shunt and Separately Excited motors, Series Motor, Compound Motor, Comparison between different types of D.C. Motors and their applications.

		and its connection with D.C. motor. Three-point starter, Four point starters, series motor starter. (3 hrs.) 88. Practice on steps to follow for dismantling the engine, cleaning of different parts; methods of assembling practices to be followed during engine overhauling as per makers shop manual. (6 hrs.) 89. Practice on BHP test of overhauled engine, inspection of leakage, and rise in temperature during testing fault identification, Diagnosis of reasons for starting difficulty in a diesel engine; and its possible remedies. (4 hrs.)	Starting, Speed Control and Methods of D.C. Motors Starting, Shunt and Compound Motor Starters, Series Motor Starters, Automatic Starters, Speed Control of D.C. Motor, Speed Control of D.C. Shunt Motor, Speed Control of D.C. Series Motor, Ward-Leonard method of speed control of d.c. motor. Detail construction and operation of multi-cylinder high powered turbo-charged diesel engine. Practice in starting and stopping of turbo-charged engine; Starting difficulties in diesel engine; Checking of oil, fuel, water levels and accessories of engine; Engine testing: Theory of different testing methods; Trouble shooting of the different sub-systems of the engine. (10 hrs.)
Professional Skill 45 Hrs.; Professional Knowledge 10Hrs.	Carryout overhauling of Alternator and Starter Motor. (Mapped NOS: MIN/N3211, MIN/N3212, MIN/N3208, MIN/N1703)	90. Speed control of D.C. shunt motor& separately excited motor. (7 hrs.) 91. Use of potentiometer for measurement of unknown e.m.f.(6 hrs.) 92. Practice on diagnosis of engine faults, like smoky, exhaust, overheating, heavy vibration-missing cylinders, exhaust noise, hunting characteristics of engine and erratic or irregular idling. (16 hrs.) 93. Diagnosis of engine faults like main bearing noises, piston pin noise, flywheel knock and crank	Analogue Measuring Instruments: - Introduction, Electrical analogue indicating instruments, Controlling devices, Damping devices, Permanent-magnet moving-coil ammeters and voltmeters, Thermocouple instruments, Electro dynamic instruments, Rectifier ammeters and voltmeters, Measurement of resistance by the Wheatstone bridge, The potentiometer. Reasons for excessive exhaust smoke, overheating, vibration, missing and hunting noises in engine, methods of elimination the noises for

		noise and diesel knock. (16 hrs.)	smooth working of the turbo-charged engine. Reasons for development of noises in the engine components; rectification, methods. (10 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**<u>Engineering Drawing:</u>** Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the freehand sketches. • Free hand drawing of hand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definitionand difference) Reading of Job drawing of related trades. Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of – • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the freehand sketches. • Free hand drawing of hand tools and measuring tools.	

		Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke. Dimensioning • Types of arrowhead • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation – • Different symbols used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and Isometric projections • Method of first angle and third angle projections (definitionand difference) Reading of Job drawing of related trades.
WORKSHOP CALCULATION & SCIENCE: 34 Hors.		
WCS- 34 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**WORKSHOP CALCULATION & SCIENCE:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity

		Speed and Velocity, Work, Power and Energy Speed and velocity - Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Thermal conductivity and insulators Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC, DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel Ohm's law, relation between V.I.R & related problems Magnetic induction, self and mutual inductance and EMF generation **Mensuration** Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Levers and Simple machines** Lever & Simple machines - Lever and its types
In-plant training/ Project work **Broad Area:** a) Total overhauling of a SI Engine. b) Diagnosis of different engine faults. c) Overhauling of Injection Pump.		

SYLLABUS FOR MECHANIC MINING MACHINERY TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 20 Hrs.; Professional Knowledge 08Hrs.	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.] (Mapped NOS: MIN/N3211, MIN/N3212)	94. Practice on Measurement of viscosity, identification of different types of oil. Identification of hydraulic and pneumatic components in a system Practice in fitting the hydraulic hoses, fittings, oil seals, O-ring; tube bending. Identification and maintenance of the components of hydraulic power pack. Pipe fittings, elbows, sockets, reducing sockets, straight coupling, tube fittings, copper tube and fittings. Maintenance practice of the airline components: Filter breather, moisture separator, air dryers etc. (12 hrs.) 95. Practice of the construction and identification of various parts of squirrel cage and slip ring induction motor. (08 hrs.)	Fluid Properties: Revision on Basics of Fluid mechanics; Fluid qualities; different grades of oil; Fundamentals of fluid power: Bernaulli's theorem, Pascal's law, laminar and turbulent flow; temperature rise and pressure transients; System of units. Transformation of energy; Advantages and disadvantages of hydraulic, pneumatic and electrical systems used in HEMM Hydraulic and Pneumatic symbols. Construction, installation and maintenance of hydraulic pipes, fittings, hoses and seals; Standard of hydraulic pipes and fittings and their selection; Construction of Hydraulic power pack and accessories: Filter, breather, tank etc. Filters and filtration technology; contamination level as per NAS standard, removal of contamination. Primary Air Treatment: Preliminary filtering, relative humidity, effects of moisture, water removal, moisture separator, oil scrubbers and air, dryers; Construction of air receivers. Three-phase Induction motor: - Construction, Principle of operation, Losses and

			Efficiency of squirrel cage and slip ring induction motor. (06 hrs.)
Professional Skill 55Hrs.; Professional Knowledge 20Hrs.	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (Mapped NOS: MIN/N3211, MIN/N3212)	96. Identification of different type of pumps and motors; Assembly and disassembly of pumps and motors; Inspection and measurement of critical parts of pumps and motors; Performance determination of pumps and motors: leakage test, efficiency test at various operating conditions (07 hrs.) 97. Practice on Identification of critical parts of hydraulic valves and cylinders, assembly and disassembly of hydraulic valves. (5 hrs.) 98. Construction of different pneumatic circuits using Pneumatic trainer. (6 hrs.)	Construction and operation and maintenance of hydraulic pumps and motors: gear pump, vane pump, piston pump, fixed and variable displacement pumps and motors; Pneumatic motors. Hydraulic accumulator Hydraulic and Pneumatic valves and cylinders: construction, operation and maintenance of manually operated, solenoid operated; Proportional valve, servo valve, controlled valve, electrical circuitry; Hydraulic cylinders: conventional cylinders, telescopic cylinder; Power loss, pressure drop, flow losses. Construction of Pneumatic filter, Regulator and lubricator.
		99. Study of stator winding of induction motor and rotor winding of Slip ring induction motor. (5 hrs.) 100. Study of starters of three-phase squirrel cage induction motor: - DOL Starter, Auto-transformer starter, Star/Delta Starter. (7 hrs.) 101. Practice on Identification of hydraulic and pneumatic circuit components; Fabrication of hydraulic and pneumatic circuits in trainers. (7 hrs.)	Starting of squirrel cage motors, Starting of wound rotor motors, Speed control of three-phase induction motor. Construction, operation and maintenance of different typical circuits used in heavy earth moving equipment. Concept of energy saving using hydraulic accumulator. Study of hydraulic and pneumatic controls used pumps and valves of equipment.

