SYLLABUS FOR PUMP OPERATOR	
1. Machinist- 30 Marks	
Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy following safety precautions. [Basic fitting operation-marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]	All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures. Soft skills, its importance and job area after completion of training. Importance of safety and general precautions observed in the industry/shop floor. Introduction of first aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Introduction to 5S concept & its application. Occupational Safety & Health: Health, Linear measurements- its units, steel rule dividers, callipers -types and uses, Punch- types and uses. Uses of different types of hammers. Description, use and care of marking of table. Safety and Environment guidelines, legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment.
	Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaw. Files- elements, types, specification and their uses. Methods Pedestal grinding machine: Use, care and safety aspect. Marking off and layout tools, scribing block, care & maintenance. Try square, ordinary depth gauge, care & maintenance of cold chisels- materials, types, cutting angles. Combination set- its components, uses and cares, of filing, care and maintenance of files. Measuring standards
	Marking media, Prussian blue, red lead, chalk and their special application, description. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance.
Produce components by different operations and check accuracy using appropriate measuring instruments. [Different Operations - Drilling,	Drill, Tap, Die-types & application. Determination of tap drill size. Basic terminology related to screw thread. Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. Vernier height gauge: construction, graduations,

Reaming, Tapping, Dieing; Appropriate Measuring Instrument- Vernier, Screw Gauge, Micrometre]	vernier setting & reading. Care and maintenance of Vernier height Gauge.
	Drilling machines-types & their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing-tools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations.
Make different fit of components for assembling as per required tolerance observing principle of interchangeablity and check for functionality. [Different Fit- sliding, 'T' fitand Square fit; Required tolerance: ± 0.2mm, angular tolerance: 1 degree.]	Interchangeability: Necessity in Engg., field, Limit- Definition, types, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero-line, tolerance zone, allowances. Different standard systems of fits and limits. (British standard system & BIS system) (14 hrs) Vernier calliper-its parts, principle, reading, uses & care. Outside micrometre- its parts, principle, reading, uses, Reading of Vernier Micrometre), care & maintenance. Dial test indicator- its parts, types, construction and uses.
Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice.	Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification. History and gradual development of lathe. Introduction to lathe- its types, centre lathe construction, detail function of parts, specification. Safety points to be observed while working on a lathe.
Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations.	Lathe cutting tool-different types, material, shapes and different angles (clearance, rake etc.) and their effects, specification of lathe tools, grinding process of tools. Types of chips, chip breaker. Tool life, factors affecting tool life.
	Driving mechanism, speed and feed mechanism of Lathe.
	Concept of Orthogonal and Oblique Cutting. Chucks & different types of job holding devices on lathe and advantages of each type, Mounting and dismounting of chucks Vernier Bevel Protractor- parts, reading and uses.
	Lathe operations- facing , turning, parting-off, grooving, chamfering, boring etc. Knurling-types, grade & its necessity.
Set different components of machine & parameters to produce taper/angular components and ensure proper assembly of the components. [Different components of machine: Form tool, Compound	Taper - different methods of expressing tapers, different standard tapers. Method of taper turning, important dimensions of taper. Taper turning by swiveling compound slide, its calculation. Calculations of taper turning by off- setting tail stock. Sine Bar- description & uses. Slip gauge-description and uses.

