

**SYLLABUS FOR THE TRADE**  
**OF**  
**MECHANIC MINING MACHINERY**  
**(SEMESTER PATTERN)**  
**UNDER**  
**CRAFTSMAN TRAINING SCHEME (CTS)**

*Designed in – 2013*

By  
Government of India  
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE  
Directorate General of Employment & Training  
Ministry of Labour & Employment  
EN-Block, Sector-V, Salt Lake  
Kolkata-700 091

List of members of Trade Committee meeting for the trade of “Mechanic Mining Machinery” held on 19/12/2011 at Women ITI Korba (C.G).

Sl. No.	Name & Designation Shri/Smt.	Representing Organisation	Remarks
1.	M.C. Sharma, JDT	CSTARI, Kolkata	Chairman
2.	Col. Rakesh Choudhary, GM Administrator	Spectrum Coal and Power ltd	Member
3.	S.P.Namdeo	J.D. Office,ITI Bilaspur	Member
4.	M.F.Ansari	Principal ITI, Koni Bilaspur	Member
5.	Abdul Rahman	CETI GEVRA, Area SECL	Member
6.	O.P. Singh	M/s Sainik Mining & Allied Services	Member
7.	N.C. Sarkar	ACBID Ltd.	Member
8.	K.K. Das	Spectrum Coal & Power ltd	Member
9.	R.P. Vishwakarma	Maruti Clean Coal & Poweer Ltd	Member
10.	S. M.Ansari Training Superintendent	Women ITI Korba	Member
11.	U.K. Shrama, Nodal Officer	Nodal Officer .IMC, Korba	Member
12.	P.L. Chaudhary ,Principal	Principal ITI, Korba	Member
13.	H.F. Saify	ANM Consultants	Member
14.	Kundan Shandilya	Spectrum Coal and Power ltd	Member
15.	J.P. Khandey	Employment Office	Member
16.	Jaggu Masih	M.C.C.P.L,Ratija	Member
17.	S.S. Patel, Principal	Govt. Polytechnic Korba	Member
18.	Anita Sayal	Student Representative	Member
19.	Atmaramkherwar	IMC Member	Member
20.	Kumud Pandey	IMC Member	Member
21.	Prateek Pandey	CII-State Head (C.G)	Member

**List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6<sup>th</sup> to 10<sup>th</sup> May'2013 at CSTARI, Kolkata.**

<b>Sl. No.</b>	<b>Name &amp; Designation</b>	<b>Organisation</b>	<b>Remarks</b>
1.	R.N. Bandyopadhyaya, Director	CSTARI, Kolkata-91	Chairman
2.	K. L. Kuli, Joint Director of Training	CSTARI, Kolkata-91	Member
3.	K. Srinivasa Rao, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Mukherjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi, Deputy Director of Training	ATI-EPI, Dehradun	Member
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, Andaman & Nicobar Island	Member
12.	A.K. Ghate, Training Officer	ATI, Mumbai	Member
13.	V.B. Zumbre, Training Officer	ATI, Mumbai	Member
14.	P.M. Radhakrishna pillai, Training Officer	CTI, Chennai-32	Member
15.	A.Jayaraman, Training officer	CTI Chennai-32,	Member
16.	S. Bandyopadhyay, Training Officer	ATI, Kanpur	Member
17.	Suriya Kumari .K , Training Officer	RVTI, Kolkata-91	Member
18.	R.K. Bhattacharyya, Training Officer	RVTI, Trivandrum	Member
19.	Vijay Kumar, Training Officer	ATI, Ludhiana	Member
20.	Anil Kumar, Training Officer	ATI, Ludhiana	Member
21.	Sunil M.K. Training Officer	ATI, Kolkata	Member
22.	Devender, Training Officer	ATI, Kolkata	Member
23.	R. N. Manna, Training Officer	CSTARI, Kolkata-91	Member
24.	Mrs. S. Das, Training Officer	CSTARI, Kolkata-91	Member
25.	Jyoti Balwani, Training Officer	RVTI, Kolkata-91	Member
26.	Pragna H. Ravat, Training Officer	RVTI, Kolkata-91	Member
27.	Sarbojit Neogi, Vocational Instructor	RVTI, Kolkata-91	Member
28.	Nilotpal Saha, Vocational Instructor	I.T.I., Berhampore, Murshidabad, (W.B.)	Member
29.	Vijay Kumar, Data Entry Operator	RVTI, Kolkata-91	Member

## GENERAL INFORMATION

1. **Name of the Trade** : **MECHANIC MINING MACHINERY**
2. **NCO Code No.** :
3. **Duration of Craftsman Training.** : 2 Years (Four Semesters)
4. **Power Norms** : 20Kw
5. **Space Norm** : 292 Sq Mtr
6. **Entry Qualification** : Passed 10th class examination under 10+2 system of education with Science and Mathematics or its equivalent.
7. **Unit Size (No. Of Student)** : 20
8. **Trainer's Qualification** : (A) Degree in Mechanical/Mining Engineering/  
Technology with one year experience in the relevant field.  
OR  
Diploma in Mechanical/ Mining Engineering with two year experience in the relevant field.  
OR  
ITI Pass out in the Trade with three year experience in the relevant field.  
  
(B) Instructor for practical workshop & Lab work:- ITI passed out in Mechanic Machine Tool Maintenance with three years experience in the relevant field.  
  
(C) Desirable qualification  
: Preference will be given to a candidate with Craft Instructor's Certificate.

\* **Note:** At least one Instructor must have Degree/Diploma in Mining/Mechanical Engg.

Syllabus for the trade of “**Mechanic Mining Machinery**” under C.T.S.

Duration: Six Month

First semester

**Code: MMM – Sem - I**

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Workshop Calculation & Science
1.	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. Accidents & their causes; up keep 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.	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, Time Table. Importance of Safety and General Precautions to be observed in the workshop and the laboratory; Storing and Handling of Inflammable Materials; Elementary first aid.	Importance of Drawing and Free Hand Sketching.	Visit to workshops & Laboratories.  Workshop layout.
2.	Practice on use of fitters hand tools; Marking off with steel rule; Calipers 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.	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, calipers and Dividers, Scriber Prick and Centre Punch Hammer and Chisel-uses and Maintenance-Safety Use, care and maintenance of scribing block.	Introduction to Engg. Drawing; Drawing Instruments and their Uses; Indian Standard for drawing; representative scale, reduced and enlarged. Practice on Lettering; Types of lines in Engineering graphics: Full lines, hidden lines, etc. Drawing of representative scales	Simple workshop problems on addition, subtraction, division and multiplication and division of whole number. Properties of CI, wrought iron, pig iron and its type; and its identification. Calculation of representative scales.

3.	Practice on Identification of simple types of screw, nuts & bolts, clamps, rivets etc.	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.	Free hand sketching of straight lines, rectangles, square, circle, polygon etc. Freehand sketching of screw, nuts & bolts, clamps, rivets etc.	Inertia, rest, motion. velocity and acceleration; Concept of scalar and vector quantity with examples, Newton's Laws of motion. Simple calculation on. stress, strain, modulus of elasticity, ultimate strength.
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4.	<p>Practice on Measurement by Micro-meter (outside and Inside), Vernier Caliper and Protector.</p> <p>Practice on Marking and Drilling of Clear and Blind Holes; Sharpening of Twist Drills; Safety precautions to be observed while using a drilling machine.</p> <p>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.</p>	<p>Construction and Method of reading Micro-meter (Internal and External); Vernier Caliper; Correct handling of Micrometer and Vernier Calipers; Reading of Vernier Scale; Description and use of combination set; Care and maintenance of Vernier caliper, Micrometer, Combination set etc. Calculation of Tap Drill Sizes. Care and maintenance of files, drills, hacksaws.</p> <p>Taps &amp; Dies-Description, use of different types of Taps &amp; Dies- Different types of threads and their uses; Precautions while using Taps &amp; Dies;</p> <p>Description and use of different types of scrapers, reamers and emery papers.</p> <p>Drill holding devices: material, construction and their uses. Drill processes: Common type (bench type, pillar type) gang and multiple drilling machine.</p>	<p>Free hand sketching of simple geometrical solids cube, cone, prism, cylinder, sphere pyramids.</p> <p>Free hand sketching of taps, dies, drills used in workshop practices,</p>	<p>Calculation involving micro-meter measurement. Simple calculation on forces, moment, torque, work, power, and energy. Properties and uses of ferrous metals and their uses; Cast iron, Wrought iron.</p> <p>Calculation of pitch of screw threads, diameter and there is standard.</p>
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5.	<p>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 Brazing of pipes.</p> <p>Practice on Identification of different types of bolts, nuts and their threads, rivets, joints etc.</p>	<p>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 metal sheets used in sheet metal shop.</p> <p>Engg. Drawing: Different types of nuts, bolts and their threads, rivets, keys, different joints; e.g. cotter joint, knuckle joint etc.</p>	<p>Freehand sketching of Bolts &amp; Nuts with dimensions from samples.</p> <p>Free hand sketching of the sheet metal work.</p> <p>Drawing of nuts, bolts, Rivets, keys as per Indian Standards</p>	<p>Properties and uses of plain and high carbon steel, high speed steel, alloy steel.</p> <p>Brief description of manufacturing process; production of CI and Steel.</p>
6.	<p>Practice on Measurement of viscosity.</p> <p>Practice on Measurement of pressure using manometers, pitot tube; Pressure gauge calibration.</p> <p>Study of the construction of Non-return valve, gate valve and globe valve</p> <p>Practice on Series &amp; Parallel connection of resistors, Connection of ammeter and voltmeter Measurement of resistance by (i) Wheatstone bridge (ii) Ammeter voltmeter method.</p>	<p>Fundamentals of Fluid mechanics; Viscosity and its measurement.</p> <p>Pressure and its measurement: manometers and mechanical gauges.</p> <p>Operation, construction and uses of valves: Non-return valve, gate valve and globe valve</p> <p>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.</p>	<p>Freehand sketch of experimental test set-up, tabular and graphical representation of the observation of pressure gauge calibration.</p> <p>Free hand sketch of Non-return valve, gate valve and globe valve</p>	<p>Mensuration: areas of rectangle, squares, triangles, circles, regular polygons etc. calculation of areas.</p> <p>Density of solids and liquids; Simple experimental determination;</p> <p>Relation between specific gravity and density.</p> <p>Specific Gravity; Principle of Archimedes.</p> <p>Simple calculation on viscosity.</p>



