MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51

1	Name of Course	**Certificate Course in Chemical (307202)**
2	Max. Nos. of Student	25 Students
3	Duration	1 Year
4	Type	Full Time
5	Nos. of Days / Week	6 Days
6	Nos. of Hours /Days	7 Hrs
7	Space Required	Theory Class Room – 200 sqft Practical – 1500 sqft
8	Entry Qualification	S.S.C. Passed
9	Objective Of Syllabus/ introduction	1) Awareness of Safety precautions 2) Knowledge of Engineering skill, use of tools in assembly 3) Awareness of Electronics & Computer Skill. 4) Awareness of Basic Mechanical Process & Instrumentation. 5) Awareness of Fundamental of General Chemistry & physics. 6) Awareness of Basic Unit Operation & Process.
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which maintain and repair Chemical plant or with working experience will be in a position to start his own independent Business.
11	Teacher's Qualification	1. Diploma in Chemical Engg. With 3 year Teaching experience in Chemical. 2. Diploma or Degree in Chemical Engineering or equivalent profession Qualification. With 1 year Teaching experience in Chemical.
12	Training System	**Training System Per Week**

Theory	Practical	Total
18 Hours	24 Hours	42 Hours

13 Exam. System

Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks
1	**30720211**	Basic Engineering, Electronics & Computer Skill.	TH-I	3 hrs	100	35
2	**30720212**	Basic Mechanical & Instrumentation.	TH-II	3 hrs	100	35
3	**30720213**	Fundamental of General Chemistry, physics & Operation Process.	TH-III	3 hrs	100	35
4	**30720221**	Basic Engineering, Electronics & Computer Skill.	PR-I	3 hrs	100	50
5	**30720222**	Basic Mechanical & Instrumentation.	PR-II	3 hrs	100	50
6	**30720223**	Fundamental of General Chemistry, physics & Operation Process.	PR-III	3 hrs	100	50
		Total			600	255

SYLLABUS

Theory & Practical - I

Fundamentals of Electronics and Computer

Theory	Practical
Atomic theory, Introduction to Semiconductor devices, semiconductor material	Study the characteristics of conductor, semiconductor & insulator. Identify and testing of different types of active and passive components.
LED, LCD,ZENER diode, SCR,DIAC application, uses and care	Making of DC power supply, smooth & regulated output voltage.
Bipolar Transistor- PNP,NPN classification, biasing, coupling FET,UJT,MOSFET	Study & test the Transistor Study & test the UJT, FET, MOSFET
Binary & Hexadecimal Systems Logic gates, Circuits, Truth Tables	Experiments on Logic Gates : AND, NAND,OR, NOR, XNOR using Digital IC-Trainer, preparation of truth table
Introduction to different types of Integrated Circuits and Microprocessor, ALU, Memory, CPU,ROM,, RAM, EPROM etc.	Study of different ICs , Combinational & sequential circuit, Conversion of Analog to Digital, Digital to Analog .
Fundamental of computers ■definition of computers ■advantage and disadvantageof computer ■history of computer ■different parts of computer ■hardware and software ■languages of computers	Start and shutdown of computer Typing tutor
Microsoft Office XP Microsoft Word Microsoft Excel Microsoft PowerPoint	Microsoft Word ❖Drafting Letters ❖Formatting Letters ❖Spelling Check ❖Page Setup ❖Table creation Microsoft Excel Microsoft PowerPoint

Sl. No.	Items	Qty. Required
1.	**Computer System**	
a.	Pentium IV Computer or latest (Server), 2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 15" Monitor, optical scroll mouse, multimedia key board, 32 bit LAN card with UPP port, necessary Drivers,	1 No.
b.	Pentium IV Computer or latest (Client- windows XP or higher) 2.8 GHz, 512 MBRAM, 40/80 GB HDD, DVD Combo Drive, 15"/17" Monitor, optical scroll mouse, multimedia key board, LAN card, necessary Drivers & Antivirus software	8 Nos.
c.	Networking: Above Computer Systems connected in LAN	—
d.	Broad Band Internet Connection, minimum speed 256 Kbps	—
e.	Software latest MS Office Window (under the OS platform for clients)	8 Nos.
f.	All related software	As required
2.	UPS 500 VA 0r Centralised UPS with 5 KVA Capacity	9 Nos. or 1 No.
3.	Desk Top Laser printer (B&W)	2 No.
4.	Ink jet printer	1 No.
5.	Dot Matrix Printer	1 No.
6.	Scanner	1 No.
7.	LCD Projector with screen	1 No.
8.	Overhead Projector with screen	1 No.
9	Allen Key set of 12 pieces (2mm -14 mm)	1 set
10.	Philips screw driver Typeset of 5 pieces (100 mm to 300mm)	04 sets
11.	1.44 MB Floppy	As required
12.	CD (Rewritable)	As required
13	Basic Electronics trainer	4 Nos.
14	Analog Trainer Kit	4 Nos.
15	Digital Trainer Kit	4 Nos.
16	Power Supply 0-30 V , 0-500mA , Variable	2 Nos.

