

**Upgradation of ITIs into Centres of Excellence-**  
**Broad guidelines for implementation of Advanced Modules of Sector**  
**“Chemical”.**

These Centres will be providing multiskill training to meet the skill requirement of particular sector of industry with their active involvement in all aspects of training. The training will be provided in three parts as given below:

- ◆ Training in Basic skill areas for a period of one year.
- ◆ Training in Advanced modules of six months duration after Broad based basic Training(BBBT)
- ◆ Testing & Certification both for the Broad Based Basic Training & Advanced Module Training during subsequent six months will be conducted under the aegis of NCVT .
- ◆ Training in specialized modules mainly by the industry (The course curricula, duration etc will be designed in consultations with the IMC/local industry). The trade testing & certification for specialized module will be done jointly by the State Government & Industry. Said certificate will have recognition from NCVT
- ◆ As per the recommendations of the EFC, Training in the shop floor should constitute atleast 25-40% of the curriculum.

The training programme will have multi-entry and multi-exit provisions as given below:

- trainee can opt to go to the labour market after completing broad based basic training of one year duration or after completing advanced module/s.
- multi-entry and multi-exit provisions would enable a trainee to take admission for advanced/ additional advanced /specialized module as per his/her need .

**Guidelines for Training in Advanced modules**

- ◆ A minimum of three modules would be essentially needed , so as to ensure that all the 96 trainees are accommodated in the three modules may be selected in consultation with IMC for which in two shifts .
- ◆ If it is felt that available modules for which the course curricula has been developed at National Level are not sufficient to cater to the needs of local industry in a particular state, States are free to select module as per need in consultation with industry . They may develop suitable module(s) accordingly in consultations with the industry clearly indicating tool & equipment list , instructor qualifications , space norms etc. & forward the same to DGE&T for seeking approval of NCVT.
- ◆ A trainee at a time can opt only for one Advanced Module .
- ◆ **Admission Criteria, Space requirement, Qualification of instructor of the various modules of “Chemical ” sector are attached herewith.**

Admission to Advanced Module for the graduates of ITI in related trades:

**There is a provision for lateral entry for graduates of ITIs (NTC /NAC passed outs from conventional system ) of the related trades subject to availability of seats in Advanced Module. Trades of conventional system mentioned against each advanced module in the enclosed statement, could be offered admission in Advanced Module .**

MODULE NO.	NAME OF THE MODULE	Admission criteria	Min Space requirement	Duration In Weeks	Qualification/ Status Of Instructor
CHAT-01	Attendant Operator	Completed BBBT in Sector Chemical OR NTC/NAC in AOCP trade OR Diploma in Chemical Engineering/.	150 sq m	24 weeks	Degree in Chemical Engineering with minimum two years teaching/industrial experience in the relevant field  OR  Diploma in Chemical Engineering with min four years teaching/industrial experience in the relevant field
CHAT-02	Maintenance Mechanic	Completed BBBT in Sector Chemical OR NTC/NAC in MMCP trade OR Diploma MECH / Production Engineering .			
CHAT-03	<u>Instrument Mechanic</u>	Completed BBBT in Sector Chemical OR NTC/NAC in IMCP trade OR Diploma in Instrument Engineering .			
CHAT-04	Lab Assistant	Completed BBBT in Sector Chemical OR NTC/NAC in AOCP trade OR Diploma in Chemical Engineering ./ BSc Chemistry			

UPGRADATION OF ITI'S INTO CENTRES OF EXCELLENCE (COE)SECTOR/ AREA- CHEMICALADVANCED MODULES IN II YEAR(FOR THE FIRST 6 MONTH OF II YEAR)

MODULE NO.	NAME OF MODULE	DURATION IN WEEK
CHAT- 01	ATTENDANT OPERATOR	24 WEEK
CHAT- 02	MAINTAINANCE MECHANIC	24 WEEK
CHAT- 03	INSTRUMENT MECHANIC	24 WEEK
CHAT- 04	LAB ASSITANT	24 WEEK

## UPGRADATION OF ITIs INTO CENTERS OF EXCELLENCE (CoE)

SECTOR / AREA : **CHEMICAL GROUP**

**ADVANCE MODULE IN II YEAR**

**CHAT-01 : ATTENDANT OPERATOR**

(Duration – 24 weeks)