7.	<p>Practice on Prepare forge; Fire for heating metals; Forge a square rod from round stock; Judge the forging temperature of various metals.</p> <p>Forge M.S. bar to square, Octagon and hexagon.</p> <p>Practice on Forge punches, screw drivers, chisels; grind them to shape and heat treat to requirement, bending metals to angles; curves &amp; twisting; Preparation of brackets.</p>	<p>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 &amp; uses.</p> <p>Heat treatment necessary various heat treatment methods such as normalizing annealing, hardening and tempering. Power hammer construction feature, method of operating and uses.</p>	<p>Scales: Construction of plain scale; Representing fraction.</p> <p>Construction of diagonal scale.</p> <p>Study of plan, elevation and side view of simple object; Simple dimensioning technique- size and location; dimension for parts, holes angles , taper, screw etc. as per IS : 696.</p> <p>First angle and third angle projections, orthographic projections. Standard conventions of section of machine elements</p> <p>Practice of orthographic projects of simple solids, Conversions of three dimensional views to orthographic views</p>	<p>Geometry: Fundamental geometrical definitions: Angles, properties of angles, triangles and properties of triangles.</p> <p>Friction, force, work, energy and power; their units and applied problems. Trigonometric functions; use of trigonometric tables; applied problems.</p>
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8.	<p>Practice on Determination of Reynold's number; Determination of <math>C_d</math>, <math>C_v</math> of orifices, discharge coefficient of notches, determination of jet forces.</p> <p>Practice on .</p> <p>Study of color code of resistor, Use of multimeter for measurement of voltage and resistance.</p>	<p>Flow through orifices and notches: introduction, classification of orifices, notches; concept of <math>C_d</math>, <math>C_v</math> etc.</p> <p>Determination of jet forces</p> <p>Simple DC Circuits: -</p> <p>Series circuits, Parallel networks, Series circuits versus parallel networks, Kirchhoff's laws, Power and energy, Resistivity, Temperature coefficient of resistance, Temperature rise.</p>	<p>Freehand sketch of experimental test set-up and tabular and graphical representation of experimental results</p> <p>Conventional symbol of electrical installation</p>	<p>Simple Calculation on the flow through orifice and notches.</p> <p>Simple Calculations to find current, voltage, resistance etc of DC circuits.</p>
9 & 10	<p>Practice on</p> <p>Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. Marking out of simple development marking out for flaps for soldering and sweating.</p> <p>Practice on</p> <p>Make 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.</p>	<p>Safety – importance of safety &amp; general precaution observed in a welding shop, precaution in electric &amp; gas welding (before, during and later) introduction to safety equipment and their uses.</p> <p>Hand tools: hammers,</p> <p>Welding description, types and uses, machine and accessories welding transformer, welding generators, description principle, and method of operating.</p>	<p>Pictorial drawings, isometric drawings of simple geometrical solids.</p> <p>Isometric drawing of simple machined and testing blocks, casting blocks, casting blocks</p> <p>Isometric projections of simple solids;</p> <p>Conversions of orthographic views to isometric views</p>	<p>Ultimate strength, different types of stress, factor of safety; examples.</p> <p>Ratio &amp; proportion, Ratio, Ratio proportions, direct proportion and indirect proportion.</p> <p>Application of ratio and proportion to related problems.</p>

	<p>Practice on Making of square butt joint and ‘T’ fillet joint-gas and arc.</p> <p>Practice on Practice on gas cutting.</p>	<p>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.</p> <p>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.</p> <p>Isometric projections.</p>		<p>Effect of alloying elements on properties of cast iron and steel.</p> <p>Pythagoras theorem; properties of triangles.</p>
11.	<p>Demonstration of chain pulley block, powered winch, screw jack.</p> <p>Practice on Identification of bearings, bushes, springs.</p>	<p>Construction and use of simple machine and machine elements; e.g.- chain pulley block, screw jack, mechanical winch, springs, bearings, coupling, cam and follower,</p>	<p>Simple sketch of chain pulley block, powered winch , screw jack, bearings, bushes and springs; Assembly, disassembly and maintenance of bearings.</p>	<p>Simple calculation of Mechanical Advantage of chain-pulley block, belt transmission, chain transmission, screw jack.</p>
12.	<p>Practice on Verification of Bernoulli’s theorem; Determination of losses in pipelines due to sudden enlargement, contraction etc.</p>	<p>Flow through pipes: losses of energy in friction, Bernoulli’s theorem, Pascal’s law, hydraulic gradient, pipes in series and parallel.</p>	<p>Freehand sketch of experimental test set-up and tabular and graphical representation of experimental results</p>	<p>Simple lever with examples; bell crank lever and others used in engines; Advantages of using them; problems on levers.</p>

<p>13 &amp; 14.</p>	<p>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.</p> <p>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 beveled undercut shoulders.</p> <p>Practice on Cut groves square, round, V, groove. Make a mandrel- turn diameter to sizes. Knurl the job.</p> <p>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.</p> <p>Practice on Turn taper (internal and external.) Turn taper pins. Turn standard tapers to suit with Gauge.</p> <p>Practice on Cutting of threads using taps &amp; dies, and on lathe. Prepare a nut and match with the bolt.</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Taper-definition use and method of</p>	<p>Machines basic principles, velocity, ratio, mechanical advantage, efficient, simple problems.</p> <p>Orthographic drawings, application of both the first angle and third angle. Method in representing the drawing for simple and complex machine given for exercises with dimensions. Standard method of sectioning as per IS : 696; Exercises for different sectional views on the given orthographic drawing of machine parts, castings etc.</p>	<p>Rectangle, square, Rhombus, parallelogram, circle, regular polygon etc. their properties;</p> <p>Application of geometry to shop problem;</p> <p>Factors and equations; types of factorization; simultaneous and quadratic equations.</p> <p>Heat and temperature; Thermodynamic scale and their conversion; Temperature measuring instrument.</p>
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		expressing tapers. Standard tapers-taper calculations. Screw threads- definition-uses and application; Terminology of screw threads, square worm buttress (non standard-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.		
15.	Study of the operation of mechanical drives, assembly, disassembly and maintenance of mechanical drives Study of the construction of reciprocating and centrifugal pumps;  Practice on Disassembly and assembly of old, unserviceable pumps; identification of its critical components: bearing, seals, impeller, casing etc.	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.	Freehand sketch of the construction of different mechanical drives Freehand sketch of the reciprocating and centrifugal pumps and their critical components.	Calculation of speed, torque and power of mechanical drives.  Mechanical advantages, Velocity ratio, Applied problems. Calculation of head, discharge capacity of reciprocating and centrifugal pump.
16.	Verification of ohms law, Kirchhoff's laws Practice on Measurement of current voltage and power of a resistive circuit.	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, Units of inductance, Inductance in terms of flux-	Electrical Circuit Diagrams.	Calculation of areas of triangles, polygons etc. with the aid of trigonometry.

		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		
17.	Relevant jobs on milling machine	Safety precautions to be observed while working on milling machine, main parts of milling machine and its constructional features, specifications	Free hand sketching of milling machine components, drive arrangement	Calculations related to milling machine operation, study of its mechanisms. Heat treatment of steel: hardening, tempering, annealing, normalizing, case hardening.
18.	Identification and Study of the operation of brakes and clutches	Classification, construction, selection and application of brakes and clutches.	Freehand sketch of the construction of different brakes and clutches	Simple calculation of braking torque.
19.	Practice on Disassembly and assembly of old, unserviceable turbine pump; mono pump, identification of its critical components: bearing, seals, impeller, casing etc.  Performance test of centrifugal pump.	Construction and operation of Multi-stage centrifugal pump, need of multistage pump; submersible pump, air lift pump, mono pump	Free hand sketch of the pump and its components.	Useful work of a machine; mechanical efficiency of a machine – problems. Further use of trigonometric functions and applied problems.
20.	Practice on Relevant jobs on shaping machine; Study of common mechanisms used in industrial equipment.	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.	Free hand sketching of shaping machine components, drive arrangement Free hand sketch of mechanisms	Properties of Non-Ferrous Metals & Their uses- Copper, Zinc, Lead, Tin, Brass, Aluminum, Bronze, Solder, Bearing Metals.

				Shop problem on estimation of material for a job to be made; time taken to manufacture the job. Simple calculation related to mechanisms
21 - 23.	Practice on Study of the constructional feature of 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.	Classification and application of air compressor and blowers: 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.	Freehand sketch of reciprocating and screw compressors, experimental test set-up, observation and report writing.	
24-25	<b>Project work / Industrial Visit (Optional)</b>			
26	<b>Examination</b>			

Syllabus for the trade of “**Mechanic Mining Machinery**” under C.T.S.

Duration: Six Month

Second Semester

**Code: MMM – Sem - II**

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Workshop Calculation & Science
1 – 2	<p>Practice on construction of single and multi-cylinder SI Engine in laboratory; their combustion processes in working models.</p> <p>Practice on the construction of combustion process, ignition system, MPFI system, cooling system, lubrication system through wall chart / posters.</p> <p>Practice on Steps to follow assembly and disassembly of two wheeler and four wheeler SI engine.</p> <p>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 and refitting them</p>	<p>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.</p> <p>Single / multi-cylinder SI engine: specification; combustion process, Principle of carburetion, Ignition system, MPFI system, Cooling system, Lubrication system</p> <p>Construction of typical two wheeler and four wheeler SI engine</p>	<p>Freehand sketch of SI and CI engine and their components.</p> <p>Freehand sketch of the cooling system, lubrication system of single / multi-cylinder SI engine.</p> <p>Preparation of flow chart for assembly and disassembly of two wheeler and four wheeler SI engine</p>	<p>Problems on Specific heat of solid, liquid and gases;</p> <p>Heat loss and heat gain with simple problems.</p> <p>Calculation of efficiencies and thermodynamic cycles of SI and CI engines.</p> <p>Calculation of volume of solid figures: Cone, Cylinder, sphere segment; prism etc.</p> <p>Logarithms-Use of Logarithmic tables for multiplication &amp; division;</p> <p>Determination of efficiency of simple machine like winch, pulley blocks etc.</p>
3.	Practice on Identification of typical problems and possible remedies of two wheeler and four wheeler SI engine	Case studies on trouble shooting of two wheeler and four wheeler SI engine	Preparation of flow chart to trouble shoots the problems.	



4 - 5	Practice on Measurement of voltage & current in RLC series and parallel circuit.	<p>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.</p> <p>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.</p> <p>Single-Phase Parallel Networks: -  Basic A.C. parallel circuits, Simple parallel circuits, Parallel impedance circuits.</p>		
6	Practice on Determination of the thermodynamic and overall efficiencies of SI engine. Practice on construction and operation of single and multi-cylinder CI engine in working models	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;	Free hand sketch of single and multi-cylinder CI engine	Calculation of thermodynamic and overall efficiencies of SI engine. Simple problems on work, energy and power.