Theory & Practical - II

Part - A

Basic Mechanical

Theory	Practical
Shop safety. Lathe -its construction, cleaning and oiling. Independent chucks different types and construction, uses.	Introduction, types of work done in the section. Lathe -its parts and functions check it for proper running, cleaning and oiling of various parts .holding job in four jaw chuck & turning.
Common lathe cutting tools roughing and finishing tool, Different types as like V-tool side cutting tool, boring tool etc. Knurling tool.	Grinding rough turning tool. Setting tools in tool post facing operation, thus making the job to specified length and centre drilling.
Lathe, accessories, such as centre mandrel, catch plate and dog face plate, lathe steady etc. construction and use. Common lathe cutting tools roughing and finishing tool, knife tool, recessing tool etc. lathe tool material.	Plain turning by holding job in the chuck. turning to specified diameter, Step turning, grinding of finishing tool.
Tapers and its purpose, standard tapers, different methods of taper turning. Taper calculations. Calculations of gear train for thread cutting. Knurling tool- types and uses advantage and disadvantage of offset method	Taper turning by swiveling compound rest. Taper turning by off setting tailstock. Knurling practice-drilling practice boring practice. Thread cutting (metric)
Types of works done in welding i.e. fabrication, structural and repair. Safety precautions comprising shop safety, equipment safety, personal and general safety.	Assembly of oxy-acetylene plant and arc welding Lighting and adjustment of oxy-acetylene flame.
Welding rods and equipments, handling, care and specifications. Welding methods and techniques Common gases used in welding.	Fusion run with and without rod. Square butt joint, corner joint on ms sheet by gas welding. Pipe joints, butt and T joints
Metal joining processes, mechanical and thermal nut bolts riveting joining welding bracing and soldering. Types of joints - arc welding accessories, machines uses. Types of weld; Weld symbols; applications.	Arc striking and bidding on ms plate. Square butt joint, centre joint on ms plate -6mm and 8 mm thick. Pipe joints, butt and T joints.

Part – B

Basic of Instrumentation

Theory	Practical
Introduction of instrumentation Definition of pressure, gauge, atmosphere, absolute, Units of pressure, Conversion of units.	To study the working construction and principle of pressure gauge C-type bourdon tube pressure gauge, spiral type, helical type. Capsule type pressure gauge
Introduction of instrumentation Definition of pressure, gauge, atmosphere, absolute, Units of pressure, Conversion of units.	Bellow type pressure gauge and diaphragm type Take reading practice of all types of manometers and capsule type gauges.
To classify the different type of temperature measuring instruments To study the working construction and principle of bimetallic thermometer	Take reading , practice of bimetallic thermometer Measuring in glass thermometer, thermocouples PT-100.
To study the working construction and principle of glass thermometer Mercury in glass thermometers Gas filled thermometer To study about RTD & thermocouple	Mercury in gas filled thermometer RTD Thermocouple
To study the classification of flow measuring instruments To study working , construction and principle of different type of flow measuring instruments	Take reading practice of Orifice meter , Venturimeter
Briefly study about . •Orifice meter •Venturimeter •Rota meter •Pitot tube •Quantity meter •V-notch •Turbine type, magnetic type, vertex flow meter and annular flow meter	Take reading practice of Rota meter, Pitot tube and magnetic flow meter.
To study classification of level measuring instruments To study working construction of different types of level measuring instruments	Take reading practice of different types of level measuring instruments
Briefly study about hydrometer Briefly study about pH meter To study the Anemometer.(velocity Measurement) To study the Hygrometer. (Humidity Measurement)	Take reading practice of hydrometers Take reading practice of pH meter Take reading practice of hygrometer.