		102. Practice on Alignment of hydraulic pumps and motors with prime mover, cleaning of filter, oil tank, breather and other accessories of hydraulic power pack, charging of accumulator. (10 hrs.) 103. Practical on developing different hydraulic circuits using hydraulic trainer. (8 hrs.)	Maintenance and Troubleshooting of hydraulic and pneumatic systems: filter replacement / cleaning, oil; Oil analysis; maintenance of compressor, reservoir, filter, lubricator, regulator valve etc.; Installation and commissioning of hydraulic and pneumatic system. (12 hrs.)
Professional Skill 55Hrs.; Professional Knowledge 16Hrs.	Conduct preventive maintenance, perform dismantling and assembly of different components machine and test for accuracy of rotor, crawler etc. (Mapped NOS: MIN/N3211, MIN/N3212)	104. Study of rotor starter for slip ring induction motor. (4 hrs.) 105. Study the construction of single-phase induction motor & starting methods. (5 hrs.) 106. Practice on dismantling an unserviceable conventional gear box used in automobile; Cleaning and Inspection of critical parts; gears, clutch plates for wear damage; Assembling of the gear box and filling in oil. (5 hrs.) 107. Using unserviceable transmission inspects critical parts of transmission: clutch plates, piston rings, gears, runner, turbine, stator, retarder unit; assembly and disassembly of transmission; Operation of selector valve, Testing of transmission in workshop. (08 hrs.)	Single-phase Induction motor: - Construction, Theories of operation, Split-phase starting, Shaded-pole starting, Capacitor motor Model, power rating, and use of hydraulic transmission in Heavy Earth Moving Machine, Construction and operation of conventional multi-speed gear box; hydraulic transmission: torque converter, gear train arrangement, control circuit, selector valve, cooling system, retarded, pistons and clutch assemblies; Maintenance and Troubleshooting of transmission.
		108. Practice on assembly / disassembly of tyre with /	Description of wheel and tyres used in HEMM; Section of tyres,

		from wheel rim; Inspection of puncture and cuts in tube / tyre. (16 hrs.)	ply rating, inflation pressure and carrying capacity, storage of tyres, different types of rims; handling of tyres, tyre inflation.
		109. Practice on assembly / disassembly of crawler pads, chain and links. (17 hrs.)	Construction of undercarriage unit: The carrier rollers, track rollers, tensioning arrangement, crawler pads, drive arrangement, chain and links, drive sprocket, idler wheel. Its maintenance and repairing. (12 hrs.)
Professional Skill 85 Hrs.; Professional Knowledge 20Hrs.	Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. (Mapped NOS: MIN/N3211, MIN/N3212)	110. Practice on study the construction of synchronous machine and identification of various components of the machine. Study the operation of three-phase alternator for the generation of constant voltage and frequency. Study the effect of variation speed and excitation of an alternator. (20 hrs.)	Synchronous Generators (Alternators): -Advantages of Rotating field alternator, Speed and frequency, Synchronous speed, Construction of three-phase synchronous Machines. Voltage generation, Armature windings, Parallel operation of alternators.
		111. Practice of the construction, operation and maintenance of different capacities of rope shovel in open cast mine. (7 hrs.) 112. Practice of rebuilding of bucket teeth and other maintenance activities carried out in machines working in mines. Assembly and disassembly of the unserviceable undercarriage unit of shovel; identification of its critical parts. (7 hrs.) 113. Maintenance practices of	Classification, model, power rating, capacity and applicability of rope shovel; Construction and operation of Rope shovel: Structural construction, gear train arrangement, power flow diagram of electro-mechanical systems; magneto-torque drive, Electrical layout, construction of bucket, boom, dipper stick, undercarriage unit; Maintenance practices of rope shovel: e.g. rebuilding of bucket, bucket teeth, changing of wire ropes, lubrication of ropes and other components;

		undercarriage unit and its Tensioning system. (8 hrs.)	Centralised lubrication system; Trouble shooting of Rope shovel; Machine's safety features. Safety aspects related to rope shovel as per mine regulation.
		114. Practice of the construction, operation and maintenance of different capacities of hydraulic shovel in open cast mine. (7 hrs.) 115. Practice of rebuilding of bucket teeth and other maintenance activities carried out in machines working in mines. Assembly and disassembly of the hydraulic actuator; identification of its critical parts; replacement of the seal kit; testing of hydraulic actuator for internal leakage. (9 hrs.) 116. Practice of synchronous motor with auto - transformer starter. Study the speed control of slip-ring induction motor. (7 hrs.)	Classification, model, power rating, capacity and applicability of hydraulic shovel; Construction and operation of Hydraulic shovel: Structural construction, hydraulic circuit, power flow diagram, Electrical layout, construction of bucket, boom, dipper stick, undercarriage unit; Maintenance practices of hydraulic shovel: e.g. rebuilding of bucket, bucket teeth, maintenance of pumps, motors, cylinders, hoses, fittings etc., Centralised lubrication system; Trouble shooting of hydraulic shovel; Machine's safety features; Safety aspects related to hydraulic shovel as per mine regulation. Three-phase Synchronous motors: -Construction, Principle of operation, Main features of synchronous motor, Effect of varying field current, Starting of synchronous motors, Comparison between three-phase synchronous and induction motors, Synchronous condenser, Applications of synchronous motors.
		117. Practice of the construction, operation and maintenance of Walking dragline working in open cast mine; Practice	Classification, model, power rating, capacity and applicability of walking dragline; Construction and operation of Walking

		of rebuilding of bucket teeth and other maintenance activities carried out in machines working in mines. Maintenance practices carried out for walking mechanism. (20 hrs.)	dragline: Structural construction, gear train arrangement, power flow diagram of electro-mechanical systems; Electrical layout, construction of bucket, boom, dipper stick, undercarriage unit; Maintenance practices of rope shovel: e.g. rebuilding of bucket, bucket teeth, changing of wire ropes, Centralised lubrication system; Trouble shooting of dragline; Machine's safety features. Safety aspects related to dragline as per mine regulation. (18 hrs.)
Professional Skill 85 Hrs.; Professional Knowledge 25Hrs.	Conduct preventive maintenance, perform dismantling & assembly of different components of machine and test for accuracy. (Mapped NOS: MIN/N3211, MIN/N3212)	118. Practice the construction of various types of overhead line conductors. (20 hrs.)	Transmission & distribution lines: -Line support, Conductor material, Overhead lines vs. Underground cables, Indian Electricity rules (1956) for overhead lines.
		119. Practice of the construction and operation of wagon drill, blast hole drill and jack hammer drill in mines. (3 hrs.) 120. Maintenance practices carried out for drill machines. (3 hrs.) 121. Practice of care and maintenance of drill bits and drill rods/tubes. (4 hrs.) 122. Care and maintenance of screw. (2 hrs.) 123. Compressor, dust collector used in drill machine. (4 hrs.) 124. Practice on Wet Drilling System. (4 hrs.)	Classification, model, power rating, capacity and applicability of Drill machines; Construction and operation of wagon drill, blast hole drill and jack hammer drill, DTH drill; Power flow diagram, hydraulic/ pneumatic system used for feed, rotation of the drill tube / rod; Construction of drill bits: button bit, cross-bit, tricone rock roller bit, maintenance of drill bit, dust suppression system of drill machine, air flushing, foam flushing, operation and maintenance of screw compressor; construction of drill tubes, rods; travel mechanism; Trouble shooting of drill