7 – 8	<p>Practice on Maintenance checks-daily weekly, monthly for deferent types of engines writing up of inspection schedules Maintenance of log sheets-details of maintenance.</p> <p>Practice of starting stationary and a transport vehicle engine.</p> <p>Practice on Measurement of power &amp; power factor of single-phase A.C. series &amp; parallel RLC circuit.</p> <p>Practice on Using Unserviceable engine remove rockers arm, assembly, manifolds-and cylinder head – removing valves and its parts, cleaning &amp; 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.</p>	<p>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 &amp; valve arrangements. Combustion chambers pumps open and closed types, advantages and disadvantages, compression ratio &amp; compression pressures compression testing of cylinders and analysis of results &amp; its importance.</p> <p>Power in AC Circuits: -</p> <p>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.</p> <p>Resonance in AC Circuits: -</p> <p>Frequency variation, Frequency variation in an RLC circuit, Resonance in a circuit having R, L and C in series, Resonance in RLC parallel networks.</p> <p>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.</p>	<p>Explanation of simple orthographic projection hand sketching of 4 stroke-two stroke cycles.</p> <p>Explanation of simple orthographic projection in 3<sup>rd</sup> angle.</p> <p>Views of simple hollow &amp; solid bodies with dimensions.</p> <p>Drawing of typical symbols used in electrical circuits.</p> <p>Freehand sketching of Valve, valve springs valve assembly with dimension.</p>	Simple problems on single phase ac series circuits.
9 - 10	Practice on Dismantle rocker arm, assembly clean & check shaft-bushes, posts and rocker arm	Description and function of valve parts-maintenance materials used-Necessity of valve, clearance prescribed by makers of	Simple isometric view of objects such as square, rectangles	Square root of perfect square and whole number square root of

	for wear and Cracks and reassemble. Check valve springs, tappets, pushrods, tappet screws and valve stem cap. Reassembling valve parts in sequence; refit cylinder head and manifold and rock arm assembly; adjust valve clearances; starting engine after decarburizing.	engine-effect of incorrect clearances-common troubles and remedy-reason for warping of cylinder head.	and cubes.	decimals.
11.	Practice on the connection of half wave & full wave rectifier circuit.	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, Smoothing, Zener diode.		Standard algebraic formula. Simultaneous equations with two unknown quantities.
12 - 13	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. 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. Measurement of voltage & current of line and phase of Star & Delta connected system.	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 & functions – 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	Freehand sketching of piston gudgeon pins rings and connecting rod with dimensions from samples.  Freehand sketching of crankshaft and flywheel with dimension from samples.  Free hand sketching of various types of d.c generators.	Shop problems involving square roots. Ratio and proportion shop problem.  Calculation of volume and weight of simple solid bodies – Cubes, squares & hexagonal prism and shop problems.

	Measurement of three-phase power and power factor by two watt meter method.	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.		
14 -15.	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. Study of construction and operation of Fuel system, lubrication system, of multi-cylinder CI engine 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.	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.	Freehand sketching of cylinder block and cylinder head.  Free hand sketch of Fuel system, lubrication system of multi-cylinder CI engine of working models Freehand sketching of oil pumps, oil coolers with dimensions from samples.	Mass, unit of mass, force-absolute unit of force-weight of a body, shop problems. Example of useful and waste friction in engine, applied problems.
16.	Practice on construction of three-phase transformer. Open circuit & short circuit test of single-phase transformer	Transformer Construction of transformer: - Core Material, Core Construction, Transformer Windings, Insulation, Leads and Terminals, Bushings, Tap Changes, Transformer Tank, Transformer Oil,	Freehand sketching of core type & shell type transformer and various parts of transformers.	Heat and temperature; Thermometric scales- Centigrade and Fahrenheit scale and their conversion. Name and uses of

		<p>Breather, Buchholz relay.</p> <p>Operation of Transformer: -</p> <p>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.</p>		temperature measuring instruments used in workshop.
17.	<p>Practice on Bleeding of air from fuel line; servicing primary and secondary filters; oil filters; removing and fixing filter elements. Maintenance of filter elements.</p> <p>Practice on Assembly, disassembly of radiators, filters, water pump, radiators, thermostat valve and other components of cooling system; maintenance of cooling system</p> <p>Practice on the connections of three-phase transformer.</p> <p>Study of auto transformer.</p>	<p>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.</p> <p>Construction and operation of cooling system of multi-cylinder CI engine; construction of radiators, cooling fan, thermostat valve etc.</p> <p>Three-phase Transformers: -</p> <p>Three-phase core-type transformers, Connection of three-phase two windings transformers, Auto-transformers, Current transformers, Potential Transformers, Air-cored transformer, Three windings transformers, Parallel Operation of transformers.</p>	<p>Free hand sketch of filter elements.</p> <p>Free hand sketch of Cooling system of multi-cylinder CI engine of working models</p> <p>Freehand sketching of three-phase core type transformer and drawing of various connections of three-phase transformer.</p>	

18.	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. Checking performance for missing cylinder by isolating defective injectors & test; dismantle and replace defective parts & reassemble and refit back to engine; importance of correct tuning while assembling the unit and fitting on the engine.	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 incorrect setting of nozzles on engine performance.	Freehand sketch of the exploded view of the injectors, fuel injection pump, PT pumps	Preparation of the test report of the injectors and fuel pumps.
19.	Practice on Study the construction of D.C. machine & identification of various components of D.C. machine. Study the armature winding of D.C. machine / visit to electrical workshop to study armature winding of dc machines	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, 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	Freehand sketching of construction of D.C. machine & its parts.	
20..	Practice on Measurement of diameter of the crank shaft, cam shaft for regrinding / replacement; Inspection of cylinder liner, cylinder head for repairing / replacement; Inspection of valve seats on cylinder head and valves; Checking of cylinder head and crank case for possible crack; Inspection of	Construction of crank case, exhaust manifold, inlet manifold, crank shaft, cam shaft, piston, cylinder liner and cylinder head	Freehand sketch of the exploded view of the crank shaft, cam shaft, piston, cylinder liner and cylinder head	Preparation of the inspection report of the components of the engine; recommendation for replacement/ repair of the items like liners,

	seals and packing of the exhaust and inlet manifolds.			cylinder head. Replacement / Allowable grinding of crank shaft and valve seat re-facing.
21.	<p>Practice on Study of the construction of turbo-charger used in high powered diesel engine; Inspection of old turbo-charger, seal, bearing for replacement / repair. 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; Precautions while connecting battery in alternator circuit; Practice of D.C. motor starter and its connection with D.C. motor. Three point starter, Four point starter, series motor starter. 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.</p>	<p>Construction and operation of turbo-charger, 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. 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.</p>	<p>Freehand sketch of turbo charger, its lubrication system. Freehand sketch of the exploded view of the Alternator, starter, batteries. Freehand sketch of electrical symbols and drawing of simple electrical circuits. Drawing of 3-point &amp; 4-point starter of D.C. motor. Freehand sketch of the exploded view of a turbo-charged diesel engine.</p>	<p>Preparation of the inspection report of the components and recommendation for replacement / repairing of components. Applied problem of power, work done, voltage, current in simple electrical circuit. Preparation of the record of inspection and maintenance with the list of the components replaced, their cost and man hour involved</p>
22.	Practice on BHP test of overhauled engine, inspection of leakage, rise in temperature during	Practice in starting and stopping of turbo-charged engine; Starting difficulties in diesel engine; Checking of oil, fuel, water		Calculation of power and overall efficiency of the engine.

	testing Fault identification, Diagnosis of reasons for starting difficulty in a diesel engine; and its possible remedies:	levels and accessories of engine; Engine testing: Theory of different testing methods; Trouble shooting of the different sub-systems of the engine		
23 - 24	Practice on Study of speed control of D.C. shunt motor & separately excited motor. Use of potentiometer for measurement of unknown e.m.f. 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. Diagnosis of engine faults like main bearing noises, piston pin noise, flywheel knock and crank noise and diesel knock.	Analogue Measuring Instruments: - Introduction, Electrical analogue indicating instruments, Controlling devices, Damping devices, Permanent-magnet moving-coil ammeters and voltmeters, Thermocouple instruments, Electrodynamical 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 smooth working of the turbo-charged engine. Reasons for development of noises in the engine components; rectification, methods.	Freehand sketching of moving coil & moving iron instruments.	Torque – definition, example; torque wrenches application-problems involved torque values of engine.
25.	Industrial Visit / Project work			
26.	<b>Examination</b>			



Syllabus for the trade of “**Mechanic Mining Machinery**” under C.T.S.

Duration: Six Month

Third Semester

**Code: MMM – Sem - III**

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Calculation & Science Practice
1.	<p>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 air line components: Filter breather, moisture separator, air dryers etc. Practice of the construction and identification of various parts of squirrel cage and slip ring induction motor.</p>	<p>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</p>	<p>Drawing of hydraulic and pneumatic symbols; Energy flow diagram Freehand sketch of hydraulic fittings, oil seals, filters, hydraulic accessories.  Free hand sketching of the air line components and pipe fittings. Freehand sketching of construction 3-phase squirrel cage induction motor and its parts.</p>	<p>Conversion of units; Calculation of power based on hydraulic variables; Calculation of energy in different domain of a system; determination of losses and useable power at each domain of a system.</p>

2.	<p>Practice on 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</p> <p>Practice on Identification of critical parts of hydraulic valves and cylinders; assembly and disassembly of hydraulic valves</p> <p>Construction of different pneumatic circuits using Pneumatic trainer</p>	<p>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</p> <p>Hydraulic and Pneumatic valves and cylinders: construction , operation and maintenance of manually operated, solenoid operated; Proportional valve, servo valve, controlled valve, electrical circuitry;</p> <p>Hydraulic cylinders: conventional cylinders, telescopic cylinder; Power loss, pressure drop, flow losses. Construction of Pneumatic filter, Regulator and lubricator</p>	<p>Freehand sketch of the Exploded view of pumps and motors, Report writing of the performance test of the pumps and motors.</p> <p>Freehand sketch of the Exploded view of hydraulic valves and cylinders, Report writing of the performance test (flow vs. pressure drop, efficiency vs. pressure drop) of the hydraulic valves.</p>	<p>Calculation of the efficiencies of pumps and motors.</p> <p>Learning for use of computers.</p> <p>Calculation of the efficiencies of hydraulic valves, leakage loss etc.</p>
3.	<p>Study of stator winding of induction motor and rotor winding of Slip ring induction motor.</p> <p>Study of starters of three-phase squirrel cage induction motor: - DOL Starter, Auto-transformer starter, Star/Delta Starter.</p> <p>Practice on Identification of hydraulic and pneumatic circuit components; Fabrication of hydraulic and pneumatic circuits in trainers;</p>	<p>Starting of squirrel cage motors, Starting of wound rotor motors, Speed control of three-phase induction motor.</p> <p>Construction, operation and maintenance of different typical circuits used in heavy earth moving equipment. Concept of energy saving using hydraulic accumulator.</p> <p>Study of hydraulic and pneumatic controls used pumps and valves of equipment</p>	<p>Freehand sketching of 3-phase slip-ring induction motor and its parts.</p> <p>Report writing of the fabrication and operation of hydraulic and pneumatic circuits; Freehand sketch of the circuit diagrams</p>	<p>Calculation of power and efficiency of hydraulic and pneumatic system.</p>
4.	<p>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.</p>	<p>Maintenance and Trouble shooting of hydraulic and pneumatic systems: filter replacement / cleaning, oil; Oil analysis; maintenance of compressor, reservoir, filter, lubricator, regulator valve etc; Installation and</p>		<p>Report writing of the maintenance practices carried out; maintaining log book, estimation of repairing cost,</p>