slide, tail stock offset; Different machine parameters- feed, speed, depth of cut.]	
Set the different machining parameters to produce metric-v threaded components applying method/technique and test for proper assembly of the components.	Different thread forms, their related dimensions and calculations of screw cutting in a lathe (Metric thread on English lathe and English thread on Metric lathe). Measurement of threads by three wire methods. Use of Screw Pitch Gauge.
Set the different machining parameters and cutting tool to prepare job by performing different slotting operation.	Slotter- Classification, principle, construction, Safety precaution. Introduction and their indexing process on a Slotter by its Rotary table graduations. Driving mechanisms, quick return motion and speed ratio. Safety points to be observed while working on a Slotter.
	Job holding devices-vice, clamps, V-block, paraller block etc. Slotting tools- types, tool angles.
	Use of tool with holder for internal operations. Precautions to be observed during slotting internal operations. Use of circular marks on the table for slotting curves. Chain, Sprocket and their applications.
	Spline- types and uses. Coolant & lubricant- Introduction, types, properties, application & applying methods.
Set the different machining parameters and cutters to prepare job by performing different milling operation and indexing. [Different machining parameters feed, speed and depth of cut.]	Milling Machine: Introduction, types, parts , construction and specification. Driving and feed mechanism of Milling Machine.
	Different types of milling cutters & their use. Cutter nomenclature.
	Different milling opereations- plain, face, angular, form, slot, gang and straddle milling etc. Up and down milling.
	Different types of milling attachments and their uses.
	Jigs and Fixtures- Introduction, principle, types, use, advantages & disadvantages.
	Properties of metals general idea of physical, mechanical properties of metals, colour, weight, hardness toughness, malleability, ductility their effect on machinability. Heat Treatment - Introduction, necessity, types, Purposes, different methods of Heat Treatment. Heat Treatmetn of Plain Carbon Steel.
	Indexing-introduction & types. Indexing head-types & constructional details, function of indexing plates and the sector arms. Calculation for various types of indexing.

Set the different machining parameters to produce square & "v" threaded components applying method/technique and test for proper assembly of the components.	Turning of taper by taper turning attachment - advantages and dis-advantages, taper calculations. Mandrel, Lathe centres, Lathe dog, catch plate/Driving plate, face plate, Rests, their types & uses.
	Terms relating screw thread major/minor diameter, pitch and lead of the screw, depth of thread. Simple gear train and compound gear train change gears for fractional pitches. Square thread and its form and calculation of depth, core dia, pitch dia. Difference between single and multi-start threads- their uses, merits and demerits.
Produce components of high accuracy by different operations using grinding.[Different operations - surface grinding, cylindrical grinding with an accuracy of +/- 0.01mm]	Grinding- Introduction, grinding wheel-abrasive, types, bond, grade, grid, structure, standard marking system of grinding wheel, selection of the grinding wheel.
	Dressing, types of dresser. Glazing and Loading of wheels - its causes and remedies. Roughness values and their symbols. Explain the importance and necessity of equality.
	Surface Grinder- Types , parts, construction, use, methods of surface grinding, specification & safety.
	Cylindrical grinder: Introduction, parts, construction, types, specification, safety, different methods of cylindrical grinding.
	Cutting speed, feed, depth of cut, machining time calculation.
	Wet grinding and dry grinding, various types of grinding wheels and their application, grinding defects and remedies.
Re-sharpen different single & multipoint cutting tool.[Different single point tools, slab milling cutter, side & face milling cutter, end mill cutter and shell end mill cutter.]	Tool & cutter grinder- Introduction, parts, construction, use and specification, different types of tool rest & their application.
	Various methods of cutter grinding.
	Various cutter grinding attachments and their uses.
Set different machining parameters and cutters to prepare job by different milling machine operations.	Geometrical tolerance, definition, symbol and their application. Depth Micrometer - parts, reading, uses and safety.
	Different types of micrometers and their uses. Inside Micrometer - its parts, reading and uses. Bore Dial Gauge - its parts, reading(both in Metric and English system) and uses. Telescopic gauge.
	Gauges - different types and their uses, difference between Gauges and Measuring Instruments.
	Gear introduction, use and type. Elements of a spur gear. Gear tooth of each forms types, merits and demerits of each.

Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. [Different machining parameters - feed, speed and depth of cut. Different components - Rack, Spur Gear, External Spline, Steel Rule, Clutch, Helical Gear].	Rack - types, uses and calculations. Selection of gear cutter type and form & various methods of checking gear and its parts. Vernier gear tooth caliper - its construction and application in checking gear tooth.
	Spur gear calculations, curves and their uses. Use of radius gauges and template.
	Vertical Milling Machine - its parts . Method of boring in Vertical milling. Difference between Horizontal and Vertical Milling Machine.
	Helix and Spiral introduction, types and elements. Difference between helix & spiral. Difference between R.H and L.H. helix. Helical gear- elements, application. Calculations for cutting helical gear.
	Reamer - types, elements and uses. Calculations for cutting Reamer. Twist drill-nomenclature, cutter selection. Calculations for cutting twist drill.
Identify and explain basic functioning of different electrical equipment, sensors and apply such knowledge in industrial application including basic maintenance work.	Study of basic Electricals- Voltage - Current etc. Working of Solenoids, Inductors, Motors, Generator Based On Electromagnetic Induction principle Switches, Fuse and Circuit Breakers Introduction to Sensors- Fundamental of Sensor Proximity Sensoirs Classification and Operation-Proximity Sensor-Types of Proximity Sensor and their Working-Industrial Application sensors for Distance and Displacement - LVDT- Linear Potentiometer Ultrasonic and Optical Sensors-Industrial Application.
Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme.	Personal safety, safe material handling, and safe machine operation on CNC turning centers. CNC technology basics, Comparison between CNC and conventional lathes.Concepts of positioning accuracy, repeatability. CNC lathe machine elements and their functions - bed, chuck, tailstock, turret, ball screws, guide ways, LM guides, coolant system, hydraulic system, chip conveyor, steady rest, console, spindle motor and drive, axes motors, tail stock, encoders, control switches. Feedback, CNC interpolation, open and close loop control systems. Machining operations and the tool paths in them - stock removal in turning and facing, grooving, face grooving, threading, drilling.
	Concept of Co-ordinate geometry, concept of machine coordinate axis, axes convention on CNC lathes, work zero, machine zero. Converting part diameters and lengths into co-ordinate system points. Absolute and incremental programming. Programming - sequence, formats, different codes and words. ISO G codes and M codes for CNC turning. Describe CNC

	interpolation, open and close loop control systems. Co-ordiante systems and Points. Program execution in different modes line MDI, single block and auto. Canned cycles for stock removal (turning/facing), grooving, threading, for external and internal operations. Tool nose radius compensation (TNRC) and why it is necessary. Find the geometry page in CNC machine. Cutting tool materials, application of various materials. Cutting tool geometry for internal and external turning, grooving.
	threading, face grooving, drilling. Insert holding methods for each. Insert cutting edge geometry. ISO nomenclature for turning tool holders, boring tool holders, Indexable inserts. Cutting parameters-cutting speed, feed rate, depth of cut, constant surface speed, limiting spindle seed. Tool wear, tool life, relative effect of each cutting parameter on tool life. Selection of cutting parameters from a tool manufacturer's catalogue for various operations. Writing part programs as per drawing & checking using CNC program verification/ simulation software. Process planning, work holding, tool and cutting parameters selection according to the part geometry and dimensions. Collisions due to program errors, effects of collisions. Costs associaed with collisions - tool breakage, machine damage, injuries.
	Program execution in different modes like MDI, single block and auto process planning & sequencing, tool layout & selection and cutting parameters selection. Work and tool offsets. Inputs value to the offset/geometry page into machine. Turning in multiple setup, hard and soft jaws, soft jaw boring, use of tailstock and steady rest. Length to diameter (L/D) ratio and deciding work holding based on it. Machine operation modes - jog, MDI, MPG, Edit, Memory. Entering and editing programs on machine console, entering offsets data in offsets page. Use of Emergency stop, Reset, Feed rate override, spindle speed override, edits lock on/off buttons and keys.
	First part checking: Program checking in single block and dry run modes - necessity and method. Tool offsets adjustment on first part for close tolerance dimensions, by over sizing (for outside dimensions) or under sizing (for inside dimensions) the dimension to prevent part