<u>WEEK NO &amp; UNITS</u>	<u>PRACTICAL</u>	<u>THEORY</u>
<u>UNIT OPERATION:</u>		
<u>1.Flow of Fluids</u>	<p>To determine Reynolds no. at different velocities.</p> <p>Determine frictional losses in a straight pipe, pipe fitting, valves</p> <p>Study of head vs capacity curve for pumps</p>	<p>Mechanism of Fluid Flow, nature of fluid, Reynolds number, Bernoulli's Theorem, losses due to friction, contraction, enlargement and fitting, various meters for fluid flow, control of flow and its use. Transportation of fluids. Classification, Principle and function of pumps, blower fan compressors and conveyor elevators, pneumatic transportation – Pressure and vacuum, Different types of valves and pipe fittings</p>
<u>2.Heat transfer</u>	<p>Calculate overall heat transfer coe. For a shell &amp; tube heat exchanger.</p>	<p>Mechanism of Heat Transfer in solid, liquid and gases and their application in industries</p> <p>Different types of transfer equipment-Heat exchangers, coolers, condenser and chillers</p> <p>Different types of boiler, steam traps, Reboilers, heaters, vaporizers, Funnels Kilns</p> <p>Fouling of heat transfer surfaces-maintenance of heat exchange equipment,</p>
<u>3.Evaporation</u>	<p>To find rate of evaporation for vertical tube evaporator.</p>	<p>. Capacity, steam economy of evaporators</p> <p>Surface and contact condensers, barometric condensers, Vacuum Producing devices-Steam jet ejectors, Vacuum pumps, Multi effect evaporation and methods of feeding Vapor recompression</p>

<p><u>4. Distillation</u></p>	<p>Separation of liquid mixture by distillation using packed tower</p>	<p>Introduction, Vapor-liquid equilibrium. Boiling point diagram, Raoult's law, Henry's Law, Relative volatility, constant boiling mixture, equilibrium diagram, distillation methods, Flash differential, rectification, Azeotropic, Extractive, vacuum. Steam distillation Binary and multi compound distillation (Batch &amp; Continuous). Determination of number of plates by McCabe-Thayer, Ponchan-Savarit method, minimum total -optimum reflux ratio. Location of feed plate, q-line, types of distillation column, plate efficiency-overall Murphree. Point /local. Factor affecting efficiency</p>
<p><u>5. Extraction and leaching</u></p>	<p>Study of spray extraction column</p>	<p>Introduction definition terms feed solvent extract solute raffinate selection of solvent to its properties application of extractions equipment used for extractions classification of equipment- single stage extraction -Agitated mixer, flow mixer settler multistage extraction Multistage mixer settler equipment spray towers packed towers perforated plate towers leaching introduction, field of application , leaching equipment , percolation tanks, counter current multiple contact , shanks system agitated vessels, turbine type agitator , Dorr agitator , oil extraction from oil seeds. Leaching- leaching equipment, percolation tanks. Counter current multiple contact, shanks system agitated vessels, turbine type agitator. Dorr agitator, oil extraction seeds.</p>

<u>6. Absorption and stripping introduction</u>	Calculation of flooding velocity by using packed tower	Equipments used for absorption –columns, tower packing, flooding velocity, and method of stripping.
<u>7. Crystallization &amp; Drying</u>	Study of super saturation	Introduction method of super saturation and different types of crystallizes and their specific applications in industries.
	Finding rate of drying by using tray dryer.	Theory, equilibrium moisture content, factors controlling constant drying rate , constant rate period falling rate period factor affecting rate of drying , types of dryers and their uses .
<u>8. Filtration &amp; Mixing</u>	Operation of plate & frame filter press	Theory, different type of filters such as plate frame filter press, rotary drum filter and centrifuges
	Operation of mixer settler	Introduction, classification of mixing equipments and it's applications, mixers for mixing Solid- solid, solid-liquid, solid-gas
<u>9. Size reduction &amp; Transportation of material</u>	Size reduction using ball mill, hammer mill. To carry out sieve analysis with sieve shaker.	Size reduction and screening, separation, Classification of crushing and grinding machineries, sedimentation – gravity session, cyclone separators Types, use of size reduction equipment i.e black jaw crusher ,hammer mill, ball mill.
	Study of Conveyor, elevators	Conveyor, elevators Pneumatic transportation – pressure and vacuum
<u>10. Humidification and cooling towers &amp; Refrigeration</u>	Determination of wet bulb & dry bulb temperature.	Theory of Humidification and different terms related to Humidification .Theory and different types of cooling towers
	Study of refrigeration units	Vapor absorption and vapor recompression system, different types of refrigerants and their properties and specific use in industries