			machines; Machine's safety features; Maintenance of drill machines, drill bits, drill tubes etc. Safety aspects related to drills as per mine regulation.
		125. Construction of various types of overhead lines insulators. (5 hrs.) 126. Practice of operation and maintenance of Tractor dozer in mines. (7 hrs.) 127. Practice of rebuilding of dozer blade and other maintenance activities carried out in dozer working in mines. (7 hrs.) 128. Maintenance practices of undercarriage unit and its Tensioning system. (4 hrs.)	Overhead line Insulators: Insulator materials, Types: - Pin type Insulators, Suspension type Insulators, Limits of pin type Insulators, Strain type Insulators, Post Insulators, Insulators Failure, Bushings Underground Cables: - construction of various types of cables, Types of cables, Armouring and covering of cables, Cable laying, Selection of cables. Classification, model, power rating, capacity and applicability of Tractor dozer; Construction and operation of Tractor Dozer; Power transmission system, hydraulic system for operation of dozer blade; Construction of dozer blade, cutting edges; undercarriage unit, steering system, electrical system; Machine's safety features; Maintenance practices of dozer; Trouble shooting of dozer. Safety aspects related to tractor dozer as per mine regulation.
		129. Construction, operation and maintenance of Wheel loader in mines. (3 hrs.) 130. Practice of rebuilding of loader bucket and other maintenance activities carried out in loader working	Classification, model, power rating, capacity and applicability of wheel loader; Construction and operation of Wheel Loader & Scraper; Power transmission system, hydraulic system for steering and bucket operations;

		in mines. (3 hrs.) 131. Practice on Identification of critical parts of hydraulic transmission, propeller shaft, differential, suspension system, front and rear axle assemblies, steering and braking system; Removing propeller shaft and universal joint from vehicle; cleaning, inspecting replacing worn out parts, reassembling and fitting to the vehicle. (08 hrs.) 132. Practice on removing rear axle assembly from the vehicle, dismantling, cleaning, inspecting parts for wear and damage; removing tail pinion and bearings-cleaning and inspection of oil seals and bearing. (8 hrs.)	braking system; Construction of bucket and its cutting edges; Wheel brake assembly; Rear axle, differential; propeller shaft and universal coupling; Electrical system; Machine's safety features; Maintenance practices of wheel loader; Trouble shooting of Wheel Loader; Safety aspects related to wheel loader as per mine regulation. (20 hrs)
Professional Skill 140 Hrs.; Professional Knowledge 35Hrs.	Plan execute commissioning and evaluate performance of AC & DC machines. (Mapped NOS: MIN/N3211, MIN/N3212)	133. Construction of various types of fuses. Study of outdoor and indoor substation through visits to nearby installations. (22 hrs.)	Sub-stations: - Types of substations, Busbar, Bus-bar Layout drawings. Power Distribution Systems: - Radial and ring main systems, Fuses: - Definitions, Fuse element material, types of fuses, High voltage H.R.C. fuses, Application of H.RC. fuse, Selection of fuse, Advantages and Disadvantages of fuse.
		134. Construction, operation and maintenance of dumpers in mines. (8 hrs.)	Classification, model, power rating, capacity and applicability of dumper; Construction and

		135. Practice on Identification of critical parts of hydraulic transmission, propeller shaft, suspension system, steering and braking system; Assembly and disassembly of unserviceable components of dumper: differential, rear axle assembly, propeller shaft. (10 hrs.) 136. Adjustment of backlash and clearances of differential, brake liner and other gear assemblies; Removing rear axles assembly from vehicle, dismantling, cleaning, inspecting parts for wear and damage, cutting packings / gaskets, inspection of oil seals and bearings. Brake work: Adjusting brake pedal play; checking brake binding; trouble shooting of master cylinder, adjustment of brake shoes for proper clearances; bleeding of hydraulic brakes. ((17 hrs.) 137. Maintenance practices carried out in dumper working in mines. Trouble tracing in braking system of a dumper-adjusting brakes, precautions. Trouble shooting in transmission system- detecting noises from transmission, rear axle, propeller shaft and	operation of Dumper; Power transmission system; hydraulic system for operation of dump body and steering; Braking system: parking brake, emergency brake and service brake; rear axle, propeller shaft and universal coupling; differential; Suspension system; Construction of dump body, Brake lining types, uses, brake fluid; Description and function of final drive assembly: Crown wheel and tail pinion, its lubrication; description of differential and its principle of operation. Electrical system; Machine's safety features. Power transmission system of electric dumper; wheel motor / drive assembly; Maintenance practices of dumper; Trouble shooting of dumper. Safety aspects related to dumper as per mine regulation. Brake testing - efficiency of brakes-braking distance, common troubles in brakes and their remedies.

		coupling. (12 hrs.)	
		138. Study the construction of Oil circuit breaker, Air circuit breaker, Vacuum circuit breaker, Minimum Oil circuit breaker, Sulphur hexafluoride (SF6) circuit-breakers. (23 hrs.)	Circuit Breakers: - ARC Phenomena:- Initiation of an Arc, Maintenance of Arc, Arc voltage, Arc Interruption, Classification of circuit breakers: - Oil Circuit-breakers , Air circuit breakers, Low oil or minimum oil circuit-breaker MOCB), Maintenance of oil circuit-breakers, Air blast breakers, Sulphur hexafluoride (SF_6) circuit-breakers, Vacuum Interrupters, Circuit-breaker rating.
		139. Connection & operation of induction type over current relay, Thermal overload relay, CBT based earth fault relay, plunger type oil dash pot relay. (23 hrs.)	Protective Relays: - Basic requirements of protective relaying, Types of protection, Classification of relays, Principle of operation, Their application, Time of operation, Ordinary electromagnetic relays, Construction and operating principle, Characteristics and applications, Non-Directional over-current and Earth-leakage (Induction type) relay. Differential relays.
		140. Practice on Experiments on (24 hrs.) a) Firing circuits of SCR. b) Single-phase half-controlled rectifier c) Single phase fully controlled rectifier d) D.C. Chopper	Power Electronics: - Thyristor, Limitations to thyristor operation, the fully controlled A.C./D.C. converter, A.C./D.C. inversion, Switching devices in inverters, Three-phase rectifier networks, The three-phase fully controlled converter, Inverter-fed induction motors, soft-starting of induction motors. (30 hrs.)
Professional	Conduct	141. Construction, operation and	Classification, model, power