	rejection. Wear offset setting - necessity, relationship with tool wear, entering in offsets page. Process and tool selection related to grooving, drilling, boring and threading. Axes over travel, recovering from over travel. Collisions due to improper machine setup and operation - causes and effects. Recovering from collisions. Find out alarm codes and meaning of those codes.
Set CNC VMC (Vertical machining center) and produce components as per drawing by preparing part program.	Safety aspects related to CNC VMC.CNC technology basics, Comparison between CNC VMC and conventional milling machines. Concepts of positioning accuracy, repeatability. CNC VMC machine elements and their functions - bed, chuck, Auto tool changer (ATC), ball screws, guide ways, LM guides, coolant system, hydraulic system, chip conveyor, rotary table, pallet changer, console, spindle motor and drive, axes motors, encoders, control switches. Feedback, CNC interpolation, open and close loop control systems. Machining operations and the tool paths in them - face milling, side milling, Pocket milling, Drillinjg, Countersinking, Rigid tapping, floating tapping Reaming, Rough boring, Finish boring, spot facing.
	Concept of Co-ordinate geometry & polar coordinate points, concept of machine axis, axes convention on CNC lathes, work zero, machine zero. Converting part dimensions into coordinate system points. Absolute and incremental programming. Programming - sequence, formats, different codes and words. ISO G and M codes for CNC milling. Canned cycles for drilling, peck drilling, reaming, tapping, finish boring. Subprograms. Cutter radius compensation (CRC) and why it is necessary. Cutting tool materials, application of various materials. Cutting tool geometry for face mill, end mill, drill, countersink, tap, finish bore, reamer. Insert holding methods face mill, insert type end mill and insert type drill. Insert cutting edge geometry. Cutting parameters- cutting speed, feed rate, depth of cut. Tool wear, tool life, relative effect of each cutting parameter on tool life. Selection of cutting parameters from a tool manufacturer's catalog for various operations. Writing part programs as per drawing & check using CNC program verification software. Process planning, work holding, tool and cutting parameters selection according to the part geometry and dimensions.

	Collisions due to program errors, effects of collisions. Costs associated with collisions - tool breakage, machine damage, injuries.
	Program execution in different modes like manual, single block and auto. Process planning & sequencing, tool layout & selection and cutting parameters selection. Work offset, tool length offset, tool radius offset. Work holding with temporary holding and fixtures. Truing of part and fixture. Machine operation modes - Jog, MDI, MPG. Edit, Memory. Entering and editing programs on machine console, entering offsets data in offsets page. Use of Emergency stop, Reset, Feed rate override, spindle speed override, edit lock on/off buttons and keys.
	First part checking: Program checking in single block and dry run modes - necessity and method. Tool offsets adjustment on first part for close tolerance dimensions, by oversizing (for outside dimensions) or under sizing (for inside dimensions) the dimension to prevent part rejection. Axes over travel, recovering from over travel. Collisions due to improper machine setup and operation - causes and effects. Recovering from collisions. State the importance of Helical inter-polar and thread milling, advantage and limitation in CNC machine. Tool wear and necessity for wear offsets change, entering wearoffsets in offsets page. Effects of sudden machine stoppage due to power shutdown or use of emergency stop. Restarting machine from sudden stoppage. Means of program transfer through electronic media. Productivity concepts, cycle time, machine down time, causes of down time- breaks, machine breakdown, inspection, part loading and unloading, chip cleaning. Effect of down time on profitability, reducing down time. Machine hour rate, components of machine hour rate - principle repayment, interest, overheads (power, tooling, space, salaries, indirect expenses). Calculation of machining cost, cost of down time.
	Machine productivity concepts - cycle time, down time, cycle time estimation. Costing - machine hour rate, machining cost, tool cost, cost of down time. Importance of Technical English terms used in industry. Technical forms, process sheet, activity log, job card, in industry-standard

	formats.
Plan and perform simple repair, overhauling of different machines and check for functionality.	Lubricating system-types and importance.(09hrs.)
	Maintenance : Definition, types and its necessity.
	System of symbol and colour coding. Possible causes for failure and remedies.(09hrs.)
Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. [Different machining parameters- feed, speed and depth of cut. Different components - end mill, bevel gear, cam, worm & worm wheel].	Calculations for cutting helica slab/ cylindrical cutter. Calculations for cutting End Mill cutter.
	Bevel gear-elements, types, application, calculation for cutting bevel gear.
	cam-types, elements & application, plate cam-manufacturing & calcutaions. Drum cam- its calculation, advantages, types of follower & its purposes.
	Worm wheel-application, elements & calcutaion, Worm-calculation.
	Types of Keys and their uses. Variation - types and causes. Testing of Gear and error.