	Practical on developing different hydraulic circuits using hydraulic trainer	commissioning of hydraulic and pneumatic system		components life etc.
5.	<p>Study of rotor starter for slip ring induction motor.</p> <p>Study the construction of single-phase induction motor &amp; Starting methods.</p> <p>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.</p> <p>Using unserviceable transmission inspect 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.</p>	<p>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 Trouble shooting of transmission.</p>	<p>Drawing of DOL starter, Auto transformer starter &amp; Star/Delta starter.</p> <p>Freehand sketch of different critical parts of hydraulic transmission; Exploded view of transmission.</p>	<p>Report writing on inspection and repair carried out in transmission; parts replaced / repaired along with their cost; reasons for replacement / repair of items.</p> <p>Learning about MS Office.</p>
6.	<p>Practice on Assembly / disassembly of tyre with / from wheel rim; Inspection of puncture and cuts in tube / tyre;</p>	<p>Description of wheel and tyres used in HEMM; Section of tyres, ply rating, inflation pressure and carrying capacity, storage of tyres, different types of rims; handling of tyres, tyre inflation.</p>	<p>Freehand sketch of tyres and tyre assemblies.</p>	<p>Report writing on failure / repair of tyres; tyre life; cost of retreading.</p>
7.	<p>Practice on Assembly / disassembly of crawler pads, chain and links.</p>	<p>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</p>	<p>Freehand sketch of the undercarriage unit and its various components.</p>	<p>Report writing on failure / repair of undercarriage unit and its various parts.</p>

8.	<p>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.</p>	<p>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.</p>	<p>Freehand sketching of construction of single phase induction motor &amp; its various parts.</p>	
9.	<p>Practice of the construction, operation and maintenance of different capacities of rope shovel in open cast mine; 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; Maintenance practices of undercarriage unit and its Tensioning system</p>	<p>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; Centralised lubrication system; Trouble shooting of Rope shovel; Machine's safety features. Safety aspects related to rope shovel as per mine regulation.</p>	<p>Freehand sketch of the machine and its different sub-systems; kinematics of its front attachment.</p>	<p>Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled by the machine.  Learning about use of MS Office for file keeping.</p>

10.	<p>Practice of the construction, operation and maintenance of different capacities of hydraulic shovel in open cast mine; 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.</p> <p>Practice of synchronous motor with auto-transformer starter.</p> <p>Study the speed control of slip-ring induction motor.</p>	<p>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.</p> <p>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.</p>	<p>Freehand sketch of the machine and its different sub-systems. Freehand sketching of synchronous motors and its different parts;</p>	<p>Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled by the machine.</p> <p>Applied workshop problems; Different forms of energy, heat, mechanical and electrical, conversion from one to another.</p>
11.	<p>Practice of the construction, operation and maintenance of Walking dragline working in open cast mine; Practice of rebuilding of bucket teeth and other maintenance activities carried out in machines working in mines. Maintenance practices carried out for walking mechanism.</p>	<p>Classification, model, power rating, capacity and applicability of walking dragline; Construction and operation of Walking 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</p>	<p>Freehand sketch of the machine and its different sub-systems.</p>	<p>Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled by the machine.</p> <p>Use of MS Office in record keeping.</p>

		dragline; Machine's safety features. Safety aspects related to dragline as per mine regulation.		
12.	Practice the construction of various types of overhead line conductors.	Transmission & distribution lines:- Line support, Conductor material, Overhead lines vs. Underground cables, Indian Electricity rules (1956) for overhead lines.	Drawing of construction of overhead line conductors.	Plotting and reading of simple graphs.
13.	Practice of the construction and operation of wagon drill, blast hole drill and jack hammer drill in mines. Maintenance practices carried out for drill machines. Practice of care and maintenance of drill bits and drill rods/tubes. Care and maintenance of screw compressor, dust collector used in drill machine. Practice on Wet Drilling System.	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.	Freehand sketch of drill machines and its different sub-systems. Sketch of hydraulic circuit diagram, line diagram of power transmission system, air flow diagram.	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per meter of hole drilled. Learning of Excell
14.	Practice the construction of various types of overhead lines insulators. Study the construction of various types of cables.	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: - Types of cables, Armouring and covering of cables, Cable laying, Selection of cables.	Drawing of construction of various types of insulators & cables.	

15.	Practice of the construction, operation and maintenance of Tractor dozer in mines; Practice of rebuilding of dozer blade and other maintenance activities carried out in dozer working in mines. Maintenance practices of undercarriage unit and its Tensioning system	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.	Freehand sketch of machine and its different sub-systems Sketch of hydraulic circuit diagram, line diagram of power transmission system.	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost of operation.  Use of Excell for record keeping.
16.	Practice of the construction, operation and maintenance of Wheel loader in mines; Practice of rebuilding of loader bucket and other maintenance activities carried out in loader working in mines; 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. 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.	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; 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.	Freehand sketch of machine and its different sub-systems; Exploded view of the critical components of dumper. Sketch of steering linkage system, circuit diagram, line diagram of power transmission system.	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost of operation.  Maintenance record keeping with the help of computer.

17.	Practice the construction of various types of fuses. Study of outdoor and indoor substation through visits to nearby installations.	Sub-stations: - Types of substations, Bus-bar, 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.R.C. fuse, Selection of fuse, Advantages and Disadvantages of fuse.	Drawing of bus-bar layout and various types of fuses Drawing of layout diagram of switchgear equipment and bus bar of a receiving station Freehand sketching of BUCHHOLZ realy.	Simple experiments on density; Simple problems involving trigonometric functions.
18 -19	Practice of the construction, operation and maintenance of dumpers in mines; 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, 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 Maintenance practices carried out in	Classification, model, power rating, capacity and applicability of dumper; Construction 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.	Freehand sketch of machine and its different sub-systems; Exploded view of the critical components of dumper. Sketch of steering linkage system, circuit diagram, line diagram of power transmission system. Free hand sketching of the layout of the air brake / hydraulic brake systems;	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled. Meaning of friction-examples of useful and wasteful friction in vehicles-coefficient of friction, simple problem on vehicle friction.  Maintenance data recording and upkeeping with the help of computer.



	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 coupling.	Brake testing – efficiency of brakes-braking distance, common troubles in brakes and their remedies.		
20.	Practice on Study the construction of Oil circuit breaker, Air circuit breaker, Vacuum circuit breaker, Minimum Oil circuit breaker, Sulphur hexafluoride (SF <sub>6</sub> ) circuit-breakers,	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 <sub>6</sub> ) circuit-breakers, Vacuum Interrupters, Circuit-breaker rating	Drawing of Oil Circuit-breakers (OCB), Air circuit breakers (ACB), Low oil or minimum oil circuit-breakers (MOCB) and Vacuum circuit breakers (VCB)	Specific gravity; Archimedes principle; Relation between specific gravity and density; Problems on trigonometry.
21.	Practice the connection & operation of induction type over current relay, Thermal over load relay, CBT based earth fault relay, plunger type oil dash pot relay.	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.	Drawing of construction of induction disc type over current relay, plunger type oil dash pot relay.	Quantity of heat, specific heat of solid, liquid and gases; Heat gained and heat lost; Simple problems on heat gained and heat lost.

22.	Practice on Experiments on 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.	Drawing of circuit diagrams of Firing circuits of SCR, Single- phase half controlled rectifier, Single phase fully controlled rectifier, D.C. Chopper	Calculation of DC voltage output of single phase and three phase controlled rectifier
23 - 25	<b>Project work / Industrial Visit. (Optional)</b> The students should be sent for training in central workshop for the experience on general maintenance of Heavy Earth Moving Machines			
26	<b>Examination</b>			

Syllabus for the trade of “**Mechanic Mining Machinery**” under C.T.S.

Duration: Six Month

Fourth Semester.

**Code: MMM – Sem - IV**

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Calculation & Science
1 & 2.	Practice of the construction, operation and maintenance of Motor grader in mines; 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; Maintenance practices carried out in Grader working in mines.	Classification, model, power 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.	Freehand sketch of machine and its different sub-systems; Exploded view of the critical components of Scraper loader. Sketch of hydraulic circuit diagram, line diagram of power transmission system.	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled.
3 & 4.	Practice on the construction, operation and maintenance of Surface Miner in open cast mine;  Practice on Maintenance practice of cutting drum and picks and other maintenance activities carried out in machines working in mines.  Practice on Maintenance practices of	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	Freehand sketch of the machine and its different sub-systems.	Report writing, log book entry, calculation of machine life, consumption of power, oils and lubricants; cost per tonne of material handled by the machine.

	undercarriage unit and its Tensioning system	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.		
5 & 6.	Practice on Maintenance of conveyor belt, belt changing / extension. Trouble shooting of crushers and screens;	Construction, operation and application of material handling equipment: Belt conveyor, crushers, screen	Freehand sketch of conveyors, crushers and screen.	Calculation related to the capacity determination of material handling equipment.
7 & 8.	Practice on Repairing of grease guns, Oil can and other items required for maintenance of HEMM; maintenance of drills, press, pedestal grinder etc.	Basic elements of maintenance system – inspection, planning, scheduling, job execution. Importance of periodical maintenance; Upkeep of shop equipment required for all type of maintenance;	Free hand sketching of grease gun, oil can and other service accessories.	Effects of forces on materials for bending, twisting and shearing problems.
9.	Practice on the protection of motor. Practice on Transformer oil testing.	Protection of Transformer, AC motors and Feeder	Drawing of LT control panel for distribution of power to domestic loads.	Resolution and composition of forces; Representation of forces by vectors; Simple problems on lifting tackles like jib wall, crane; Solution of the problems with the aid of vectors.