Week no	Unit	Practical	Theory
<b>UNIT PROCESS:-</b>			
11 Inorganic chemical industries	Sulphur and Sulphuric acid  Fuel & industrial gases  Fertilizer industries  Phosphorous Industries  Cement & lime	To determine the purity of given $H_2SO_4$ acid sample    To determine the purity of given $HNO_3$ acid sample  Study expt.  Study expt.	Manufacturing of sulphur by oxidation & reduction of hydrogen sulphide Manufacturing of sulphuric acid by contact process  Manufacturing of producer gas Manufacturing of water gas  Nitrogen industries Manufacturing of Ammonia by synthesis gas Manufacturing of Nitric acid by ammonia oxidation process  Manufacturing of urea from ammonium carbamate Manufacturing of Phosphoric acid Manufacturing of super Phosphate & triple super phosphate  Manufacturing of Portland cement
Natural products industries			
12	Oil, soap, & detergents, glycerin  Carbohydrate & fermentation Industries  Pulp & paper product Petroleum	To prepare soap from oil by laboratory method	Vegetable oil extraction method, sulfated fatty alcohol Paint & varnish  Manufacturing of sugar from sugar cane Manufacturing of ethyl alcohol by fermentation method  Manufacturing of pulp by sulfate process Manufacturing of paper from pulp  Manufacturing of petroleum by refining process

Synthetic organic chemical Industries			
13	Petrochemicals		Manufacturing of methanol
	Aromatics		Manufacturing of benzene by alkyl aromatics Manufacturing of phenol by cumene process Manufacturing of 2, 4 - di chlorophenol
	Pesticide		
14	Pharmaceutical Industry		Manufacturing of aspirin
	<u>Polymerization industries</u>	To prepare bakelite from phenol & formal dehyde by lab. Method	Manufacturing of polyvinyl chloride, bakelite
	<u>Biotechnology</u>		Manufacturing of wines, bears by fermentation process

**EFFLUENT TREATMENT (WATER MANAGEMENT SYSTEM) & AIR POLLUTION:-**

Week no.	Practical	Theory
15	1. Determine the COD of given water sample	1) Sources of water and water quality Water pollutants-Organic inorganic, Sediments, thermal, Radioactive, biological 2) Sources of water pollution 3) Treatment of water - purification, Sedimentation, Coagulation, Filtration, Sterilization (Physical and Chemical methods of Sterilization) 4) Water Softening (Removal of hardness) -Boiling, Distillation, Clark's Method, Caustic soda process, Ion exchange
16	Determine the BOD of given water sample	5) Effluent, types & source of effluent 6) Effluent analysis (PH, COD, BOD, TSS, Clarity) 7) Treatment of effluent 8) Types of equipments use for treatment
17	Determine the TDS of given water sample	9) Permissible standards 10) Air pollution 11) Types of pollutants 12) Sources of pollutants
18	Determine the TSS of given water sample	13) Effect of air pollution 1. Analysis of air pollutant 2. Equipment use for measurement and control of air pollution 16) Permissible standards

Week no	UNIT	PRACTICAL	THEORY
<b>MAINTAINANCE TECHNOLOGY</b>			
<u>19</u>	<u>Maintenance of pipe line and valves</u>	Cutting and threading of pipes. Bending and fitting of pipe as per drawing. Fitting of different types of pipe joints use of quick released coupling.	Pipe and pipe joints. Pipe bending fixture. Standard pipe threads. Tap and dies Standard pipefitting.
20		Maintenance of globe valve, Gate valve, Stop cock, Non return valve, ball valve , needle valve, Plunger valve, Piston valve, Pneumatic valve, Electrical glass line button valve, butterfly valve Testing and fitting of different type of valves on pipe line .	Construction and future of different types of valves. Metallurgy - Corrosion along with respect to corrosion. Selection of metal for chemical application. Lining material. Metal testing method destructive and non destructive.
<u>21</u>	<u>Maintenance of machinery</u>	Maintenance compressor, blowers, crushers, mixers and pulverizes.	Construction use of compressor ,blower ,crusher, mixer, and pulverizes .
<u>22</u>	<u>Maintenance of Pumps</u>	Maintenance and assembly of different type of pump such as centrifugal pump, gear pump, plunger pump , vacuum pump , hydraulic pump, screw pump, and multistage pump Application of voice, RPM,	Type of pumps their construction details and use .
		Fitting of bearing such as ball bearing, roller bearing, bush bearing etc. Their care. Lubrication and maintenance . Removing bearing with bearing puller .	bearing their type material and use information about bearing removing and fitting kit. Lubricant and lubrication type of lubricant and method of lubrication . Properties of lubricant

Week no.	Practical	Theory
	<b>ADVANCE UNIT OPERATION</b>	
23	On line training at relevant industries	<p><u>VALVS</u>- Pneumatically operated valve, electrically operated valve, rotary air lock valve , piston valve , solenoid valve ,plunger valve .</p> <p><u>PUMPS</u> - Vacuum pump with mechanical seal,vaccum pump with normal gland packing, metering pump ,screw pump for viscous flow</p>
24	On line training at relevant industries	<p><u>HEAT EXCHANGERS</u> - Multipass heat exchanger, Plate heat exchanger, spiral heat exchanger. Cooling tower.</p> <p><u>BOILER</u> - Oil fire boiler, rice hark boiler, gas fire boiler.</p> <p><u>EXPLOSIVE METER FOR SAFETY</u> - Gas detector ,smoke detector, fire alarm system, sprinklers system for safety</p>