Skill 85 Hrs.; Professional Knowledge 30Hrs.	preventive maintenance, perform dismantling &assembly of different components and test for accuracy to carryout advance lathe operation. [Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting]. (Mapped NOS: MIN/N3211, MIN/N3212)	maintenance of Motor grader in mines. (09 hrs.) 142. Practice on Identification of critical parts of hydraulic transmission, propeller shaft, differential, suspension system, tandem drive assembly, front and rear axle assemblies, steering and braking system. (15 hrs.) 143. Maintenance practices carried out in Grader working in mines. (17 hrs.)	rating, capacity and applicability of Motor grader; Construction and operation of Motor Grader; Power transmission system, hydraulic system for steering and blade control system; braking system; Construction of grader blade, cutting edges; steering system, electrical system; Machine's safety features; Wheel brake assembly; Tandem drive, Rear axle, differential; propeller shaft and universal coupling; Electrical system; Machine's safety features; Maintenance practices of Grader;. Trouble shooting of Grader; Safety aspects related to Grader as per mine regulation.
		144. Construction, operation and maintenance of Surface Miner in open cast mine. (08 hrs.) 145. Practice on Maintenance practice of cutting drum and picks and other maintenance activities carried out in machines working in mines. (18 hrs.) 146. Practice on Maintenance practices of undercarriage unit and its Tensioning system. (18 hrs.)	Classification, model, power rating, capacity and applicability of Surface Miner; Construction and operation of Surface Miner: Structural construction, Undercarriage unit; power flow diagram of electro-mechanical systems; Cutting Unit: cutting drum, cutting picks, drive for cutting unit, Control arrangement: depth control of cutting drum, steering control; Material discharge system: drives for primary conveyor and discharge conveyor, height and swing control of discharge conveyor; Electrical system; Maintenance practices of Surface miner; Centralised lubrication system;

			Trouble shooting of Surface miner; Machine's safety features. (20 hrs.)
Professional Skill 45 Hrs.; Professional Knowledge 20Hrs.	Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. (Mapped NOS: MIN/N3211, MIN/N3212)	147. Practice on Maintenance of conveyor belt, belt changing/ extension. (20 hrs.) 148. Troubleshooting of crushers and screens. (25 hrs.)	Construction, operation and application of material handling equipment: Belt conveyor, crushers, screen. (8 hrs.)
Professional Skill 45 Hrs.; Professional Knowledge 12Hrs.	Plan & perform basic day to day preventive maintenance, repairing and check functionality. (Mapped NOS: MIN/N3211, MIN/N3212)	149. Practice on repairing of grease guns, Oil can, and other items required for maintenance of HEMM; maintenance of drills, press, pedestal grinder etc. (45 hrs.)	Basic elements of maintenance system -inspection, planning, scheduling, job execution. Importance of periodical maintenance; Upkeep of shop equipment required for all type of maintenance; (8 hrs.)
Professional Skill 55 Hrs.; Professional Knowledge 12Hrs.	Troubleshoot & Overhaul of pumps, fans, blowers & compressors and perform preventive maintenance. (Mapped NOS: MIN/N3211, MIN/N3212)	150. Practice on the protection of motor. (08 hrs.) 151. Practice on Transformer oil testing. (10 hrs.)	Protection of Transformer, AC motors and Feeder.
		152. Different types of wear in components of engine, gear box etc. (2 hrs.) 153. Condition based monitoring. (2 hrs.) 154. Practice on testing of lighting circuits; finding out short and open circuit; checking of wiring; testing of tail and brake lights. (3 hrs.)	Science of friction and wear: different types of wear, such as abrasive, corrosive, seizure, scoring, scuffing, pitting etc. Description of light circuits used in HEMM; Description and operation of each; Pre-focused bulb and sealed beams; Fuses and their importance; Layout of different sensors; malfunctioning

		155. Checking functions of malfunctioning of indicating lamp. (2 hrs.) 156. Removing wiper motor, dismantling, cleaning, inspecting and repairing; assembling and fitting; setting blades for correct functioning. (10 hrs.)	of indicating lamp in HEMM Description and operation of electric wiper motor; Care and maintenance; Common troubles remedies.
		157. Construction of various types of lightning arrestors. (18 hrs.)	Protection against over voltages due to lightning: Protection against lightning: - Protection of power stations and sub-stations against direct strokes, Protection of transmission lines against direct strokes. Protection of Electrical apparatus against traveling waves: - The rod gap, Expulsion type lightning arrester, Valve type lightning arresters, Metal oxide lightning arresters and Magnetically blow out spark gaps. (12 hrs.)
Professional Skill 85 Hrs.; Professional Knowledge 16Hrs.	Identify fault carryout maintenance work and break down of different machineries/ equipments viz., , drilling, loaders, dozers, shovels, dumper etc., in the shop floor, using appropriate tools &equipments to ensure its	158. Practice on assembling and disassembly of air compressor, hydraulic hoist for maintenance and its care. Identification of critical parts. (16 hrs.) 159. Practice of maintenance of service equipment like injectors testing machine, valve seat grinder, HP testing machine etc. (25 hrs.)	Basic definitions: preventive, operating and shutdown maintenance; general maintenance carried out for service equipment in workshop.
		160. Practice on Maintenance of shovels, dragline and dumper. (22 hrs.)	Planned preventive maintenance of rope shovel, hydraulic Shovel, dragline, dumper; Electrical

	functionality. (Mapped NOS: MIN/N3211, MIN/N3212)		components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers.
		161. Practice on Maintenance of drills, loaders and dozers. (22 hrs.)	Planned preventive maintenance of drills, loaders and dozer: Electrical components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers. (12 hrs.)
Professional Skill 85 Hrs.; Professional Knowledge 16Hrs.	Plan, execute testing, evaluate performance and carry out maintenance of cable system, measurement of insulation resistance. (Mapped NOS: MIN/N3211, MIN/N3212)	162. Electrical braking of A.C. &D.C. motor. (4 hrs.) 163. Practice on Maintenance of scraper, grader and surface miner. (16 hrs.)	Electrical Braking for A.C. & D.C. Motors: Plugging, Rheostatic braking, Regenerative braking Planned preventive maintenance of scraper, grader and surface miner: Electrical components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers.
		164. Practice on Measurement of illumination. (15 hrs.) 165. Practice on Measurement of earth resistance. (13 hrs.) 166. Measurement of insulation resistance. (10 hrs.)	Illumination: - Laws of Illumination, Electrical lamps, Electric discharge lamps, Cold cathode lamps, Lighting fitting, Illumination for different purposes, Factory lighting, Flood-lighting, street lighting. Power System Grounding: - Ungrounded neutral system, Grounded neutral systems, solid grounding, Resistance grounding, Reactance grounding, Resonant grounding (Arc-Suppression coil grounding), Choice of the method of neutral earthing, Grounding practice, Equipment grounding (or Earthing) for safety, Grounding at sub-stations,

			Grounding of line structure.
		167. Practice on measurement of energy, power factor and frequency of a three-phase system. (6 hrs.) 168. Connection of CT & PT for measuring instrument. (7 hrs.) 169. Practice on Testing of energy meter. (6 hrs.) 170. Practice on Measurement of speed using contact type and non-contact type tachometer. (6 hrs.)	Measurement of Energy & Industrial Metering: - Single-phase induction type watt hour meter, Three-phase energy meter, Maximum demand indicator, Average demand indicator, Measurement of Vah&Varh, Industrial metering & tariff. (12 hrs.)
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	• Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints • Reading of drawing of pipes and pipe joints • Reading of Job Drawing, Sectional View & Assembly view	
WORKSHOP CALCULATION & SCIENCE: 30 Hors.			
WCS- 30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment**	

		Heat treatment and advantages **Profit and Loss** **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
Project Work/ Industrial Visit: - a) Visit of underground coal and metal mines to study the construction and operation of the machines. Visit to open cast mines for the study of electrical systems in rope shovel and dragline.		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (160 Hrs. + 80 Hrs.)