2. <u>Fitter – 30 Marks</u>	
Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy following safety precautions , [Basic fitting operation – marking, Hacksawing , Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy : ±.25 mm] ±	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft skills, its importance and job area after completion of training. Importance of safety and general precautions observed in the industry/ shop floor. Introduction of First Aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g; power failure, fire and system failure. **Importance of housekeeping & good shop floor practices.** Introduction to5 S concept & its application. **Occupational Safety & Health :** Health, Safety and Environment guidelines, legislations & regulations as applicable.
	Basic understanding on Hot work , confined space work and material handling equipment.
	Linear measurements – its units, dividers, calipers, hermaphrodite, centre punch, dot punch, prick punch their description and uses of different types of hammers. Description use and care of 'V' Blocks, marking off table. Measuring standards (English, Metric Units), angular measurements.
	Bench vice construction, types, uses, care & maintenance , vice clamps , hacksaw frames and blades, specification, description, types andtheir uses, method of using hacksaws. Files – Specifications, description, materials, grades, cuts, file

	elements, uses. Types of files, care and maintenance of files. Measuring standards (English Metric Units), angular measurements.
	Marking off and layout tools, dividers, scribing block, - description, classification, material, care & maintenance . Try square, ordinary depth gauge, protractor- description , uses and cares. Uses , care and maintenance of cold chisels – materials , types, cutting angles.
	Marking media , marking blue, prussian blue, red lead, chalk and their special application, description. Use, care and maintenance of scribing block. Surface plat and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance.
	Physical properties of engineering metal: colour, weight, structure, and conductivity , magnetic, fusibility, specific gravity. Mechanical properties : ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity.
	Power saw, band saw, Circular saw machines used for metal cutting.
	Micrometer – outside and inside –principle, constructional features, parts graduation, reading, use and care. Digital micrometer.
	Vernier calipers, principle, construction, graduation, reading, use and care. Vernier bevel protractor, construction, graduations, reading , use and care, dial Vernier Caliper, Digital Vernier caliper. Vernier height gauge: material construction , parts, graduations (English & Metric) uses, care and maintenance.
	Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine. Determination of tap drill size.
Manufacture simple sheet metal items as per drawing and join them by soldering , brazing and riveting.	Safety precautions to be observed in a sheet metal workshop, sheet and sizes.
	Commercial sizes and various types of metal sheets, coated sheets and their uses per BIS speciafications. Shearing machine – description, parts and uses.
	Marking and measuring tools, wing, campuss, tin man's square tools, snips, types and uses. Tin man's hammers and mallets type-sheet metal tools, types, specifications, uses. Trammel-description, parts, uses. Hand grooves- specifications and uses. Sheet and wire gauge.
	Stakes – bench types, parts, their uses. Various types of metal joints , their selection and application, tolerance for various

	joints, their selection & application. Wired edges.
	Solder and soldering : Introduction- types of solder and flux. Composition of varoius types of solders and their heating media of soldering iron. Method of soldering, Selection and application-joints. Hard solder- Introduction, types and method of brazing.
Join metal components by riveting observing standard procedure.	Various rivets shape and form of heads, importance of correct head size. Rivets –Tin man's rivets types, sizes, and selection for various works. Riveting tools, dolly snaps description and uses. Method of riveting. The spacing of rivets. Flash riveting, use of correct tools, compare hot and cold riveting.
Join metal component by arc welding observing standard procedure.	Safety-importance of safety and general precautions observed in a welding shop. Precautions in electric and gas welding. (Before, during, after) Introduction to safety equipment and their uses. Machines and accessories, welding transformer, welding generators.
Cut and join metal component by gas (oxy-acetylene)	Welding hand tools: Hammers, welding description, types and uses , description, principle, method of operating, carbon dioxide welding. H.P welding equipment: description , principle, method of operating L.P. welding equipment : description , principle, method of operating. Types of Joints- Butt and fillet as per BIS SP: 46- 1988 specifications. Gases and gas cylinder description, kinds, main difference and uses.
	Setting up parameters for ARC welding machines- selection of welding electrodes. Care to be taken in keeping electrode.
	Oxygen acetylene cutting- machine description, parts, uses, method of handling, cutting torch-description, parts, function and uses.
Procedure components by different operations and check accuracy using appropriate measuring instruments. [Different Operations – Druing, Reaming, Taping, Dieing ; Appropriate Measuring Instrument- Vernier, Screw Gauge, Micrometer	Drill- material, types, (Taper shank, straight shank) parts and sizes. Drill angle- cutting angle for different materials, cutting speed feed. R.P.M for different materials. Drill holding devices-materials, construction and their uses.
	Counter sink, counter bore and spot facing- tools and nomenclature, Reamer-material, types (Hand and machine reamer), kinds, parts and their ueses, determining hole size (or reaming), Reaming procedure. Screw thread: terminology, parts, types and their uses. Screw pitch gause: material parts and uses. Taps British standards (B.S.W. & B.S.F., B.A & B.S.P.) and metric / BIS (coarse and fine) material, parts (shank body, flute, cutting edge).
	Tap wrench : material, parts, types(solid & adjustable types) and their uses removal of broken tap, studs (tap stud extractor). Dies: British standards, metric and BIS