**Attendant operator**  
**List of Equipment For Unit Operation Laboratory**

Sr. No.	Description	Qty
01	Reynolds's Experiment equipment	01 Set
02	Shell and tube heat exchanger glass type	01 No.
03	Boiler (Electrically Heated)	01 No.
04	Vertical Tube Evaporator	01 No.
05	Packed tower of glass for flooding velocity experiment	01 No.
06	Top driven centrifuge	01 No.
07	Rotary vacuum filter	01 No.
08	Tray drier	01 No.
09	Hammer mill	01 No.
11	Ball mill	01 No.
12	Blake jaw crusher	01 No.
13	Mixer settler type extractor	01 No.
14	Spray extraction tower	01 No.
15	Multistage compressor fitted with inter cooler	01 No.
16	Sieve shaker and sieves	01 No.
17	Annular ( for flow of fluids)	01 No
18	Vacuum pump with mechanical Seals	01 No
19	Vacuum pump with normal gland packing	1
20	Pneumatically operated valve	1
21	Electrically operated valve	1
22	Multipass heat exchanger	
23	Thermal mass flow meter	11
24	Magnetic flow (Rota meter)	1
25	Screw pumps for viscous flow	
26	Metering pump	1
27	Rotary air lock valve	1
28	Plate heat exchanger	1
29	Spiral heat exchanger	1

30	Glass Tube heat exchanger	1
31	Oil fire boilers	1
32	Rice hurk fire boiler	1
33	Gas fired boiler	1
34	Rising film and fallowing film Evaporators	1
35	Bruck field viscometer	1
36	Crystallizers - Flickers	
37	Absorption- striping	1
38	dryer , Pedal dryer ,	1
39	Droplet formation, Uses of nozzle, and water Distribution concept in cooling towers	1
40	Filtration - Lift filter, Sparker filter, Star filter, Notch filter, filtration media, Micron size	1
41	Explosive meters for safety i) Gas detector ii) Smoke detector iii) Fire alarm system iv) Sprinklers system for safety	1 1 1 1
42	Humidification /Dehumidification and air handling unit	1
43	Piston valve	2
44	Solenoid valve	2
45	Plunger valve	2
46	Pneumatic control valve	2
47	Safety valve	2
48	Rotary air lock valve	2
49	Cooling tower (common for instrumentation lab )	2
50	Pressure vessel with all accessories (training type)	2

**MODULE : ATTENDANT OPERATOR**  
**LIST OF TOOLS & EQUIPMENTS**  
**(FOR A BATCH OF 16 TRAINEES)**

S.N.	Description	Qty. required
1	Caliper outside spring 6" /15" cm	1 for instructor + 16 for trainees
2	Caliper inside spring 6" /15cm	"
3	Divider spring 6" /15cm	"
4	Center punch 4" /10cm	"
5	Prick punch 6" /15cm	"
6	Chisel cold flat 1" /2.5cm	"
7	Chisel cross cut 3" /8" X 1/8"	"
8	Chisel diamond point 3" /8" /10mm	"
9	Chisel half round 3/8" /10mm	"
10	Hammer ball pain 1lb handle	"
11	Hammer ball pain ½ lb handle	"
12	Hack saw frame adjustable with pistol gripe for 8"-12" blade by 20cm-30cm	"
13	Steel rule 12" English & metric /30cm	"
14	Screw diver set	"
15	Square engg. 6" blade /15cm	"
16	Scriber	"
17	Safety goggles	"
18	Soldering gun with stand	"
19	De soldering pump	"
20	Connector	"
21	Safety shoes	"
22	Neon tester	"
23	Magnetic point screw driver	"
24	Combination pliers	"
25	Long nose pliers	"
26	Insulator fine cutter	"

**LIST OF WORKSHOP FURNITURE**

**ATTENDANT OPERATOR**

<b>S.No.</b>	<b>Name of item</b>	<b>Req.</b>
1	Storage rack	2
2	Storage cupboard	2
3	Instructor table	1
4	Revolving chair	1
5	Work bench with vice	4
6	Stool	17
7	Trainee locker	1
8	Glass black board	01
9	Fire fighting equipment	01
10	First aid box	01
11	Discussion table	02
12	Tool cabinet	01
13	Smoke detector	02
14	Book shelf	01

UPGRADATION OF ITI'S IN TO CENTERS OF EXCELLENCE (C<sub>o</sub>E)

SECTOR/AREA: CHEMICAL GROUP

**ADVANCED MODULE IN II YEAR**

CHAT-02: MAINTENANCE MECHANIC

(Duration -24 Weeks)