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

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
MECHANIC MINING MACHINERY (For batch of 24 candidates)			
S No.	**Name of the Tool &Equipment**	**Specification**	**Quantity (No.)**
A. TRAINEES TOOL KIT			
1.	Iron jack	9"x2" plane with cutter	7 Nos.
2.	Iron smoothing plane	9"x2" with cutter 1.7 kg approx.	7 Nos.
3.	Wooden jackplane	9"	12 Nos.
4.	Wooden smoothing plane	9" 11"	12 Nos.
5.	Rebate plane	*3A"*	2Nos.
6.	Rebate plane	V2"	2 Nos.
7.	Rebate plane	Vi"	2 Nos.
8.	Corner plane (Taper)	1"	2 Nos.
9.	Rounding plane	%"	2 Nos.
10.	Cast steel hand saw	12"	12 Nos.
11.	Firmer chisel	1" size with handle	12 Nos.
12.	Firmer chisel	%" with handle	12 Nos.
13.	Firmer	**V2"** with handle	12 Nos.
14.	Firmer chisel	1/8" with handle	12 Nos.
15.	Dovetail chisel	%" with handle	7 Nos.
16.	Mortise chisel	3/8" with handle	12 Nos.
17.	Mortise chisel	**Vi"** with handle	12 Nos.
18.	Mortise chisel	1/8" with handle	12 Nos.
19.	Try square	10" stainless steel blade 0.45kg approx.	12 Nos.
20.	Mallet (wooden)	500gm approx.	12 Nos.
21.	Gimlet	screw Auger **V2"**	1 No.
22.	Gimlet	screw Auger 3/8"	1 No.
23.	Pistal type hand drill M/c electric single phase	12mm Cap	1 No.
24.	Spring divider	6"	2 Nos.
25.	Outside firm joint caliper	6"	2 Nos.
26.	Cross pen hammer	200gm Approx.	7 Nos.
27.	Adze (	3" angle Edge 1kg Approx.	1 No.

28.	Pincer	8" 350gm Approx.	2 Nos.
29.	Flat basterd file	12" single cut & double cut (2 each)	4 Nos.
30.	Half round basterd file	12" single cut & double cut (2 each)	4 Nos.
31.	Rasp cut half round file	10"	2 Nos.
32.	Round basterd file	12" x *V₂"*	2 Nos.
33.	Triangular file (slim taper)	6"	12 Nos.
34.	Triangular file (slim taper)	4"	12 Nos.
35.	Carpentry bench vice quick release, front dog heavy duty	7"x 9" 12kg approx.	24 Nos.
36.	Adjustable spanner set	12" 0.8kg approx.	1 No.
37.	Double end spanner set	(six piece) 6mm-7mm to 16mm-17mm drop forged chrome plated (pie, Jhalani, Tapria, Inder)	1 No.
38.	Screwdriver engg.	pattern 10mm dia 12" size (pie, Jhalani, Tapria, Inder)	4 Nos.
39.	Screwdriver engg.	pattern 10mm dia 10" size (pie, Jhalani, Tapria, Inder)	8 Nos.
40.	Number punch set	0-9 - size **Vi"**	1 No.
41.	Marking gauge	6"	12 Nos.
42.	Carborundum universal stone (oil stone)	6" x 2" x 1"	8 Nos.
43.	Cross peen hammer	800 gm with wooden handle	12 Nos.
44.	Rasp cut file	8"	8 Nos.
45.	Letter Punch Set (A-Z),	Size **Vi"**	2 Nos.
46.	Blacksmith Flat Tongs	**V2"** Flat size	12 Nos.
47.	Metric hand Tap set	Pitch: 0.25-12mm; TPI 4-80; HSS Steel; Right Hand Thread: M 1.0 - M100.0; Left Hand thread: M4.0-M45.0	1 No.
48.	Metric Dies(Adjustable)	HSS Steel; Right Hand Thread:M3.0 - M30.0; Left Hand thread: M4.0-M30.0	1 No.
49.	HSS Drill Bit Set	3-12 mm	1 No.
50.	Chipping hammer		4 Nos.
51.	Body Protection (Asbestos Suit)		4 Nos.
52.	Welding Goggles (flip / flop)		4 Nos.
53.	Ear Protection		4 Nos.

54.	Auto Darkening Welding Helmets		4 Nos.
55.	Cabinet Dry Oven (big Size) Thermostatic Control,	Temp range up to 250° C	1 No.
56.	Outside and inside Jaw Vernier Caliper (Manual)	150 mm capacity; depth reading facility; Venier Constant 0.05 mm;	2 Nos.
57.	Digital Outside and inside Jaw Vernier Caliper	150 mm capacity; Venier Constant 0.05 mm;	2 Nos.
58.	External Micrometer	0-25 mm	2 Nos.
59.	Measuring tape	8mm wide, (3 m length)	12 Nos.
60.	Internal Spring Caliper	150 mm size	2 Nos.
61.	External Spring Caliper	150 mm size	2 Nos.
62.	Feeler Gauge	Stainless Steel Blades; 25 blades of different thickness, *V2* " wide, 3" long, minimum blade thickness 0.0015", maximum blade thickness 0.025"	2 Nos.
63.	Tpi, Unf & Unc screw pitch gauge	30 blades	2 Nos.
64.	BSW Screw gauge	52 blades	2 Nos.
65.	Level gauge	Size 4"	2 Nos.
66.	Magnetic Stand	Stem dia.	2 Nos.
67.	Steel ruler	12"	12 Nos.
68.	Electronic Weighting Machine, Tabletop metal body with pole	100 kg capacity	2 Nos.
69.	Double ended open jaw spanner set *(for Machine Shop & Fitting Shop)*	Drop forged; Chrome Plated; Sizes: 6x7, 8x9, 10x11, 12x13, 14x15, 16x17, 18x19, 20x22, 21x23, 24x26, 25x27, 30x32	2 Nos.
70.	Double ended Ring end spanner set *(for Machine Shop & Fitting Shop)*:	Drop forged; Chrome Plated; Size: as above	2 Nos.
71.	Ratchet spanner set *(for Machine Shop & Fitting Shop)*	Drop forged; Chrome Plated; Size: as above	2 Nos.
72.	Adjustable Spanner,	Size: 8"	2 Nos.
73.	First Aid Kit		2 Nos.
74.	Hand gloves set		12 Nos.
75.	Fire Extinguisher (Mechanical Foam Type)		4 Nos.
76.	Try-square,	300 x 150 x 20 x 2 mm	12 Nos.
77.	Handheld Wire Brush with handle	6" size	7 Nos.