	stabdards, material, parts, types, Method of using dies. Die stock : material, parts and uses.
	Drill troubles : causes and remedy. Equality of lips, correct clearance, dead centre, length of lips. Drill kinds: Fraction, metric, letters and numbers, grinding of drill.
	Grinding wheel: Abrasive, grade structures, bond specifications, use, mounting and dressing. Selection of grinding wheels. Bench grinders parts and use.
	Radius/ fillet gauge, feeler gauge, hole gauge, and their uses, care and maintenance.
Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functinality.	Interchange ability : Necessity in Engg, field definition, BIS. Definition, types of limit, terminology of limits and fits- basic size, actual size, deviation, high and low limit, zero line, tolerance zone. Different standard systems of fits and limits. British standard system, BIS system.
[Different Fit- Sliding, Angular, Step fit, 'T' fit, Square fit and profile fit; Required tolerance: ± 0.04 mm, Angular tolerance : 30 min.]	Method of expressing tolerance as per BIS Fits: Definition, types, description of each with sketch. Vernier height gauge : material construction, parts, graduations (English & Metric) uses, care and maintenance.
	Pig Iron : types of pig Iron, properties and uses. Cast Iron : types, properties and uses wrought iron : - properties and uses . Steel: Plain carbon steels, types, properties and uses. Non- ferrous metals (copper, aluminium , tin, lead, zinc) properties and uses.
	Simple scraper – flat, half round , triangular and hook scraper and their uses. Blue matching of scraped surfaces (flat and curved bearing surfaces). Testing scraped surfaces: ordinary surfaces whithout a master plate.
	Vernier micrometer, material, parts, graduation, use, care and maintenance. Calibration of measuring instruments. Introduction to mechanical fasteners and its uses. Screw thread micrometer: Construction, graduation and use.
	Dial test indicator, construction, parts, material, graduation, Method of use, care and maintenance. Digital dial indicator. Comparators- measurement of quality in the cylinder bores.
Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations – facing, plain turning, step turning, parting,chamfering,	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. Holding of job between centres, works with catch plate, dog, simple description of a facing and roughing tool and their applications.
	Lathe cutting tools- Nomenclature of single point & multipoint

shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]	cutting tools, Tools selection based on different requirements and nesessity of correct grinding, solid and comparison for H.S.S. , carbide tools. Use of coolants and lubricants.
	Chucks and chucking the independent four- jaw chuck. Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting, chucks, chucking true, face plate, drilling – method of holding drills in the tail stock, Boring tools and enlargement of holes.
	General turning operations –parallel or straight, turning. Stepped turning, grooving, and 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, speed, feed calculation. Taper- definition, use and method of expressing tapers. Standard tapers- taper, calculations Morse taper.
	Screw thread definition- uses and application. Square, worm, buttress, acme (nonstandard-srew threads), Principle of cutting screw
	Thread in centre lathe- principle of chasing the screw thread of centre gauge, setting tool for cutting internal and external threads, use of screw pitch gauge for checking the screw thread.
Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]	Maintenance -Total productive maintenance -Autonomous maintenance -Routine maintenance -Maintenance schedule -Retrieval of data from machine manuals Preventive maintenance, section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding. Revision, simple estimation of materials, use of handbooks and reference table. Possible causes for assembly failures and remedies. Installation, maintenance and overhaul of machinery and engineering equipment.
	Assembling techniques such as aligning , bending, fixing, mechanical jointing , threaded jointing, sealing, and torqueing. Dowel pins : material,construction, types, accuracy and uses.
Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality.	Screw : material, designation, specifications, property classes (e.g. 9.8 on screw head), Tools for tightening/loosening of screw or bolts, Torque wrench, screw joint calculation uses. Power tools: its constructional features, uses & maintenance.
	Locking device: Nuts- types (lock nut castle nut, slotted nuts, swam nut, grooved nut) Description and use. Various types of keys, allowable clearances & tapers, types, uses