WEEK NO & UNITS	PRACTICAL	THEORY
1. Advance welding	Importance of welding in workshop. Safety equipments and their uses. Edge joint with and without filler rod - D Brazing and gas cutting Hard facing steeling Welding - PVC Welding , all types joints on sheets 3,4,6 mm , HDPE, FRP, FRV, FRB pipe welding	Importance of welding in maintenance of chemical plant. Welding terms and their definitions. group of welding. Type of Flame. effect of atmospheric oxidation. Edge preparation method of heating material. Welding position and Development for pipe joints hard facing necessary and New welding technology - rectifier (solid state) Cold welding testing of welding joints Definitions of PVC its type properties and use
<u>2 &amp; 3</u> <u>Repairing of</u> <u>Key way &amp;</u> <u>surface</u> <u>finishing</u> <u>process</u>	Marking out key way in shaft repairing of worn out key way. Fitting key in key way.  Filling for smoothness of machine surface. Use of Persian blue for high spot. Scrapping of sheet surface and bearing surface. Process of lapping and checking lapped surface.	Various types of keys, allowable clearance and taper diameter of shafts type and used of key pullers.  Scrappers their use types method of scrapping testing of scrape surface. Process lapping, emery paste and powder, lapping tools for external internal and flat surface. Lead lining, rubber lining,FRP lining , glass lining

<u>4. Maintenance of pipe line Lagging materials</u>	Cutting and threading of pipes. Bending and fitting of pipe as per drawing. Fitting of different types of pipe joints use of quick released coupling. Repairing pipeline. Use of various pipefittings.	Pipe and pipe joints. Pipe bending fixture. Standard pipe threads. Tap and dies Standard pipefittings. Method of replacement pipefitting.
	Use and maintenance of lagging material Maintenance of glass, polyurethane foam , lead and rubber lined equipment.	Lagging material type use. How to use high, Medium, and slow pressure pipeline. Testing of leakage.

<u>5. Maintenance of Valves</u> <u>Maintenance of gear boxes</u>	Maintenance of globe valve, Gate valve, Stop cock, Non return valve, ball valve, needle valve, Plunger valve, Piston valve, Pneumatic valve, Electrical glass line button valve, butterfly valve Testing and fitting of different type of valves on pipe line .	Construction and future of different types of valves. Metallurgy – Corrosion along with respect to corrosion. Selection of metal for chemical application. Lining material. Metal testing method destructive and non destructive.
	Fitting of gears and assembling gearbox. Such as reducing gearbox, PIV gearbox, Epicycle (Planetary) gearbox, Worm wheel gearbox, Variable frequency drives. Reduction of gears	Type of gear such as spur, helical, worm, bevel etc. Use and advantages. Different types of gear box use and advantages.
<u>6.Maintenance of Pumps</u> <u>Alignment</u> <u>Shaft &amp; coupling</u> <u>Different types</u>	Maintenance and assembly of different type of pump such as centrifugal pump, gear pump, plunger pump, vacuum pump, hydraulic pump, screw pump, and multistage pump Application of voice, RPM, heat efficiency of all pump.	Type of pumps their construction details and use. Multistage pump
	Checking alignment of shafts and coupling of motors. Correcting the alignment. Check alignment by Three-dial gauge.	Causes of miss alignment. Different method of testing alignment. Three dial gauge testing method Effects of miss alignment on shaft and coupling
<u>7. BEARING</u>	Fitting of bearing such as ball bearing, roller bearing, bush bearing etc. Their care. Lubrication and maintenance. Removing bearing with bearing puller.	Bearing their type material and use Information about bearing removing and fitting kit. Lubricant and lubrication type of lubricant and method of lubrication. Properties of lubricant.
<u>8. Maintenance of machinery</u>	Maintenance compressor, blowers, crushers, mixers and pulverizes.	Construction use of compressor, blower, crusher, mixer, and pulverizes.
<u>Purpose of preventive maintenance</u>	Fitting of seals. Checking and replacing of oil seals. Use of 'O' ring, 'V' packing and mechanical seals testing of leakage from seals	Information about various types of seals. Testing of seals.

<u>9.Lifting appliances</u>	Dismantling, cleaning, replacing and reassembling machinery using chain pulley block, jack etc.	Installation maintenance and over oiling of machinery. Leveling equipments and alignment of machine.
<u>10.Pressure vessel</u> <u>Study of air compressor</u>	Maintenance of pressure vessel fitting marking of packing gaskets. Auto pressure vessel testing and maintenance	Different types of pressure vessel their care and maintenance different types of packing materials and gaskets.
	Study of air compressor	Various types of lifting appliances different method of gating mechanical advantage. Handling of heavy machinery precaution to be taken. Tools and equipment to lift and travel heavy metal. Type of knots on rope. Air compressor & its types