10.	<p>Practice on different types of wear in components of engine, gear box etc. Condition based monitoring.</p> <p>Practice on Testing of lighting circuits; finding out short and open circuit; checking of wiring; testing of tail and brake lights; Checking functions of malfunctioning of indicating lamp.</p> <p>Removing wiper motor, dismantling, cleaning, inspecting and repairing; assembling and fitting; setting blades for correct functioning.</p>	<p>Science of friction and wear: different types of wear, such as abrasive, corrosive, seizure, scoring, scuffing, pitting etc.</p> <p>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 of indicating lamp in HEMM</p> <p>Description and operation of electric wiper motor; Care and maintenance; Common troubles remedies.</p>	<p>Freehand sketch of the circuits of HEMM with electrical symbols.</p> <p>Freehand sketch of wiper motor circuit.</p>	<p>General condition of equilibrium for series of forces on a body; Reading and plotting of simple graph.</p> <p>Simple problem on laws of friction, coefficient of friction and angle of friction.</p> <p>Purpose of measurement; Display requirement; Errors in measurement; calibration of measuring instruments; noise and response time.</p>
11.	<p>Study the construction of various types of lightning arrestors</p>	<p>Protection against over voltages due to lightning:</p> <p>Protection against lightning:-</p> <p>Protection of power stations and sub-stations against direct strokes, Protection of transmission lines against direct strokes.</p> <p>Protection of Electrical apparatus against traveling waves: -</p> <p>The rod gap, Expulsion type lightning arrester, Valve type lightning arresters, Metal oxide lightning arresters, Magnetically blow out spark gaps.</p>	<p>Drawing of various type lightning arrestors &amp; its connection.</p>	<p>Problems on estimation.</p>
12.	<p>Practice on Assembly and disassembly of air compressor, hydraulic hoist for maintenance and its care. Identification of critical parts.</p> <p>Practice of maintenance of service equipment like injectors testing machine, valve seat grinder, HP testing machine etc.</p>	<p>Basic definitions: preventive, operating and shutdown maintenance; general maintenance carried out for service equipment in workshop</p>	<p>Free hand sketch of compressor and its different parts.</p>	<p>Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility examples.</p>

13.	Practice on Measurement of earth resistance. Measurement of insulation resistance.	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.	Drawing of earth pit & its connection with the equipment & neutral of the supply system.	
14.	Practice on Maintenance practice carried out shovels, dragline and dumper	Planned preventive maintenance of rope shovel, hydraulic Shovel, dragline, dumper; Electrical components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers.	Filling of machine history card & maintenance cards and inventory control card.	Analysis of failures; maintenance of log sheets-details of maintenance
15.	Practice on Measurement of illumination	Illumination: - Laws of Illumination, Electrical lamps, Electric discharge lamps, Cold cathode lamps, Lighting fitting, Illumination for different purposes, Factory lighting, Flood-lighting, street lighting.		
16.	Practice on Maintenance practice carried out drills, loaders and dozers	Planned preventive maintenance of drills, loaders and dozer: Electrical components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers.		Definition: Condition based maintenance and condition monitoring

17.	Practice on Study the electrical braking of a.c. & d.c. motor.	Electrical Braking for A.C. & D.C. Motors: Plugging, Rheostatic braking, Regenerative braking	Drawing of circuit diagram of various type electrical braking of a.c. & d.c. motor.	
18.	Practice on Maintenance practice carried out scraper, grader and surface miner	Planned preventive maintenance of scraper, grader and surface miner: Electrical components; hydraulic components, gear boxes, undercarriage unit, tyres as recommended by manufacturers.		
19.	Practice on Localization of cable fault by Murray loop test.	Study of the operation and control of rope shovel's electrical system – power supply, types of motor with specifications, operation, protection and control of motors, maintenance of electrical system.	Drawing of electrical layout of rope shovel electrical system.	
20.	Practice of lubrication engineering in HEMM	Lubrication: Types of lubricants and their properties, lubricating methods used in HEMM. Centralised lubrication system used in HEMM.	Freehand sketch of lubricating systems used in HEMM	Calculation of consumption of lubricating oil, analysis of lubricating system failure.
21.	Visit to open cast mines for the study of electrical systems in rope shovel and dragline.	Study of the operation and control of dragline's electrical system – power supply, types of motor with specifications, operation, protection and control of motors, maintenance of electrical system.	Drawing of electrical layout of dragline electrical system.	
22.	Practice on Case studies of condition based maintenance and condition monitoring carried out in HEMM.	Definition: Condition based maintenance and condition monitoring; Examples of condition based maintenance.	Representation of maintenance work through bar charts	Calculation on maintenance steps
23.	Practice on Measurement of energy, power factor and frequency of a three-phase system. Connection of CT & PT for measuring instrument. Practice on Testing of energy meter. Practice on Measurement of speed using contact type and non-contact type tachometer.	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.	Drawing the construction of single-phase energy meter.	Calculation of electrical power, energy and power factor.

24.	Visit of underground coal and metal mines to study the construction and operation of the machines.	Classification and application of different types of underground machines used for production, loading, and transportation and hoisting-their special constructional features related to their use in underground gassy mines. Safety rules and regulation related to the construction and operation of the machines.	Freehand sketch of the machines used in underground coal and metal mines.	Simple calculation of power and capacity of different underground coal mining machines.
25	<b>Revision</b>			
26	<b>Examination</b>			



## MECHANIC MINING MACHINERY

Tools & Equipments for 20 trainees + one

### A. Trainees Kit – ( As per the below table)

Sl. No.	Name of the items	Quantity
1	Iron jack 9"x2" plane with cutter	5
2	Iron smoothing plane 9"x2" with cutter 1.7 kg approx.	5
3	Wooden jackplane 9"	10
4	Wooden smoothing plane 9"/7"	10
5	Rebate plane 3/4"	2
6	Rebate plane 1/2"	2
7	Rebate plane 1/4"	2
8	Corner plane (Taper) 1"	2
9	Rounding plane 3/4"	2
10	Cast steel hand saw 12"	10
11	Firmer chisel 1" size with handle	10
12	Firmer chisel 3/4" with handle	10
13	Firmer 1/2" with handle	10
14	Firmer chisel 1/8" with handle	10
15	Dovetail chisel 3/4" with handle	5
16	Mortise chisel 3/8" with handle	10
17	Mortise chisel 1/4" with handle	10
18	Mortise chisel 1/8" with handle	10
19	Try square 10" stainless steel blade 0.45kg approx.	10
20	Mallet (wooden) 500gm approx.	10
21	Gimlet (screw Auger 1/2")	1
22	Gimlet (screw Auger 3/8")	1
23	Pistal type hand drill M/c 12mm Cap electric single phase	1
24	Spring divider 6"	2
25	Outside firm joint caliper 6"	2
26	Cross pen hammer 200gm Approx.	5
27	Adze (3" angle Edge) 1kg Approx.	1
28	Pincer 8" 350gm Approx.	2
29	Flat basterd file 12" single cut & double cut (2 each)	4
30	Half round basterd file 12" single cut & double cut (2 each)	4
31	Rasp cut half round file 10"	2
32	Round basterd file 12" x 1/2"	2
33	Triangular file (slim taper) 6"	10
34	Triangular file (slim taper) 4"	10
35	Carpentry bench vice 7"x 9" quick release, front dog heavy duty 12kg approx.	20
36	Adjustable spanner set 12" 0.8kg approx.	1
37	Double end spanner set (six piece) 6mm-7mm to 16mm-17mm drop forged chrome plated (pie, jhalani, Tapria, Inder)	1
38	Screw driver engg. pattern 10mm dia 12" size (pie, jhalani, Tapria, Inder)	4
39	Screw driver engg. pattern 10mm dia 10" size (pie, jhalani, Tapria, Inder)	6
40	Number punch set 0-9 – size 1/4"	1
41	Marking gauge 6"	10
42	Carborundum universal stone (oil stone) 6" x 2" x 1"	6
43	Cross peen hammer 800 gm with wooden handle	10

44	Rasp cut file (8")	6
45	Letter Punch Set (A-Z), Specifications : Size ¼"	2
46	Blacksmith Flat Tongs Specifications : ½" Flat size	10
47	<b>Metric hand Tap set</b> <b>Specifications :</b> 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
48	<b>Metric Dies(Adjustable)</b> <b>Specifications :</b> HSS Steel; Right Hand Thread:M3.0 – M30.0; Left Hand thread: M4.0 – M30.0	1
49	<b>HSS Drill Bit Set(3-12 mm)</b>	1
50	Chipping hammer	4
51	Body Protection (Asbestos Suit)	4
52	Welding Goggles (flip / flop)	4
53	Ear Protection	4
54	Auto Darkening Welding Helmets	4
55	Cabinet Dry Oven (big Size) Thermostatic Control, Temp range up to 250 <sup>0</sup> C	1
56	<b>Outside and inside Jaw Vernier Caliper (Manual)</b> <b>Specifications :</b> 150 mm capacity; depth reading facility; Venier Constant 0.05 mm ;	2
57	<b>Digital Outside and inside Jaw Vernier Caliper</b> <b>Specifications :</b> 150 mm capacity;; Venier Constant 0.05 mm ;	2
58	<b>External Micrometer</b> <b>Specifications :</b> 0-25 mm	2
59	<b>Measuring tape</b> <b>Specifications :</b> 8mm wide, (3 m length)	20
60	<b>Internal Spring Caliper</b> <b>Specifications :</b> 150 mm size	2
61	<b>External Spring Caliper</b> <b>Specifications :</b> 150 mm size	2
62	<b>Feeler Gauge</b> <b>Specifications :</b> Stainless Steel Blades; 25 blades of different thickness, ½ " wide, 3" long, minimum blade thickness 0.0015", maximum blade thickness 0.025"	2
63	<b>Tpi, Unf &amp; Unc screw pitch gauge</b> <b>Specifications :</b> 30 blades	2
64	<b>BSW Screw gauge</b> <b>Specifications :</b> 52 blades	2
65	<b>Level gauge</b> <b>Specifications :</b> Size 4"	2
66	<b>Magnetic Stand</b> <b>Specifications :</b> Stem dia ¾"	2
67	<b>Steel ruler,Specifications :</b> 12"	10
68	<b>Electronic Weighting Machine, Table top metal body with pole</b> <b>Specifications :</b> 100 kg capacity	2
69	<b>Double ended open jaw spanner set (for Machine Shop &amp; Fitting Shop)</b> <b>Specifications :</b> Drop forged; Chrome Plated; Sizes : 6x7, 8x9, 10x11, 12x13, 14x15, 16x17, 18x19, 20x22, 21x23, 24x26, 25x27, 30x32	2