78.	Pipe wrench,	Sizes: 4",8" 10" & 12"	1 each
79.	Flat Nose plier		7 Nos.
80.	Screwdriver Set (No. 1 - 6),	Size: 8"	2 Nos.
81.	Allen Key Set Specifications:	2.5, 3, 4, 5, 6, 8, 10, 12, 14, 17, 19, 22, 24, 27, 30 and 36 mm	2 Nos.
82.	Pincers,	210 mm	2 Nos.
83.	Stopwatch		7 Nos.
84.	Open Jaw Fixed Type Torque Wrench:	25,30,32 mm	1 each
85.	Vernier Depth Gauge (Digital)	Stainless steel body, range 0-150 mm	2 Nos.
86.	Dial Depth Gauge	Range 0-150 mm	2 Nos.
87.	Digital Height Gauge	0-300 mm	2 Nos.
88.	Radius Gauge	1/32" - 17/64"	2 Nos.
89.	Depth gauge with protector		2 Nos.
90.	Helmet		24 Nos.
91.	Megger	500V and lkV	1 No.
92.	Megger Earth Tester		1 No.
93.	Murrey Loop Tester		1 No.
94.	Lux Meter		1 No.
95.	Single phase wattmeter	5 Amp/10Amp, 110V/250V 10 Amp/20 amp, 250V/500V	1 no each
96.	Three phase wattmeter	10 Amp/20 Amp 250V/500V	1 No.
97.	Three phase power factor meter	10 Amp/20 Amp 250V/500V	1 No.
98.	Single phase power factor meter i. 5 Amp/ 10Amp, ii. 10 Amp/20 Amp,	 110V/250V 250V/500V	1 No. each
99.	Ammeter i. Moving Iron Type - ii. Moving Coil Type -	 5 Amp, 10 Amp, 20 Amp 1 Amp, 5 Amp, 10 Amp, 20 Amp.	1 No. each
100.	Voltmeter i. Moving Iron Type - ii. Moving Coil Type -	 110V, 250V, 500V 50V, 100V, 250V	1 No. each
101.	Stroboscope		1 No.
102.	CT (Current transformer)	100/5 Amp, 100/1 Amp 50 Amp/5 Amp, 50 Amp/1 Amp	1 No. each

103.	PT (Potential Transformer)	500V/250V, 500V/110V	1 No. each
104.	Clamp meter	50 Amp, 100 Amp, 400 Amp	1 No.
105.	Multimeter for measurement of V_{ac}, Vd_c, lac, Idc, Resistance & Continuity		1 No.
106.	20 MHz Dual Trace CRO.		1 No.
107.	100 MHz Dual channels Digital storage oscilloscope.		1 No.
108.	Contact type &Non-Contact type tachometer for the measurement of speed.		1 No.
109.	Transformer oil testing setup.		1 No.
110.	Dual Regulated Variable	dc power supply 0-30V, 2Amp.	1 No.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
111.	Bench Type Drilling Machine	(a) drilling 40 mm ; (b) face mill : 100 mm ; (c) end mill : 20mm; (d) tapping : 20mm mill	1 No.
112.	Vice Working Table	4 ' x 4 '	3 Nos.
113.	Bench Vice	Size : 6" ; Body : cast Iron; jaw : hardened and Knurled Steel jaw	12 Nos.
114.	Surface Plate (small),	size 1' x 1'	2 Nos.
115.	Surface Plate (big),	size 2 x 2 '	2 Nos.
116.	Hand Hacksaw frame with blade,	size 5 x 300 mm	12 Nos.
117.	Bench Grinder	Wheel size : 125 mm; no. load speed : 2950 rpm	1 No.
118.	Portable Electric Drill Machine	Hole size : 5 mm to 25 mm; variable chuck;	1 No.
119.	Blacksmith Hammer with handle	Alloy steel hammer head; harden and normalized; weight of head : 1.5 kg and 2 kg	12 each.
120.	Sledgehammer	Drop forged, hardened and tempered alloy steel hammer head : weight of hammer head : 3 kg	2 Nos.
121.	Open hearth Coal Fired Furnace	Size : 600 x 600 mm MS fabricated complete with water tank; coal tank, air control valve, electrically operated motorized blower, ash-	2 Nos.

		tray, hopper with smoke outlet (hood); complete with fire brick lining; 8" diameter chimney with installation	
122.	Pneumatic Power Hammer	Distance between Dies: 9" ; Blows per minute : 240; Dia size : 2.375" x 4.75";	1 No.
123.	Anvils with damping base	Weight: 200 kg (approx); hardy hole : 1"; Pritchel hole : 7/8" ; Round horn : 12" ; Flat horn : 10"; Face : 6.5" x 16" ' Total Length : 38"; Height : 13"; Base dimension : 12" x 14"	4 Nos.
124.	Steel Swage Block		2 Nos.
125.	Working Table Specifications :	Size : ***VA"*** x 7" x 3"	2 Nos.
C. GENERAL MACHINERY SHOP OUTFIT			
126.	V-belt Driven Lathe Machine	Length of Bed : 1370 mm; Width of bed : 235mm; Height of centre : 165mm; Admit between canters : 765mm; Hole through spindle : 42mm; Swing over bed : 315mm; Swing over carriage : 230mm; Lead screw : 6 TPI; Power : 1HP; Accessories : Electrical Motor, 160mm x 3 jaws true chuck, 200mm x 4 jaws dog chuck, motorized coolant pump with fittings, face plate, steady rest, follow rest, Norton gear box, turning attachment, flame hardened bed ways	1 No.
127.	All Geared Lathe Machine	Length of bed : 1370mm; Width of bed : 285mm; Height of centre : 205mm; swing over bed : 410mm; Swing Over cross slide : 205mm; Distance between centers : 750mm; Movement of cross slide :	1 No.

		240mm; Bed type : 2V & 2 Flat; Type of spindle nose : Taper nose; Taper bore in spindle sleeve : MT-3; Spindle bore : 42mm; Tail stock spindle diameter : 52mm; Tail stock taper bore in spindle : MT-3; Tail stock spindle travel : 150mm; Travel of top side : 160mm; Tool shank section : 25x25mm; No. of speeds : 9; Range : 90 - 1200rpm; No. of feeds : 30; Motor HP : 3HP; Accessories : 160mm x 3 jaw true chuck; 200 mm x 4 jaw dog chuck ; electric - magnetic brake, coolant equipment; splash guard, fixed steady rest, follow rest, face plate, chuck plate, machine lamp, revolving centre, taper turning attachment.	
128.	Turret Lathe	Bar stock capacity : 25-64mm; Chuck size : 250380mm; Drive motor capacity : 5-10 HP; Swing over ways : 550mm; Speed : 50-150rpm	1 No.
129.	All Geared Capstan Lathe	Length of bed: 1370mm; Width of bed: 150mm; Maximum distance between spindle nose to turret face : 275mm; Cross slide traverse travel : 110mm; cross slide longitudinal travel : 150mm; No. of spindle speeds : 3; Range of Spindle speed : 650 - 1660 rpm; Effective stoke of capstan slide : 95; Bore size of hex turret: 25; Centre of holes above turret slide : 40 mm; Height of centre above bed : 150mm; Accessories : bar feed attachment, true chuck 160mm x 3 jaws,	1 No.

		adjustable knee tool holder, bush guide tool holder, boring tool holder, circular forming tool holder for rear end, coupling for spindle nose 160mm dia., coupling for spindle nose 200mm dia., collet end roll above 8mm, compound slide for cross slide, centering and facing tool holder, drill chuck 13mm with sleeve, four way tool holder with stopper, knee tool holder, knurling tool holder for turret, multi tool holder, plain drill holder, parallel shank sleeve MT-1/MT-2/MT-3, recessing slide for turret screw/rack operated, roller tool steady, self-releasing tap and die holder, vertical slide	
130.	Universal Radial Drilling Machine	Drilling Capacity in MS : 38mm; Drilling Capacity in CI : 45mm; Spindle nose : MT-4; Spindle Travel : 220mm; Number of spindle speed : 8 (gear drive); Range of spindle speeds (rpm); 62-1980; Main motor hp : 2; Elevating motor hp : 0.5; Size of working table : 380 x 300 x 300mm; Drilling radius max/min : 895/440; Max/Min distance column to spindle : 930/230mm; Diameter of column : 165mm; Swivel of arm L/R side : 90 degrees; Size of base plate : 760 x 1250 x 150; No of T-slots : (4) 16; Overall height : 2000mm; Motorized coolant pump with fittings	1 No.
131.	Planning Machine	Length of stroke : 1220mm; Width between arms : 762mm; Height under cross rail : 762mm; Length of	1 No.