<u>UNITS</u>	<u>PRACTICAL</u>	<u>THEORY</u>
<b><u>UNIT OPERATION:</u></b>  <u>11. Heat transfer</u> <u>Evaporation</u> <u>Distillation</u>	maintenance of heat exchange equipments	Different types of heat transfer equipment Fouling of heat transfer surfaces-
	Determination of rate of evaporation .	Capacity, and Multi-effect evaporators .Surface and contact condensers, barometric condensers, Vacuum producing devices-Steam jet ejectors, Vacuum pumpsMulti effect evaporation and methods of feeding ,Vapor recompression
	Maintenance & Precautions for distillation.	Flash, Isotropic, Extractive, vacuum. Steam distillation Binary and multi compound distillation (Batch & Continuous ). Packing material
<u>12.Extraction and leaching</u> <u>Absorption and stripping introduction</u>	Separation of missible components	Classification of equipment-single stage extraction, Multistage extraction. Mixer settler equipment. Leaching- leaching equipment, percolation tanks. Counter current multiple contact , shanks system agitated vessels, turbine type agitator. Dorr agitator , oil extraction from oil seeds.
	Maintenance of absorption& adsorption columns	Equipments used for absorption -columns, tower packing, flooding velocity, method of stripping .

<u>13.Crystallization</u> <u>Filtration</u> <u>Size reduction</u>	Maintenance of crystallizers	Their specific applications in industries.
	Solid liquid separation using filter press	Different type of filters such as plate frame filter press , rotary drum filter and centrifuges. Filteraid.
	Size reduction using ball mill, hammer mill.	Types, use of size reduction equipment i.e black jaw crusher ,hammer mill, ballmill.
<u>14.Humidification and cooling towers</u> <u>Mixing</u> <u>Refrigeration</u>	Determination of wet bulb & dry bulb temperate.	Theory and different types of cooling towers
	Maintenance of Mixers & settler	Mixers for mixing. (solid- solid, solid-liquid, solid-gas)
	Study of refrigeration units & there maintenance	Vapor absorption and vapor recompression system, different types of refrigerants and their properties and specific use in industries
<u>15.Transportation of material &amp; pipe fitting</u>	Study of Conveyor, elevators & there maintenance	Conveyor, elevators Pneumatic transportation - pressure and vacuum
	Threading , bending, plumbing	Material of construction , specification , threading , bending, leakage rectification , clamps

Week no	Units /Unit Process	Practical	Theory
<b>UNIT PROCSS:</b>			
<b>Inorganic chemical industries</b>			
16.	Fertilizer industries  Phosphorous Industries  Cement & lime	1)Determine The Purity Of Given Nitric Acid Sample  2) Study Expt.  3) Study Expt.	Nitrogen industries Manufacturing of Ammonia by synthesis gas Manufacturing of Nitric acid by ammonia oxidation process  Manufacturing of urea from ammonium carbamate  Manufacturing of Phosphoric acid Manufacturing of super Phosphate & triple super phosphate  Manufacturing of Portland cement
<b>Natural products industries</b>			
17.	Oil, soap, & detergents, glycerin  Carbohydrate & fermentation Industries  Pulp & paper product Petroleum	4)To Prepair Soap From Laboratory Method.	Vegetable oil extraction method, sulfated fatty alcohol Paint & varnish  Manufacturing of sugar from sugar cane Manufacturing of ethyl alcohol by fermentation method  Manufacturing of pulp by sulfate process Manufacturing of paper from pulp  Manufacturing of petroleum by refining process

<b>Synthetic organic chemical industries</b>		
18 &19	Petrochemicals Aromatics Pesticide Pharmaceutical Industry	Manufacturing of methyl alcohol Manufacturing of benzene by alkyl aromatics Manufacturing of 2,4 D Manufacturing of aspirin
<b>PIPING TECHNIC:</b>		
<u>WEEK NO.</u>	<u>PRACTICAL</u>	<u>THEORY</u>
20 &21	1) Determination of internal & external diameter. 2) Internal & External threading practices. 3) Pipe bending practice. 4) Plumbing. 5) Pipe welding.	1) Pipes, joints & fittings Introduction - water pipes, galvanized iron pipes, copper pipes , rigid PVC pipe, CPVC , Green PPRC, composite pipes, jointing material, PVC pipes & sewers - CI , AC , PVC jointing , resting of pipes , PVC pipes 2) Valves & terminal fittings Introduction - Control valves, sluice valve, sour valve, flat valves, reflux valves, Flap valves, butterfly valves, pressure relief valves, pressure reducing valves, Air valves, globe valve, gate valve, pillar taps, bib tap & stop valves Self closing valve, Flash Valves, mixing valves, Aerated faucets, Shower rose, Waste coupling 3) Specialize plumbing system - Emergency system - fixtures for the laboratory plumbing, High quality water supply, fuel gas, plumbing in cold region, salt water supply system, emergency shower. 4) Pump & pump houses- Introduction, installation, & commissioning, use & selection of pumps, horse power of pumps, pumping power & pump laws, pumping station (sewage) Sump & sump well structure, Design of sump well, Automation in pumping systems.