70	<b>Double ended Ring end spanner set (for Machine Shop &amp; Fitting Shop)</b> Specifications : Drop forged; Chrome Plated; Size : as above	2
71	<b>Ratchet spanner set (for Machine Shop &amp; Fitting Shop)</b> Specifications : Drop forged; Chrome Plated; Size : as above	2
72	<b>Adjustable Spanner, Specifications : Size : 8"</b>	2
73	<b>First Aid Kit</b>	2
74	<b>Hand gloves set</b>	10
75	<b>Fire Extinguisher (Mechanical Foam Type)</b>	4
76	<b>Try-square, Specification : 300 x 150 x 20 x 2 mm</b>	10
77	<b>Hand held Wire Brush with handle</b> Specifications : 6" size	5
78	<b>Pipe wrench, Specifications : Sizes : 4", 8" 10" &amp; 12"</b>	1 each
79	<b>Flat Nose plier</b>	5
80	<b>Screw Driver Set (No. 1 – 6), Specifications : Size : 8"</b>	2
81	<b>Allen Key Set</b> Specifications : 2.5, 3, 4, 5, 6, 8, 10, 12, 14, 17, 19, 22, 24, 27, 30 and 36 mm	2
82	<b>Pincers, Specifications : 210 mm</b>	2
83	<b>Stop watch</b>	5
84	<b>Open Jaw Fixed Type Torque Wrench: 25,30,32 mm</b>	1 each
85	<b>Vernier Depth Gauge (Digital)</b> Specifications : Stainless steel body, range 0-150 mm	2
86	<b>Dial Depth Gauge</b> Specifications : Range 0-150 mm	2
87	<b>Digital Height Gauge</b> Specifications : 0-300 mm	2
88	<b>Radius Gauge</b> Specifications : 1/32" – 17/64"	2
89	<b>Depth gauge with protector</b>	2
90	<b>Helmet</b>	20
91	500V and 1kV Megger	1
92	Megger Earth Tester	1
93	Murrey Loop Tester	1
94	Lux Meter	1
95	Single phase wattmeter i. 5 Amp/10Amp, 110V/250V ii. 10 Amp/20 amp, 250V/500V	1 no each
96	Three phase wattmeter i. 10 Amp/20Amp, 250V/500V	1
97	Three phase power factor meter i. 10 Amp/20 Amp, 250V/500V	1
98	Single phase power factor meter i. 5 Amp/10Amp, 110V/250V ii. 10 Amp/20 Amp, 250V/500V	1 no each
99	Ammeter i. Moving Iron Type – 5 Amp, 10 Amp, 20 Amp ii. Moving Coil Type – 1 Amp, 5 Amp, 10 Amp, 20 Amp.	1no each
100	Voltmeter i. Moving Iron Type – 110V, 250V, 500V ii. Moving Coil Type – 50V, 100V, 250V	1 no each
101	Stroboscope	1

102	CT – 100/5Amp, 100/1 Amp 50 Amp/5Amp, 50 Amp/1 Amp PT – 500V/250V, 500V/110V	1 no. each
103	Clamp meter – 50 Amp, 100 Amp, 400 Amp	1
104	Multimeter for measurement of $V_{ac}$ , $V_{dc}$ , $I_{ac}$ , $I_{dc}$ , Resistance & Continuity	1
104	20 MHz Dual Trace CRO.	1
105	100 MHz Dual channels Digital storage oscilloscope.	1
106	Contact type & Non Contact type tachometer for the measurement of speed.	1
107	Transformer oil testing setup.	1.
108	Dual Regulated Variable dc power supply 0-30V, 2Amp.	1

### B.General Machinery Shop Outfit ( as per the table)

Sl. No.	Name & Description of machines	Quantity
1.	<b>Bench Type Drilling Machine</b> Specifications : (a) drilling 40 mm ; (b) face mill : 100 mm ; (c) end mill : 20mm; (d) tapping : 20mm mill	1
2.	<b>Vice Working Table, Specifications : 4' x 4'</b>	3
3.	<b>Bench Vice</b> Specifications : Size : 6" ; Body : cast Iron; jaw : hardened and Knurled Steel jaw	12
4.	<b>Surface Plate (small), size 1' x 1'</b>	2
5.	<b>Surface Plate (big), size 2' x 2'</b>	2
6.	<b>Hand Hacksaw frame with blade, size 5 x 300 mm</b>	10
7.	<b>Bench Grinder</b> Specifications : Wheel size : 125 mm; no. load speed : 2950 rpm	1
8.	<b>Portable Electric Drill Machine</b> Specifications : Hole size : 5 mm to 25 mm; variable chuck;	1
9.	<b>Blacksmith Hammer with handle</b> Specifications : Alloy steel hammer head; harden and normalized; weight of head : 1.5 kg and 2 kg	10 each
10.	<b>Sledge Hammer</b> Specifications : Drop forged, hardened and tempered alloy steel hammer head : weight of hammer head : 3 kg	2

Sl. No.	Name & Description of machines	Quantity
1.	<b>Open hearth Coal Fired Furnace</b> Specifications : Size : 600 x 600 mm MS fabricated complete with water tank; coal tank, air control valve, electrically operated motorized blower, ash-tray, hopper with smoke outlet (hood); complete with fire brick lining; 8" diameter chimney with installation	2
2.	<b>Pneumatic Power Hammer</b> Specifications : Distance between Dies: 9" ; Blows per minute : 240; Dia size : 2.375" x 4.75";	1

3.	<b>Anvils with damping base</b> <b>Specifications :</b> 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
4.	<b>Steel Swage Block</b>	2
5.	<b>Working Table</b> <b>Specifications :</b> Size : 1½” x 7” x 3”	2
	<b>List of machines:-</b>	
<b>Sl no.</b>	<b>Description of the item</b>	<b>Quantity</b>
1.	Automatic Submerged Arc Welding Machine – 470 A 415V, 3 Phase	1 no.
2.	AC/DC pulse TIG welder set 415 V, AC 3 Phase Max No. of Load Voltage – 75 V	1 no.
3.	Arc Welding Machine Supply Voltage 390/415 V	1 no.
4.	CO2 / MIG Welding Machine 415 V AC 3Phase 50hz	1 no.
5.	Manual plasma cutting system (Power Max Systems) Power Max 30, 45, & 1000	1 no.
6.	Mig Welding Torch Gas Cooled – Cap 180A/250A/300A Water Cooled – Cap 300A/500A	1 no.
7.	Pneumatic Spot Welding machines Primary Supply Voltage – 415V Rating 20KVA	1 no.
8.	Seam Welding machine Working Voltage 220v/380v	1 no.
9.	A/C, D/C Welding Rectifiers Input Supply voltage – 380/415/440	1 no.
10.	AC Arc Welding transformer 30-300 AMPS	1 no.
11.	Fully Insulated Electrode Holder Capacity : 400 – 600 AMP	5 no.
12.	Ground Clamp required for electric arc welding	5 no.
13.	Welding consumables	As needed
14.	Oxy-Acetylene Gas Regulator Oxygen 15Mpa – 0.03-1.2Mpa Acetylene 3Mpa – 0.01-0.15Mpa	2 nos.
15.	Welding tool Kit consists of Cutting torch, Gas Regulator, Welding Nozzles, Cutting Nozzles, Rubber Tube, Binkers, Copper Brush, Lighter, Spanner, Nozzle Cleaner	2 sets.
16.	Pencil / Hand Grinder Collet Capacity 3, 6, 6 mm each	2 nos.

Sl. No.	Name & Description of machines	Quantity
1.	<b>V-belt Driven Lathe Machine</b> <b>Specifications :</b> 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
2.	<b>All Geared Lathe Machine</b> <b>Specifications :</b> 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 : 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.	1
3.	<b>Turret Lathe</b> <b>Specifications :</b> Bar stock capacity : 25-64mm; Chuck size : 250-380mm; Drive motor capacity : 5-10 HP; Swing over ways : 550mm; Speed : 50-150rpm	1
4.	<b>All Geared Capstan Lathe</b> <b>Specifications :</b> 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 stroke 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, 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	1
5.	<b>Universal Radial Drilling Machine</b> <b>Specifications :</b> 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	1

	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	
6.	<b>Planing Machine</b> <b>Specifications :</b> Length of stroke : 1220mm; Width between arms : 762mm; Height under cross rail : 762mm; Length of bed : 2033mm; Width of bed : 457mm; Working surface : 1220 x 610mm; No. of T-Slots : 4; Width of T-slots : 19mm; Motor hp : 3	<b>1</b>
7.	<b>Slotting Machine</b> <b>Specifications :</b> 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	<b>1</b>
8.	<b>All Geared Shaping Machine</b> <b>Specifications :</b> 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	<b>1</b>
9.	<b>Universal Milling Machine</b> <b>Specifications :</b> Surface of table : 900 x 225mm; Distance between T-slot : 55mm; Longitudinal travel of table : 485mm; Cross travel of table : 150mm; Vertical adjustment of 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	<b>1</b>
10.	<b>V-Belt Driven Hydraulic Control Hacksaw Machine</b> <b>Specifications :</b> Size : 7"; Stroke : 5½"; 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	<b>1</b>
11.	<b>Double Ended Motorized Bench Grinder</b> <b>Specifications :</b> Motor HP : 1; Three Phase; 440V; 2800 rpm; Coolant pump; Wheel size : 250 x 25mm; Wheel guard	<b>1</b>
12.	<b>Double Ended Pedestal Grinder</b> <b>Specifications :</b> Motor HP : 1; Three Phase; 440V; 2800 rpm; Coolant pump; Grinding wheel : 200 x 40mm; Working table size : 185 x 175mm	<b>1</b>
13.	<b>Hand Operated Hydraulic Press</b> <b>Specifications :</b> Capacity : 5tons; Dimension between columns : (LxB) 500 x 125mm; Distance between ram and bed maximum 600mm and minimum 75mm; Travel of ram : 100mm	<b>1</b>

14.	<b>Puller</b> <b>Specifications :</b> Size : 4"; 3 legs reversible for internal and external use; Forcing screw, links and bolts	<b>1</b>
15.	<b>Hydraulic Jack</b> <b>Specifications :</b> Capacity : 1t with hand pump	<b>1</b>
16.	<b>Manual Chain Pulley Black</b> <b>Specifications :</b> Capacity : 1t & 3t	1 each
17.	<b>Portable Blower</b> <b>Specifications :</b> Air volume : 4.5m <sup>3</sup> /min; Air pressure : 0-7.2 KPa; No-load speed : 0-16000 rpm; Weight : 1.8kg	<b>1</b>

Sl. No.	Name & Description of machines	Quantity
1. *	Mechanical Transmission training Unit, Trolley Version with Storage cabinet and Toolkit (Product of Feedback Instruments Ltd. / UK)	1 set
2. *	Mechanical Training Bench (IMP-1) with TSA Two student Add-On (Product of Intelitek, USA)	1 set
3. *	Belt drive trainer (Product of DAC, USA)	1 no.
4. *	Chain Drive Trainer (Product of DAC, USA)	1 no.
5. *	Combined mechanical trainer (Product of DAC, USA)	1 no.
6. *	Coupling / Shaft Alignment Trainer (Product of DAC, USA)	1 no.
7. *	Combined mechanical trainer (Product of DAC, USA)	1 no.
8. *	BSC Bearing Service Cart with two students Add-on (Product of Intelitek, USA)	1 no

**Note:- Items marked "\*" MOU to be signed with industry for imparting training, if not purchase.**

The item indicated in Sl. No. 1 will be able to provide hands-on experience to allow students to set-up different transmission systems and compare them in terms of underlying principles, ease of assembly, maintenance uses and operational characteristics.