		bed : 2033 mm; Width of bed : 457mm; Working surface : 1220 x 610mm; No. of T-Slots : 4; Width of T-slots : 19mm; Motor hp : 3	
132.	Slotting Machine	Length of stroke (maximum) : 175mm; Working Stroke : 150mm; Ram adjustment: 125mm; length of ram bearing : 500mm; Throat adjustment : 300mm; Maximum diameter accommodated when machine at centre : 500mm; Height between table and head : 300 mm; Longitudinal feed (manual); 200mm; Longitudinal feed (auto): 175mm; Cross feed (manual) : 225mm; Cross feed (auto): 200mm; Dimension of table : 275mm; Dimension of base plate : 700 x 490mm; Number and range of speeds : 2(30-50); Motor (960 rpm) : 1.5 HP; Optional Accessories : Tilting Head, rapid feed	1 No.
133.	All Geared Shaping Machine	Maximum Length of ram stroke : 315mm; Length and width of table top : 315 x 250mm; Depth of table slide : 280mm; Horizontal traverse of table : 400mm; Vertical traverse of table : 350mm; Travel of tool slide 125mm; Swivel of tooth head on either side of vertical : 60degree; Number of ram speed : 4; Range of ram speeds : 20-115rpm; Range of table feeds : 3; Driving motor : 3HP	1 No.
134.	Universal Milling Machine	Surface of table : 900 x 225mm; Distance between T-slot: 55mm; Longitudinal travel of table : 485mm; Cross travel of table : 150mm; Vertical adjustment of	1 No.

		table : 275mm; Distance between centerline of spindle to lower surface of overarm : 140mm; Taper in spindle : ISO 40; Diameter of milling arbor : 25.4mm; Range of spindle speed : 75,140,210,275,350,525 rpm; Number of feeds : 3; Motor : 2HP/1440 rpm; Motorized coolant pump	
135.	V-Belt Driven Hydraulic Control Hacksaw Machine	Size : 7"; Stroke : S[1]/^'; Number of stokes per minute : 100-120; Motor HP : 1; Blade size : 12-14"; capacity to cut round bar : 7"; Capacity to cut square bar : 5"; coolant pump; Automatic lifting and lowering arrangement; Vice; Machine belt guard	1 No.
136.	Double Ended Motorized Bench Grinder	Motor HP: 1; Three Phase; 440V; 2800 rpm; Coolant pump; Wheel size : 250 x 25mm; Wheel guard	1 No.
137.	Double Ended Pedestal Grinder	Motor HP: 1; Three Phase; 440V; 2800 rpm; Coolant pump; Grinding wheel: 200 x 40mm; Working table size : 185 x 175mm	1 No.
138.	Hand Operated Hydraulic Press	Capacity: 5tons; Dimension between columns: (LxB) 500 x 125mm; Distance between ram and bed maximum 600mm and minimum 75mm; Travel of ram: 100mm	1 No.
139.	Puller	Size: 4"; 3 legs reversible for internal and external use; Forcing screw, links and bolts	1 No.
140.	Hydraulic Jack	Capacity:I t with hand pump	1 No.
141.	Manual Chain Pulley Black	Capacity:I t & 3t	1 each
142.	Portable Blower	Specifications: Air volume: 4.5m^3/min; Air pressure: 0-7.2 KPa;	1 No.

		No-load speed : 0-16000 rpm; Weight: 1.8kg	
143.	Mechanical Transmission training Unit, Trolley Version with Storage cabinet and Toolkit (Product of Feedback Instruments Ltd. / UK)		1 set
144.	Mechanical Training Bench (IMP-**1)** with TSA Two student Add-On (Product of Intelitek, USA)		1set
145.	Belt drive trainer (Product of DAC, USA)		1 No.
146.	Chain Drive Trainer (Product of DAC, USA)		1 No.
147.	Combined mechanical trainer (Product of DAC, USA)		1 No.
148.	Coupling / Shaft Alignment Trainer (Product of DAC, USA)		1 No.
149.	Combined mechanical trainer (Product of DAC, USA)		1 No.
150.	BSC Bearing Service Cart with two students Add-on (Product of Intelitek, USA)		1 No.
151.	Automatic Submerged Arc Welding Machine	470 A 415 V, 3 Phase	1 No.
152.	AC/DC pulse TIG welder set 415 V, AC 3 Phase Max No. of Load Voltage -	75 V	1 No.
153.	Arc Welding Machine Supply Voltage	390/415 V	1 No.
154.	C02 / MIG Welding Machine 415 V A C	3Phase 50hz	1 No.
155.	Manual plasma cutting system (Power Max Systems) Power Max	30, 45, & 1000	1 No.
156.	Mig Welding Torch Gas Cooled - Cap Water Cooled - Cap	180A/250A/300A 300A/500A	1 No.
157.	Pneumatic Spot Welding machines Primary Supply Voltage	415 V Rating 20KVA	1 No.

158.	Seam Welding machine Working Voltage	220v/380v	1 No.
159.	A/C, D/C Welding Rectifiers Input Supply voltage -	380/415/440	1 No.
160.	AC Arc Welding transformer	30-300 AMPS	1 No.
161.	Fully Insulated Electrode Holder Capacity	400 - 600 AMP	5 Nos.
162.	Ground Clamp required for electric arc welding		5 Nos.
163.	Welding consumables		As needed
164.	Oxy-Acetylene Gas Regulator Oxygen	15Mpa- 0.03-1.2Mpa Acetylene 3Mpa - 0.01-0.15Mpa	2 Nos.
165.	Welding tool Kit consists of Cutting torch, Gas Regulator, Welding Nozzles, Cutting Nozzles, Rubber Tube, Binkers, Copper Brush, Lighter, Spanner, Nozzle Cleaner		2 sets.
166.	Pencil / Hand Grinder Collet Capacity	3, 6, 6 mm each	2 Nos.
D. ITEMS REQUIRED FOR VARIOUS HYDRAULICS EXPERIMENTS(OPEN CIRCUIT)			
167.	Apparatus for Verification of Bernoulli's Theorem complete with Collecting Tank		1 No.
168.	Reynolds's Apparatus Complete with Collecting Tank		1 No.
169.	Determination of Losses in pipeline Due to Sudden Enlargement, Contraction etc. with collecting tank and differential manometer		1 No.
170.	Determination of Critical Velocity Complete with all Accessories		1 No.
171.	Determination of CD,CV & CC Orifices Complete with all Accessories		1 No.
172.	Forces of Jet Apparatus		1 No.
173.	Apparatus for Determination of Discharge & Coefficient of Discharge		1 No.