### Advanced Techniques In Machining

Week no/ Unit	Practical	Theory
22 , 23 CNC LATHE	SIEMENS CNC CONTROL - TURNING  Study of CNC machine , key board & specification Machine starting & operating in reference point , JOG& Incremental modes co-ordinate system points, assignments & simulations. Absolute & increment programming assignments & simulations  Identification of machine over travel limits & emergency stop Work & tool setting. CNC M/C part program preparation , simulation & Automatic Mode Execution : Simple turning & facing ( step turning )	Safety Precautions - Safe handling of tools , equipment & CNC machines, Conventional & CNC machining , types of CNC machines, advantages & limitations of CNC , computer numerical control application Future of computer numerical control technology. CNC system - CNC interpolation, open loop & close loop control system. Co-ordinate system & points CNC machine - turning types machine axes. Review , assignment / practice , test
	Linear interpolation, assignment & simulations on software. Circular interpolation, assignment & simulations on software. Work offset measurement & entry in CNC control Tool offset measurement & entry in the control Part program preparation , simulation & automatic Mode Execution CNC M/C. Turning with Radius / chamfer with TNRC Review , assignment / practice , test	CNC Control Hardware & operating Software NC verse CNC system The CNC Machine Control Unit organization CNC Software organization Input Media & tape formats Computer & Information processing of the CNC system CNC Machine working principle Zero off sets & tool offsets in SIEMENS CNC TURNING Feedback device for CNC control Tool Nose Radius Compensation ( TNRC)
24	INDUSTRIAL VISIT	

## Maintenance Mechanic

### List Of Equipments/Machinery for Maintenance Workshop

SR. NO.	Name of machinery and equipment	Qty.
1	Auto control valve with positional	01 No
2	Piston valve	01 No
3	Plunger Valve	01 No
4	Safety valve	01 No
5	Hydraulic Pump	01 No
6	Vacuum pump	01 No
7	Screw pump	01 No
8	Multistage pump	01 No
9	Air operated pump	01 No
10	Vane pump	01 No
11	Metering pump	01 No
12	Diaphragm pump	01 No
13	Magnetic coupling pump	01 No
14	Lapping Plate 12" x 12"	01 No
15	Mechanical seals	As required
16	Three dial gauge	01 No
17	Electric pipe cutter	01 No
18	Pneumatic calibrator	01 No
19	Worm wheel gear box	01 No
20	Cycle seal gear box	01 No
21	Variable frequency drive	01 No
22	Shock pull treasure measurement	01 No
23	Bearing removing and fitting kit	01 No
24	Quick released coupling set	01 No
25	Pump pressure gauge	01 No
26	Hydraulic puller	01 No
27	Thread gauge	01 No
28	Planetary gear box	01 No
29	Piston valve	01 no

30	Solenoid valve	01 no
31	Pneumatic control valve	1
32	Rotary air lock valve	1
33	PVC welding torch / gun with compressor & all accessories	1
34	Welding rectifier 400 Amp	1
35	Mirror welding hot plate with Accessories	1
36	FRP repair kit	5

### **B) List of Machinery**

1	Cooling tower (common for instrumentation lab)	1
2	Pressure vessel with all accessories (training type)	1
3	CNC-Lathe - intermediate	1
4	Lathe Tool Room	1
5	Drilling machine 12mm	1
6	Drilling machine 06mm	1
7	Bench grinder	1
8	TIG welding equipment with all accessories	1
9	MIG welding equipments with all accessories	1
10	Ultra sonic crack detector	1
11	X-ray machine	1

**MODULE: MAINTENANCE MECHANIC**  
**LIST OF TOOLS & EQUIPMENTS**  
**(FOR A BATCH OF 16 TRAINEES)**

S.N.	Name of Tool	Qty. required.
1	Caliper outside spring 6" /15" cm	1 for instructor + 16 for trainees
2	Caliper inside spring 6" /15cm	"
3	Divider spring 6" /15cm	"
4	Center punch 4" /10cm	"
5	Prick punch 6" /15cm	"
6	Chisel cold flat 1" /2.5cm	"
7	Chisel cross cut 3" /8" X 1/8"	"
8	Chisel diamond point 3" /8" /10mm	"
9	Chisel half round 3/8" /10mm	"
10	Hammer ball pain 1lb handle	"
11	Hammer ball pain ½ lb handle	"
12	Hack saw frame adjustable with pistol gripe for 8" -12" blade by 20cm-30cm	"
13	Steel rule 12" English & metric /30cm	"
14	Screw diver set	"
15	Square engg. 6" blade /15cm	"
16	Scriber	"
17	Safety goggles	"
18	Soldering gun with stand	"
19	De soldering pump	"
20	Connector	"
21	Safety shoes	"
22	Neon tester	"
23	Magnetic point screw driver	"
24	Combination pliers	"
25	Long nose pliers	"
26	Insulator fine cutter	"