The item indicated in Sl. No. 2 is stand alone mobile training station to train in mechanical power transmission. It provides power transmission using same industrial strength components used in factory environment. Students can work with basic machines, machine static and dynamics, shafts and keys, belt drives, chain drives, speed reducers, electric brakes and gear drives.

The item indicated in Sl. no. 3 is a table top equipment. It is heavy-duty multi-functional training fixture for convenient training in the identification, installation, tensioning and alignment of common belt drives types found in industry.

The item indicated in Sl. no. 4 is a table top equipment. It is heavy-duty bench top fixture allowing for realistic training in industry chain drive systems.

The item indicated in Sl. no. 5 is a table top equipment. It will be provide training relating selection of industrial quality gears, shafts and bearings, allowing for use in variety of configurations. It allows for convenient hands on training in gear identification, installation,



alignment and trouble-shooting.

The item indicated in Sl. no. 6 is a table top equipment. It will be used to provide training in shaft alignment. Each element can be adjusted to create unique alignment problems.

The item indicated in Sl. no. 7 is a table top equipment. It will be provide training relating to chain drive, belt drive, gear drive, industrial bearing and shaft alignment combined together in one unit.

The item indicated in Sl. no. 8 is a trolley mounted machine. It will provide training in installation, identification, assembly, disassembly of industrial bearings.

**Note: All the above equipment should be procured with instruction manual.**

Sl. No.	Description of the item (Optional)	Quantity
1.	Gear Model Single Stage Spur Gear with intermediate Two stage spur Gear Three stage spur gear Single stage Bevel Gear Single stage Helical Gear Single stage Spiral Gear Gear Sets Set of 4 Herringbone Gear Big Small Internal Gear Pinion Drive Rack & Quadrant Gears Sliding Wedge Gear with Straight Line Rack & Quadrant Gears Sliding wedge Gear with straight line Rack & pinion Epicycle Gear Epicycle Gear (Sun & Planet Type) Cycloidal Gear Reversing Gears Worm Gears Train of Gear Wheels Simple Compounds Different Gear Inter Connected Gear Gear Box (3 speed & Reverse Gear ) Without clutch With clutch Shaper model	1 no. of each model
2.	Mechanism Models i. Friction wheel Drive ii. Chain Drive iii. Pawl & Ratchet Motion	1 no. of each model

	iv. Crank & Connecting Rod Motion v. Slide Crank Mechanism Reciprocating engine mechanism Oscillating Cylinder mechanism Witworth Quick Return Mechanism, vi. Slide Crank Mechanism with calibrated Dial Reciprocating engine mechanism Oscillating Cylinder mechanism Witworth Quick Return Mechanism, vii. Four bar link mechanism viii. Scotch Yoke Mechanism ix. Ellipse tracer model x. Watt's mechanism xi. Peculiar linkage Drive model xii. Pentograph mechanism xiii. Kinematic pairs Crank shaft to slider mechanism Crank & Slotted link mechanism Two crank linkage drive model Slotted link bar mechanism Inversion of four bar mechanism Crank drive to oscillating link mechanism Crank & slotted lever apparatus (fully calibrated) Inversion of single slide crank mechanism Inversion of double slide crank mechanism	
3.	CAM & Follower Models CAMS & Followers Set of 5 Plate Cam (with flat faced Reciprocating Follower) Tangent Cam (with roller oscillating Follower) Cylindrical Cam (with Translating Follower ) Translating cam (with reciprocating knife edge Follower) End Cam (with translating Follower)	1 no. of each model
4.	Brake Models Single Shoe Brake Double Shoe Brake Band Brake Band & block Brake Internally Expanding Brake Disc Brake Model Disc Brake Actual Working Hydraulic Brake Unit Hydraulic Brake Unit (Two Brake Drums ) Hydraulic Brake Unit (Four Brake Drums ) Mechanical Brake Working Power Brake Actual Working Air Brake Actual Working	1 no. of each model
5.	Brake Models Single Shoe Brake Double Shoe Brake Band Brake Band & block Brake Internally Expanding Brake	1 no. of each model

	Disc Brake Model Disc Brake Actual Working Hydraulic Brake Unit Hydraulic Brake Unit (Two Brake Drums ) Hydraulic Brake Unit (Four Brake Drums ) Mechanical Brake Working Power Brake Actual Working Air Brake Actual Working	
6.	Bearing Models Shafting General Bearing <ol style="list-style-type: none"> <li>a) Open Truck Bearing</li> <li>b) Simple Bearing</li> <li>c) Bush Bearing</li> <li>d) Thrust Bearing</li> <li>e) Plummer Block or Pedestal Bearing</li> <li>f) Foot Step Bearing</li> </ol> Bearings <ol style="list-style-type: none"> <li>a) Ball Bearings</li> <li>b) Roller Bearings</li> <li>c) Taper Bearings</li> <li>d) Thrust Bearings</li> </ol> Ball Bearings Set Swivel Bearings Hanger Brackets Wall Brackets	1 no.of each model
7.	KEY & JOINTS MODELS Keys (Set of 5) Knuckle Joint Cotter Joint Gib & Cotter Joint Tie Rod Joint Sleeve & Cotter Joint Socket & Spigot Joint Riveted Joints Set of Four (Wooden Models) Riveted Joints (Wooden Models) <ol style="list-style-type: none"> <li>(a) Riveted Joints Triple</li> <li>(b) Riveted Joints Quadruple</li> <li>(c) Riveted Joints Angle Iron &amp; Girder Joints</li> </ol> Rivets Set of Four (Metal Model) Rolled Sectional Models Set of Four (Wooden ) Girder Models (Wooden) <ol style="list-style-type: none"> <li>a) Plate Girder</li> <li>b) Box Girder</li> <li>c) N. Girder</li> </ol>	1 no. of each model
8.	COUPLING MODELS Sellers Coupling Universal Coupling Hook's Coupling Hook's Coupling (Double) Double Hook's Coupling Experimental Apparatus Flexible Coupling Box or Muff Coupling	1 no. of each model

	Flanged Coupling Split Muff Coupling Oldham's Coupling (a) Small (b) Big	
9.	CLUTCH MODELS Claw Clutch Conical Friction Clutch Plate Clutch Centrifugal Clutch Multiplate Clutch	1 no. of each model
10.	SCREW & NUT MODELS Hemispherical Sectional Models of Screw Threads Hemispherical Sectional Models of Screw Threads Nuts Standard Bolt Bolts of Four Types Foundation Bolts Foundation Bolts with Nomenclature Locking Arrangement of Bolts	1 no. of each model

<b>Product required for various hydraulics Experiments (Open circuit)</b>		
<b>Sl. No.</b>	<b>Description of the item</b>	<b>Quantity</b>
1.	Apparatus for Verification of Bernoulli's Theorem complete with Collecting Tank	1 no.
2.	Reynolds's Apparatus Complete with Collecting Tank	1 no.
3.	Determination of Losses in pipe Line Due to Sudden Enlargement, Contraction etc. with collecting tank and differential manometer	1 no.
4.	Determination of Critical Velocity Complete with all Accessories	1 no.
5.	Determination of CD,CV & CC Orifices Complete with all Accessories	1 no.
6.	Forces of Jet Apparatus	1 no.
7.	Apparatus for Determination of Discharge & Coefficient of Discharge of Notches Complete with all Accessories	1 no.
8.	Collection tank with two compartments	1 no.
<b>Venturimeters and Orifice meters</b>		
9.	Venturimeters (Brass) of different sizes (25 mm, 38 mm, 50 mm)	1 set
10.	Orifice Meter (Cast Iron Body Brass Plates) of different sizes (25 mm, 38 mm, 50 mm)	1 set
<b>Manometers</b>		
11.	Pitot Tube	1 set
12.	U Tube Double Column Manometer of different sizes (15 cm, 25 cm, 50 cm, 100 cm)	1 set
13.	Differential Manometer and Inclined Tube Manometer of 50 cm Scale	1 set
14.	Inclined Manometer 20-0-20 cm	1 set

15.	Demonstration Manometer 50 cm	1 set
16.	Piezometer Tube (One Meter Long)	1 no.
17.	Differential Manometer (One Meter Long)	1 no.
<b>Valves</b>		
18.	Hydraulic Non-return valve	1 no.
19.	Hydraulic Gate valve	1 no.
20.	Hydraulic Globe Valve	1 no.
<b>Pumps</b>		
21.	Centrifugal Runner Actual Cast Iron	1 no.
22.	Different Impellers of Pumps	1 set
23.	Display Board for Pipes	1 no.
24.	Hydraulic Jack	1 no.
25.	Hydraulic Press Model	1 no.
26.	Hydraulic Ram	1 no.
27.	Gear Pump Model	1 no.
28.	Rotary Pump	1 no.
29.	Centrifugal Pump (Actual Cut Section)	1 no.
30.	Reciprocating Pump	1 no.
31.	Submersible Pump	1 no.
<b>Hydraulics &amp; Fluid Mechanics Lab Equipments (Closed Circuit)</b>		
32.	Centrifugal Pump Test Rig	1 no.
33.	Reciprocating Pump Test Rig	1 no.
34.	Gear Pump Test Rig	1 no.
35.	Hydraulic Ram Test Rig	1 no.
36.	Two Stage Air Compressor Test Rig	1 no.
37.	Centrifugal Compressor Test Rig	1 no.
38.	Rotary Compressor Test Rig	1 no.
<b>Demonstration Unit with Experimental Set-Up</b>		
39. *	Axial Flow Fan Demonstration Unit fitted with sensors and Instruments to carry out various experiments (Manufactured by Armfield Ltd. / USA)	1 set
40. *	Centrifugal Pump Demonstration Unit fitted with sensors and Instruments to carry out various experiments (Manufactured by Armfield Ltd. / USA)	1 set
41. *	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