List of Tools

Sr.No.	Name of Tools	Qty Req.
1	Caliper out side spring 6 "/15 cm.	10
2	Caliper inside spring 6 "/15 cm	10
3	Dividers spring 6 "/15 cm	10
4	Center punch 4"/10cm.	10
5	Prick punch 6 "/15 cm	10
6	Chisel cold flat 1"/2.5cm	10
7	Chisel cross cut 3/8" X 1/8	10
8	Chisel diamond point 3/8"10mm.	10
9	Chisel half round 3/8"/10mm	10
10	Hammer ball pain 1lb handled	10
11	Hammer ball pain % lb handled	10
12	Hacksaw frame adjustable with pistol grip For 8"-12"blade/20cm-30cm.	10
13	Rule steel 12"English &metric/30cm	
14	Screw driver 3"x3/8"blade	10
15	Screw driver 12"x1/2 blade	10
16	Square engineers 6"blade/15cm	10
17	Scriber	10
18	Safety goggles.	10
19	Hand gloves pair chrome leather 16"	10
20	Apron leather 36" x 24" with belt	10
21	Hand screen fibre glass with filter glass	10
22	Head screen fibre glass with flexible band and filter glass	10
23	Welding goggles with filter glass for 4A or 6A dia, 50mm x 3mm thick	10
24	Chipping hammer	10
25	Chisel cold flat 19mm	10
26	Centre punch 150mm x 8mm	10
27	Divider 20 cm. long	10
28	Steel rule 12"	10
29	Wire brush steel	10
30	Spark lighter	10
31	Safety boots	10 pairs
32	Flat tongs 16"	10
33	Hammer ball pein 2 lbs 350 mm long handle	10
34	Hexa frame adjustable 30 cms.	10
35	Flat file 14" bastard	10
36	Tip cleaner	10

List of Tools -

List of tools , Equipment & Machines
Hammer ball pein 1lb handled
Hammer ball pein % lb handled
Hacksaw frame adjustable with pistol grip For 8"-12"blade/20cm-30cm
Rule steel 12"English &metric/30cm
Screw driver 3"x3/8"blade
Screw driver 12"x1/2 blade
Tweezer
Safety goggles.
Tube cutter
Flearing tool kit
Magnifying glass
Pointer puller and pointer fixer
Watch meter screw driver set
Needle file set
Soldering iron 25 watts.
Soldering iron 10 watts.
Multimeter digital
Pressure regulating valve
BP indicator
Pressure indicator digital

Theory & Practical – III

Part - A

Fundamentals of General Chemistry And Physics

Theory	Practical
Units & dimensions Force Friction Acceleration.	To study triangular and parallelogram of force with the help of mechanical board. Determination of coefficient of static friction using inclined plane.
Velocity & speed Density & specific gravity Viscosity, surface tension, time, energy, power, mass, volume, temp, pressure	Determination of mechanical advantage velocity ratio and % efficiency of simple machine. Determination of acceleration due to gravity by simple pendulum.
Stress & Strain Heat, conduction, convection, radiation, light, motion, heat transfer equipments. Optical activity Specific rotation Polarimeter.	Determination of Young's modulus by Searle's apparatus. Determination of coefficient of expansion of solid and liquid. Determination of coefficient of thermal conductivity of metal rod. Determination of specific rotation of optically active substance by a polarimeter.
Electricity Work simple machine, power & energy Electro chemistry Electrolysis To study the relation between currents, voltage, resistance. Electricity by chemical cell (lead) /accumulator. Introduction to transformer, capacitor ampere meter , volt meter , fuse , voltage stabilizer	To study Ohm's law and Kirchoff's law about current and voltage. To study electric cell using series and parallel connections. Determination of specific resistance using wheat stone's bridge. Verification of Faraday's First Law of electrolysis. Determination of mechanical equivalent of heat using electrical method
-> Introduction to chemistry -> Safety precautions to be taken in chemical lab & plant. -> Acid , base and salt -> Element , Atom and Molecule -> Molecular wt. , equivalent wt. and atomic wt. Normality, Molarity, Molality. -> Volumetric analysis -> Different equipments & Apparatus used in lab. -> Periodic tables & it's detail study IUPAC nomenclature. General chemistry of alkane, alkene and	Volumetric analysis -> Acidimetric titration ->Alkalimetric titration ->Redox titration -> Precipitation titration. Iodometric titration Complexo metric titration
* Extraction of Metal & Non-Metal -> Introduction of inorganic chemical: NaoH, silica, glass... -> Corrosion & erosion -> Fertilizer -> Dies intermediate -> Bulk drugs -> Insecticides -> Cement industry -> Pulp & paper industry -> Glass industry -> Common effluent treatment plant (CETP)	[A] Preparation of Chemicals -> To study the allotropic forms of sulphur. -> To study the properties of mixture (Fe+ S) and Compound (FeS) -> Preparation of aniline-> Preparation of copper sulphate -> To study Action of pure and salt water on metals and alloys -> To study action of acids and base on metals alloys