	of key pullers.
	Special files: types (pillar, Dread naught, Barrow, warding description & their uses.

	Templates and gauges-Introduction, necessity, types. Limit gauge: Ring gauge, snap gauge, plug gauge, description and uses. Description and uses of gauge-types (feeler, screw, pitch, radius, wire gauge).
	Slip gauge: Necessity of using, classification & accuracy, set of blocks (English and Metric). Details of slip gauge. Metric sets 46:103:112. Wringing and building up of slip gauge and care and maintenance.
	Application of slip gauges for measuring, Sine Bar-Principle, application & specification. Procedure to check adherence to specification and quality standards.
	Lapping: Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface inish importance, equipment for testing- terms relation to surface finish. Equipment for tasting surfaces quality – dimensional tolerances of surface finish.
	Honing: Application of honing, material for honing, tools shapes, grades, honing abrasives. Frosting- its aim and the methods of performance.
	Metallurgical and metal working processes such as Heat treatment, various heat treatment methods – normalizing, annealing, hardening and tempering, purpose of each method, tempering colour chart.
	Annealing and normalizing, Case hardening and carburising and its methods, process of carburising (solid, liquid and gas).
	Tapers on keys and cotters permissible by various standards.
	The various coatings used to protect metals, protection coat by heat and electrical deposite treatments. Treatments to provide a pleasing finish such as chromium silver plating, nickel plating and galvanizing.
Make different gauges by using standards tools & equipment and checks for specified accuracy.[Different Gauges) – Snap gauge, Gap gause; Specified Accuray - ±0.02mm]	Gauges and types of gauge commonly used in gauging finished product -Method of selective assembly 'Go' system of gauges, hole plug basis of standardization.
	Bearing – Introduction, classification (Journal and Thrust), Description of each, ball bearing : Single row, double row, description of each, and advantages of double row.
	Roller and needle bearing : Types of roller bearing. Description & use of each. Method of fotting ball and roller bearings.
	Bearing metals – types, composition and uses.

	Synthetic materials for bearing: The plastic laminate materials, their properties and uses in bearings such as phenolic, Teflon polyamide (nylon).
	The importance of keeping the work free from rust and corrosion.
Apply arange of skills to execute pipe joints, dismantal and assemble valves & fittings with pipes and test for leakages. [Range of skills- Cutting, Threading, Flaring, Bending and Joining]	Pipes and pipe fitting – commonly used pipes. Pipe schedule and standard sizes, Pipe bending methods. Use of bending fixture, pipe threads – Std. Pipe threads Die and Tap, pipe vices.
	Use of tools such as pipe cutters, pipe wrenches, pipe dies, and tap, pipe bending mechine etc.
	Standard pipefitting- Methods of fitting or replacing the above fitting, repairs and erection on rainwater drainange pipes and household taps and pipe work. Inspection & Quality control -Basic SPC -Visual Inspection.
Make drill jig & produce components on drill machine by using jigs and check for correctness.	Drilling jig- constructional features, types and uses. Fixtures-Constructional features, types and uses.
Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]	Aluminum and its alloys, Uses, advantages and disadvantages, weight and strength as compared with steel. Non-ferrous metals such as brass, phosphor bronze, gunmetal, copper, aluminum etc. Their composition and purposes, where and why used, advantages for specific purposes, surface wearing properties of bronze and brass.
	Power transmission elements. The object of belts, their sizes and specifications, materials of which the belts are made, selection of the type of belts with the consideration of weather, load and tension methods of joining leather belts.
	Vee belts and their advantages and disadvantages, use of commercial belts, dressing and resin creep and slipping, calculation. Power transmissions-coupling types-flange coupling, -Hooks coupling-universal coupling and their different uses. Pulleys-types-solid, split and 'V' belt pulleys, standard calculation for determining size crowning of faces-loose and fast pulleys-jockey pulley. Types of drives-open and cross belt drives. The geometrical explanation of the belt drivers at an angle.
	Power transmission – by gears, most common form spur gear, set