	of Notches Complete with all Accessories		
174.	Collection tank with two compartments		1 no.
175.	Venturimeters (Brass) of different sizes	25 mm, 38 mm, 50 mm	1 set
176.	Orifice Meter (Cast Iron Body Brass Plates) of different sizes	25 mm, 38 mm, 50 mm	1 set
177.	Pitot Tube		1 set
178.	U Tube Double Column Manometer of different sizes	15 cm, 25 cm, 50 cm, 100 cm	1 set
179.	Differential Manometer and Inclined Tube Manometer	50 cm Scale	1 set
180.	Inclined Manometer	20-0-20 cm	1 set
181.	Demonstration Manometer	50 cm	1 set
182.	Piezometer Tube	One Meter Long	1 No.
183.	Differential Manometer	One Meter Long	1 No.
184.	Hydraulic Non-return valve		1 No.
185.	Hydraulic Gate valve		1 No.
186.	Hydraulic Globe Valve		1 No.
187.	Centrifugal Runner Actual Cast Iron		1 No.
188.	Different Impellers of Pumps		1 set
189.	Display Board for Pipes		1 No.
190.	Hydraulic Jack		1 No.
191.	Hydraulic Press Model		1 No.
192.	Hydraulic Ram		1 No.
193.	Gear Pump Model		1 No.
194.	Rotary Pump		1 No.
195.	Centrifugal Pump (Actual Cut Section)		1 No.
196.	Reciprocating Pump		1 No.
197.	Submersible Pump		1 No.
E. HYDRAULICS & FLUID MECHANICS LAB EQUIPMENTS (CLOSED CIRCUIT)			
198.	Centrifugal Pump Test Rig		1 No.
199.	Reciprocating Pump Test Rig		1 No.
200.	Gear Pump Test Rig		1 No.
201.	Hydraulic Ram Test Rig		1 No.
202.	Two Stage Air Compressor Test Rig		1 No.

203.	Centrifugal Compressor Test Rig		1 No.
204.	Rotary Compressor Test Rig		1 No.
F. DEMONSTRATION UNIT WITH EXPERIMENTAL SET-UP			
205.	Axial Flow Fan Demonstration Unit fitted with sensors and Instruments to carry out various experiments (Manufactured by Armfield Ltd. / USA)		1 set
206.	Centrifugal Pump Demonstration Unit fitted with sensors and Instruments to carry out various experiments (Manufactured by Armfield Ltd. / USA)		1 set
207.	Basic Hydraulic Bench with Accessories to carry-out the following experiments.	Dead weight calibrator Hydrostatic pressure Bernoulli's Theorem demonstration Orifice discharge Energy losses in pipes Flow meter demonstration Energy losses in bends Hydraulic Ram Series / Parallel Pumps Cavitation demonstration (Manufactured by Armfield Ltd. / USA)	1 set
208.	Machine suitable for separately excited, series, shunt and Compound Connections and excitation.	2.5 kW, 250V, 1000 r.p.m	1 No.
209.	3-point, 4 point starter & series motor starter suitable for	2.5 kW, 250V, 1000 r.p.m	1 No.
210.	Shunt motor.	3kW, 250V, 1000 r.p.m	1 No.
211.	3-Phase Squirrel cage induction motor.	4kW, 440V, 50Hz, 960 r.p.m	1 No.
212.	single phase transformer.	5KVA, 200V/400V, 50Hz	1 no.
213.	single phase auto transformer.	5 Amp, 50Hz	1 No.
214.	single phase auto transformer.	16 Amp, 50Hz	1 No.
215.	phase auto transformer.	30 Amp, 50Hz 3	1 No.
216.	DOL starter (ii) Star -Delta starter (iii) Auto transformer starter Suitable for Squirrel Cage induction motor.	4kW, 440V, 50Hz 3-phase 960 r.p.m	1 No.

217.	3-phase slipring induction motor with rotor starter.	5kW, 440V, 50Hz 960 r.p.m	1 No.
218.	3-phase alternator.	4KVA, 440V, 50Hz, 0.9 power factor (lag), 1000 r.p.m	1 No.
219.	shunt motor with starter.	5kW, 250V, 1200r.p.m	1 No.
G. LIST OF AUTOMOBILE EQUIPMENT			
220.	Fuel supply System of a 4-cylinder Diesel Engine		1 No.
221.	Lubrication System of an Automobile		1 No.
222.	Cooling System of an Automobile (with Actual Parts)		1 No.
223.	Actual Cut Section Gear Box:	4 Forward & 1 Reverse	1 No.
224.	Actual Cut Section Gear Model with Clutch		1 No.
225.	Actual Cut Section Automatic Gear Box Car (internal Gear)		1 No.
226.	Actual Cut Section Gear Box Car	Constant Mesh	1 No.
227.	Actual Cut Section Gear Box Jeep	Synchronic Mesh	1 No.
228.	Differential Gear Assembly (Actual Cut Section)		1 No.
229.	Rear Axial Assembly (Actual Cut Section)		1 No.
230.	Sectional Working Model of 2 Stroke Petrol Engine		1 No.
231.	Sectional Working Model of 4 Stroke Petrol Engine		1 No.
232.	Sectional Working Model of 2 Stroke Diesel Engine		1 No.
233.	Sectional Working Model of 4 Stroke Diesel Engine		1 No.
234.	Actual Cut Section of Four stroke	Single cylinder Vertical Diesel Engine	1 No.
235.	Four Stroke Four Cylinder	Actual Cut-section Engine Model (Motor driven)	1 No.
236.	Twin Cylinder Four stroke vertical diesel engine test rig		1 No.
237.	Oil cooled 3 - phase transformer.		1 No.

238.	Circuit breaker. i. Air circuit breaker (ACB). ii. Oil circuit breaker (OCB). iii. Minimum oil circuit breaker (MOCB). iv. Sf6 circuit breaker. v. Vacuum circuit breaker (VCB).		 1 No. 1 No. 1 No. 1 No. 1 No.
239.	Isolator, Earthing switch & Lightning Arrestor.		1 No.
240.	Various Types of Fuses.		1 No.
241.	Various Types of Armoured& Flexible Power Cables.		1 No.
242.	Overhead Line Insulators.		1 No.
243.	Flame Proof Enclosures of Mining Type Circuit Breaker & Electrical Motor.		1 No.
244.	D.C Machine for study of Armature winding & magnetic poles.		1 No.
245.	3-Phase Squirrel Cage Induction Motor.		1 No.
246.	3-Phase Slip-ring Induction Motor.		1 No.
247.	3-Phase Synchronous Motor.		1 No.
248.	Nozzle Tester	Max Pressure : 40 MPa or 60 MPa Volume of fuel Tank 1500ml	1 No.
249.	Cummins PT Pump Test Stand	Model No. PTW 100	1 No.
250.	Fuel Injector Pump Tester for Heavy Duty Type for Multi Cylinder Engine		1 No.
251.	Cummins Tools and equipments		1 No.
252.	Cummins PT Injector Test Stand	Model No. PTW200	1 No.
253.	Injector Leakage tester		1 No.
254.	Injector Top Stop Fixture		1 No.
255.	STC Top Stand	STC with digital indicator	1 No.
256.	Injector Disassembly & Assembly Tool		1 No.
257.	Injector Cup Spray Tester		1 No.
258.	Common Rail System Injector Tester		1 No.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the classroom.*

ABBREVIATIONS

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


कौशलं बलम्