Part - B

Basic of Unit Operations and Processes

Theory	Practical
Introduction of unit operations & unit processes. Transportation of fluid Plant Utility: Steam, cooling water, chilled water, brine, instrument air, Nitrogen, vacuum, etc... Introduction of Boiler, cooling tower, chilling plant, compressor, ejector.	**Introduction** Pipe fitting like as Elbow 'T', Cross, Bend, Union, Coupling, Nipples etc. Flange fittings. Flexible hosepipe fittings. Instrument airline tube fittings: banding, brazing etc.. Gasket cutting
Types of pipes and tubes Types of gasket sheet , their properties and uses Flow of fluid Principle construction , working and uses of Venturimeter , Orifice meter , Rota meter etc.	Flow measurement by different instruments as like Venturimeter , Orifice meter , Rota meter ,V-notch etc
Construction and working of gate valve , Globe valve, Check valve, Ball valve, Butterfly valve etc. Various insulating materials Fertilizers : Different types , Manufacturing process of Urea with raw material chemical reaction , process flow diagram , description & uses	Study of different types of flow controlling devices like as check valve , Needle valve , Diaphragm valve, Ball valve, Stop cock, Butterfly valve etc. Its structure and overhauling Study of lagging material such as glass wood , thermo Cole etc.
Construction and working of centrifugal pump Reciprocating pump Rotary pump Extraction, leaching, absorption , adsorption and their industrial application. Introduction to different unit operations: Mechanical operation, Heat transfer, Mass transfer.	Characteristic curve of centrifugal pump Study of head Vs capacity curve of a gear pump
Distillation: - Definition stripping, rectification, reflux ratio. Types of distillation Distillation of Petroleum products Evaporation :- Definition steam economy types of evaporators Filtration: - Types of filters. Filter aids, Types of filter media.	Operation of packed distillation column Operation of a multiple effect evaporator Operation of plate and frame filter press
Introduction to unit process. Manufacturing of soap and glycerin with flow sheets, its uses , chemical reaction	Introduction Laboratory preparation 1) Oil and Soap 2) Nitro Benzene 3) Aspirin
Manufacturing process of Nitric Acid by Oswald process with flow sheets , chemical reactions , process description and uses	

List of Equipments

Sr.No.	Name of Equipments	Req Qty.
1	Mechanical board for testing triangle and parallelogram of forces including all accessories	6
2	Instrument for determining 'G' (simple pendulum)	2
3	Searle's apparatus for young's modulus	2
4	Apparatus of measurement of co-efficient of expansion of solid & liquid	2
5	Equipment to study Kirchof's law	1
6	Resistance box Rheostat 25 ohms	2
7	Resistance box 0 -100 ohms	2
8	Resistance box 0 -500 ohms	2
9	Wheaston's bridge	2
10	Potentio meter accuracy not < 0.01%	2
11	Resistance centre 0 galvanometer	4
12	Ameters with stands : 0 - 1 Amp (DC)	2
13	Ameters with stands : 0 - 3 Amp (DC)	2
14	Ampere meter : 0 - 10 Amp (AC / DC)	2
15	Ampere meter : 0 - 30 Amp (AC / DC)	2
16	Volt meter with stands 0 - 1 volt (DC)	2
17	Volt meter with stands 0 - 3 volt (DC)	2
18	Volt meter 0 - 5 volt (DC)	2
19	Volt meter 0 - 10 volt (DC)	2
20	Volt meter with stands 0 - 50 volt (DC)	2
21	Volt meter with stands 0 - 250 volt (AC / DC)	2
22	Volt meter 0 - 5 MV	2
23	Volt meter 0 - 500 MV	2
24	Resistance coils (2 ohm , 1 ohm & 5 ohm)	2
25	Charger for battery Accumulator	1
26	Battery eliminator	2
27	Spoons Plastics	24
28	Each inch clamps spring or screw	24
29	Bunsen burners	32
30	Tripods Stand	32
31	Asbestos wire gauge	32
32	gauge wire without asbestos	32
33	Clamp holders	48
34	Clamps for burret holding	48
35	Stands with clamps for burret	24
36	Triangles clay	48
37	Burettes 25 ml	24
38	Burettes 50 ml	12
39	Burettes 100 ml	6
40	Pipettes10 ml	48
41	Pippetes 25 ml	48
42	H.D.P Distill water bottle	32