	names of some essential parts of the set-The pitch circles, Diametral pitch, velocity ratio of a gear set.
	Helical gear, herring bone gears, bevel gearing, spiral bevel gearing, pinion and rack, worm gearing, velocity ratio of worm gearing. Repair of gear teeth by building up and dovetail method.
	Method or fixing geared wheels for various purpose drives. General cause of the wear and tear of the toothed wheels and their remedies, method of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required derive. Care and maintenance of gears.
	Fluid power, Pneumatics, Hydraulics, and their comparison, Overview of a pneumatic system, Boyle's law. Overview of an industrial hydraulic system, Applications, Pascal's Law. (0.9 hrs.)
Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different Components- Compressor, Pressure Gauge, Filter Regulator Lubricator,	Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, Conductors and fitting, FRL unit, Applications of pneumatics, Hazards & safety pneumatic systems.
Valves and Actuators.]	Pneumatic actuators: - Types, Basic operation, Force, Stroke length, Single-acting and double-acting cylinders.
Construct circuit of pneumatics and hydraulics observing standard operating procedure & safety aspect.	Pneumatic valves: - Classification, Symbols of pneumatic components,3/2- way valves (NO & NC types) (manually actuated& pneumatically actuated) & 5/2- way valves, Check valves, Flow control valves, one-way flow control valve Pneumatic valves: Roller valve, Shuttle valve, Two- pressure valve Electro-pneumatics: Introduction, 3/2-way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components Pushbuttons (NO & NC type) and Electromagnetic relay unit, Logic controls.
Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different Components- Compressor, pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]	Symbols of hydraulic components, hydraulic oils-function, properties, and types, Contamination in oils and it control -hydraulic Filters – types, constructional features, and their typical installation locations, cavitation, Hazards &safety precautions in hydraulic systems -hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/piston types, Pressure relief valves- Direct acting and pilot- operated types - Pipes, tubing, Hoses and fittings – constructional details, Minimum bend radius, routing tips for hoses.
Construct circuit of pneumatics and hydraulics observing standard operating procedure & safety aspect.	Hydraulic cylinders – Types - Hydraulic motors- Types - Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves

	- Hydraulic valves: 4/2- and 4/3-way valves, Centre positions of 4/3-way valves - Hydraulic valves: Check valves and Pilot-operated check valves, Load holding function Flow control valves: Types,
	Speed control methods – meter-in and meter-out - Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitation, and proper sampling of hydraulic oils.
Plan & perform basic day-to-day preventive maintenance, repairing and check functionality. [Simple Machines – Drill Machine, Power Saw and Lathe]	Importance of Technical English terms used in industry – (in simple definition only) Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards.
	Method of lubrication-gravity feed, force (pressure) feed, splash lubrication. Cutting lubricants and coolants: Soluble off soaps, suds- paraffin, soda water, common lubricating oils and their commercial names, selection of lubricants. Clutch: Type, positive clutch (straight tooth type, angular tooth type). Washers- Types and calculation of washer sizes. The making of joints and fitting packing. Chains, wire ropes and clutches for power transmission. Their types and brief description.
Plan erect simple machine and test machine tool accuracy. [Simple Machines – Drill Machine, Power Saw and Lathe]	Lubrication and lubricants- purpose of using different types, description and uses of each type. Method of lubrication. A good lubricant, viscosity of the lubricant, Main property of lubricant. How a film of oil is formed in journal Bearings.
	Foundation bolt: types (Lewis cotter bolt) description of each erection tools, pulley block, crowbar, spirit level, Plumb bob, wire rope, manila rope, wooden block. The use of lifting appliances, extractor presses and their use. Practical method of obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts.
3. <u>Mathematic (Matriculation Level, BSEB) – 20 Marks</u>	
4. <u>General Knowledge – 20 Marks</u>	