**Note:- Items marked "\*" MOU to be signed with industry for imparting training, if not purchase.**

Sl. No.	Name & Description of machines	Quantity
1.	2.5 kW, 250V, 1000 r.p.m d.c machine suitable for separately excited, series, shunt and Compound Connections and excitation.	1 no.
2.	3 point, 4 point starter & series motor starter suitable for 2.5 kW, 250V, 1000 r.p.m d.c motor.	
3.	3kW, 250V, 1000 r.p.m d.c shunt motor.	
4.	4kW, 440V, 50Hz, 960 r.p.m 3-Phase Squirrel cage induction motor.	
5.	5KVA, 200V/400V, 50Hz single phase transformer.	1 no.
6.	5 Amp, 50Hz single phase auto transformer.	1 no.
7.	16 Amp, 50Hz single phase auto transformer.	1 no.
8.	30 Amp, 50Hz 3-phase auto transformer.	1 no.
9.	) DOL starter (ii) Star –Delta starter (iii) Auto transformer starter Suitable for 4kW, 440V, 50Hz 3-phase 960 r.p.m Squirrel Cage induction motor.	1 no.
10.	5kW, 440V, 50Hz 960 r.p.m 3-phase slipring induction motor with rotor starter.	1 no.
11.	4KVA, 440V, 50Hz, 0.9 power factor (lag), 1000 r.p.m 3-phase alternator.	1 no.
12.	5kW, 250V, 1200r.p.m d.c shunt motor with starter.	1 no.

#### List of Automobile Equipments:

Sl. No.	Name & Description of machines	Quantity
1.	Fuel supply System of a 4-cylinder Diesel Engine	1 no.
2.	Lubrication System of an Automobile	1 no.
3.	Cooling System of an Automobile (with Actual Parts)	1 no.
4.	Actual Cut Section Gear Box: (4 Forward & 1 Reverse )	1 no.
5.	Actual Cut Section Gear Model with Clutch	1 no.
6.	Actual Cut Section Automatic Gear Box Car (internal Gear)	1 no.
7.	Actual Cut Section Gear Box Car (Constant Mesh)	1 no.
8.	Actual Cut Section Gear Box Jeep (Synchronic Mesh)	1 no.
9.	Differential Gear Assembly (Actual Cut Section)	1 no.
10.	Rear Axial Assembly (Actual Cut Section)	1 no.
11.	Sectional Working Model of 2 Stroke Petrol Engine	1 no.
12.	Sectional Working Model of 4 Stroke Petrol Engine	1 no.
13.	Sectional Working Model of 2 Stroke Diesel Engine	1 no.
14.	Sectional Working Model of 4 Stroke Diesel Engine	1 no.
15.	Actual Cut Section of Four stroke Single cylinder Vertical Diesel Engine	1 no.
16.	Four Stroke Four Cylinder Actual Cut-section Engine Model (Motor driven)	1 no.
17.	Twin Cylinder Four stroke vertical diesel engine test rig	1 no.

Sl. No.	Name & Description of machines	Quantity
1.	Oil cooled 3 – phase transformer.	1 no.
2.	Circuit breaker. i. Air circuit breaker (ACB). ii. Oil circuit breaker (OCB). iii. Minimum oil circuit breaker (MOCB). iv. S <sub>f</sub> 6 circuit breaker. v. Vacuum circuit breaker (VCB).	1 no. 1 no. 1 no. 1 no. 1 no.
3.	Isolator, Earthing switch & Lightning Arrestor.	1 no.
4.	Various Types of Fuses.	1 no.
5.	Various Types of Armoured & Flexible Power Cables.	1 no.
6.	Overhead Line Insulators.	1 no.
7.	Flame Proof Enclosures of Mining Type Circuit Breaker & Electrical Motor.	1 no.
8.	D.C Machine for study of Armature winding & magnetic poles.	1 no.
9.	3-Phase Squirrel Cage Induction Motor.	1 no.
10.	3-Phase Slip-ring Induction Motor.	1 no.
11.	3-Phase Synchronous Motor.	1 no.

### **Automobile Parts Testing Unit**

Sl. No.	Name & Description of machines	Quantity
1.	Nozzle Tester Max Pressure : 40 MPa or 60 MPa Volume of fuel Tank 1500ml	1 no.
2.	Cummins PT Pump Test Stand Model No. PTW 100	1 no.
3.	Fuel Injector Pump Tester For Heavy Duty Type for Multi Cylinder Engine	1 no.
4.	Cummins Tools and equipments	1 no.
5.	Cummins PT Injector Test Stand (Model No. PTW200)	1 no.
6.	Injector Leakage tester	1 no.
7.	Injector Top Stop Fixture	1 no.
8.	STC Top Stand (STC with digital indicator)	1 no.
9.	Injector Disassembly & Assembly Tool	1 no.
10.	Injector Cup Spray Tester	1 no.
11. *	Common Rail System Injector Tester	1 no.

**Note:- Items marked “\*” MOU to be signed with industry for imparting training, if not purchase.**

### **A. Workshop Furniture**

SL.NO	NAMES & DESCRIPTION OF FURNITURE	QUANTITY
1.	Work bench 250x120x75 with four vices of 12.5 cm	4
2.	Locker with 8 drawers ( standard size )	2
3.	Metal Rack 180x150x45cm	2
4.	Steel almirah / cupboard	1
5.	Black board and easel	1
6.	Instructor’s Desk or table	1
7.	Chair	1

The items to be provided with complete instruction manual

## Appendix 1

### **Cummins PT Injector Test Stand (Model No. PTW200)**

#### Main Technical Specification

- Main Technical Specification
- Range of flowmeter : 0-700 ml/min
- Oil supply pressure : 100 PSI
- Pressure of nose Cone assembly: 350 PSI
- Rotary Speed : 1050 rpm
- Speed control Accuracy : +/- 1 rpm
- Test oil temperature : 40 degrees automatic control
- Temperature control accuracy : +/- 1 degree
- Cam driven Motor : 2.50 HP
- Power supply : 380V, 50 Hz, 3Phase or 220V, 60Hz, 3 Phase
- Measurement approx. 2.0 CBM

### **Fuel Injector Pump Tester For Heavy Duty Type for Multi Cylinder Engine**

#### **Main Features**

- New Modern Gauge panels
- Improved design and outlooking
- Heavy duty type, with two rear electrical cabinet and independent mobile accumulator system
- A/C direct driving system. A/C motor coupled directly with output shaft 100% power output without loss
- Frequency variable speed controller, high accuracy and reliability, smooth running, low noise, incensed efficiency
- Automatic test oil constant temperature control, through the cooling and heating system
- Continuously variable speed control, pre-setting function
- Electronic automatic speed feedback system , keeping excellent stability of speed
- Motor protection system
- Convenient and accurate fuel measurement control
- Standard test injectors for heavy duty type
- Oil supply with both low & high pressure back ways
- 12V and 24V DC power supply
- Touch button control panel, easy controlling
- Frame construction with cover panels removable, convenient for servicing
- Independent, complete mobile accumulator structure with wheels, easily sited on any side of test bench.
- Return oil flow meter
- Vacuum device
- Two working sides, arbitrary each other
- Reduced shock, vibration and noise
- Complete standard accessories and tools



### **Main Technical Data**

- Electricity : 380V, 50Hz, 3 Phase or 220V, 60Hz 3 phase
- Rated power: 30 hp, 40hp, 50 hp,60 hp,75 hp,80 hp,102 hp
- Max. Speed : 4000 rpm
- Speed Control Accuracy : +/- 1rpm
- Max. Working points / cylinders : 12 cylinders
- Selectable range of counting times : 0-9999 times
- Oil tank volume: 40 ltr. / 60 ltr.
- Oil Supply Pressure : low 0-4 Mpa, High 0-4.0 Mpa
- Test oil temperature : 40 degrees automatic control
- Temperature control accuracy : +/- 1 degree
- Volume of measuring graduates: 400 ml or 600 ml
- Main Shaft revolving direction : clockwise and anti clockwise
- Centre distance (clamping bed to coupling center ) : 125 mm
- Weight Approx 1600 kgs., - 2800 kgs.

### **Cummins Tools and equipments**

- Injector Leakage tester – the tester is mainly used to test the leakage properties of PT injectors
- Injector Top Stop Fixture – The device is mainly used to test and adjust the moving distance of injector plunger with top setting.
- STC Top Stand (STC with digital indicator) – The equipment is also used to test injectors with STC device.
- Injector Disassembly & Assembly Tool – The tool is mainly used to disassemble and assemble PT injectors. It is with manual screw mechanism
- Injector Cup Spray Tester – The tester is mainly used to test injector cups.

### **Common Rail System Equipment**

CR100 Common Rail Injector Tester

Technical Features and Specifications

The main technical features and specification of the common rail injector tester, series CR1000 are as following :

The main features

- CRI cleaning
- Sealing Feature test
- Fuel injection Volume Measurement
- Backleak fuel Volume Measurement

### **Main specification**

- Max. test pressure : 1000 bar or 1600 bar
- Fuel Injection frequency : 1-10 Hz
- Times of injection : 100 – 1000 times adjustment
- Driving pulse width : 0.5 3ms, adjustable
- Fuel injection graduation : 150 ml
- Backleak Fuel Graduate : 150 ml
- Frequency: 50 / 60 Hz.

## **NOTE ON COURSE COVERAGE**

The weeks in which there are both mechanical and electrical course contents, the teaching hours to be engaged for mechanical and electrical subjects are as follows:

Theory : About 15 classes for mechanical subjects, 5 classes for electrical subjects in a week.

Practical/Practice: About 4 or 3 classes for mechanical subjects, 1 or 2 classes for electrical subjects in a week.

Standard : Theoretical exposure should be of Intermediate (Science) level.  
Technical input should be of ITI standard.

Industrial Training: Industrial Training is part of 1<sup>st</sup> Semester (for 2 weeks), 2<sup>nd</sup> Semester (for 8 weeks) and 3<sup>rd</sup> Semester (for 4 weeks).

In the theory, some topics are to be covered through field visits as indicated in the syllabus and for this short visits (of one day) are required.

Examination : Last week of every semester is earmarked for Examination, Test and Viva-Voce.