43	Measuring cylinder 25 ml plastic	10
44	Measuring cylinder 50 ml plastic	10
45	Measuring cylinder 100 ml plastic	10
46	Measuring cylinder 250 ml plastic	10
47	Measuring cylinder 500 ml plastic	10
48	Measuring cylinder 1000 ml plastic	10
49	Volumetric flask 100 ml	32
50	Volumetric flask 250 ml	10
51	Volumetric flask 500 ml	10
52	Volumetric flask 1000 ml	08
53	Weighing bottles polyethylene or glass 50 ml	10
54	Weighing bottles polyethylene or glass 100 ml	10
55	Funnels with regular and long stem dia 7 cms	10
56	Funnels dia 4 cms	10
57	Funnels dia 9 cms	10
58	Beaker 250 mls corning	10
59	Beaker 400 mls corning	10
60	Beaker 600 mls corning	10
61	Bottles for solutions 1000 ml	12
62	Bottles for solutions 2000 ml	12
63	Bottles for solutions 3000 ml	6
64	Bottles for solutions 5000 ml	5
65	Instructor Table	1
66	Instructor chair	1
67	White Board with Marker	1
68	Vol. flask-50	10
69	Weighing digital balance 0.1 mgm-100 gm	1
70	Weighing digital balance 1.0 mgm-100 gm	1
71	Air oven (250°C)	1
72	Refrigerator (250lit)	1
73	Weighting balance digital 1-1000 gm.	1
74	Hot plate round 10" dia	3
75	Hot plate 12" x 24"	2
76	Conical flask - 150ml cap.	32
77	Conical flask - 250 ml cap.	10
78	Iodine flask - 250 ml	10
79	China dish - 50 ml.	32
80	Watch glass - 3" dia	32
81	Glass rod - 8" ml	10
82	Tong	10
83	Spatula - 6"	10
84	Spatula - 8"	10
85	Centrifuse	1
86	CO_2 fire extinguisher	1
87	First aid box	1

List of Tools & Equipments

Sr.No.	Name of Tools	Qty Req.
1	Hammer ball pain 1lb handled	10
2	Hammer ball pain % lb handled	10
3	Hacksaw frame adjustable with pistol grip For 8"-12"blade/20cm-30cm.	10
4	Rule steel 12"English &metric/30cm	10
5	Screw driver 3"x3/8"blade	10
6	Screw driver 12"x1/2 blade	10
7	Safety goggles.	10
Shop Outfits		
SR	**Name of Equipments**	**Req.Qty**
1	R.P.M. indicator	1
2	Gate valve dia 4"	2
3	Globe valve dia 4".	2
4	Dia phragm valves- dia 4".	2
5	Ball valves-dia 4"	2
6	Stop cock- dia 4"	2
7	Butterfly valves - dia 4"	2
8	Needle valve- dia 4"	2
9	Reduction gear box.	
10	C.F pump	
11	Gear pump	
12	Plunger pump	
13	Reciprocating pump.	
14	Lobe pump	
15	Instructor Table	
16	Instructor chair	
17	Black board	
18	Various type of Flow meter test rig (Venturimeter , orificemeter , rotometer, V-notch)	
19	Packed distillation column	
20	Multiple/ triple effect Evaporator	
21	Plate and Frame fillter	
22	Air Compressor/ blower for fitter press	
23	All types of pipe fitting	2 set
24	Digital/ Dial stop watch	2 No.
25	Centrifugal pump test rig	1 set
26	Gear pump test rig	1 set
27	Tool kit/ Box	1 No.
28	Over head projector	1 No.
29	White board/ Screen for OHP	1 No.