List of Work shop furniture

**MAINTAINANCE MECHANIC**

s.n.	Name of item	Req.
1	Storage rack	2
2	Storage cupboard	2
3	Instructor table	1
4	Revolving chair	1
5	Work bench with vice	4
6	Stool	17
7	Trainee locker	1
8	Glass black board	01
9	Fire fighting equipment	01
10	First aid box	01
11	Discussion table	02
12	Tool cabinet	01
13	Smoke detector	02
14	Book shelf	01

## UPGRADATION OF ITIS INTO CENTERS OF EXCELLENCE (C<sub>o</sub>E)

SECTOR/AREA: CHEMICAL GROUP

**ADVANCED MODULE IN II YEAR**

CHAT-03: INSTRUMENT MECHANIC

**(Duration -24 Weeks)**

### SYLLABUS

WEEK NO & UNIT	PRACTICAL	THEORY
<b><u>. PROCESS ONTROL &amp; INSTRUMENTATION:</u></b>		
1 &2 <u>PRESSURE:-</u>	<p>Calibration of pressure instruments using dead weight tester</p> <p>Dismantle the pressure gauge &amp; study the construction &amp; correct functioning.</p>	<p>Standard pressure gauge Pressure recorder Pressure switch Barograph</p> <p>Pressure regulating Valve Pressure transmitter Draft gauge Magnetic pressure gauge Magnehelic gauge</p>

3. <u>TEMPERATURE:-</u>	Calibration of expansion thermometers Calibration maintenance & reconditioning of thermocouple, Pyrometers	Temperature switch Optical pyrometer Radian pyrometer Thermostats Temperature gauges (Fluid) Thermostat Thermister IR temperature indicator (contact less)
4. <u>FLOW :-</u>	To study of flow nozzles , heads ,there shape & connection	PD flow meter Differential flow indicator Capacitance type level indicator Sight glass level indicator Air purge system Weighting machine for level management Elbow transmitter Flow switch Thermal mass flow Ultrasonic flow Mass flow
5. <u>LEVEL:-</u>	Study construction of hook type, sight glass,& float type Level measuring instruments of closed & open tank. static pressure level measuring system	Buoyancy level transmitter DP transmitter Magnetic level transmitter Level switches Displayer type level transmitters Capacitive level switch Turbine flow meter Magnetic level gauge



<p>9 To 12. <u>TRANSMITTERS,</u> <u>CONVERTOR &amp;</u> <u>RECORDER</u></p>	<p>Calibration of mechanical recorders, adjustment of time travels, changing charts, ink, minor rectification.</p> <p>Calibration of temperature transmitter &amp; its adjustment</p> <p>Recording &amp; calibration Of current to air &amp; pressure to current converter Reconditioning of EMF To current, converter &amp; Its calibration</p>	<p>Digital temperature transmitters Potential metric type recorders DP recorder Receiver recorder</p> <p>Temperature transmitter (Pneumatic &amp; Electronic) Pressure transmitter (Pneumatic &amp; Electronic) DP transmitter (Pneumatic &amp; Electronic) R.T.D. Transmitter (Electronic) Thermocouple transmitter ( Electronics)</p> <p>PH (on line ) - PH sensor, PH transmitter Dissolve oxygen - D.O.sensor,D.O.transmeter Online conductivity meter- sensor + indicator Ultrasonic transmitter Radar type transmitter Servo level gauge Foric type transmitter P to I converter EMF to I converter RTD to I converter 0.5 V to P converter Pressure recorder Temperature recorders Temperature indicator cum recorder</p>
<p>13 To 15. <u>CONTROLLERS AND</u> <u>CONTROL VALVES</u></p>	<p>Study the construction ,identification of component of ON-OFF type controller Testing &amp; calibration of ON-OFF type control system of</p>	<p>Temperature scanners ON OFF controllers PID controllers (Pneumatic and Electronics ) Control valves Control valves with petitioners</p>

	<p>pneumatic &amp; electronic pressure, temperature.</p> <p>Check calibration of proportional controller, Reconditioning, adjustment, setting of propotional band.</p>	<p>Pneumatic calibrators Pulse to current converter Serial converter</p> <p>Solenoid valve RS 382 tro RS 485 converter K I to P type converter profile controller</p>
<p>16 To 21. <u>ADVANCED ELECTRICAL AND DIGITAL ELECTRONICS</u></p>	<p>Study of digital millimeter &amp; Study of analog millimeter</p> <p>Study off LCR, PLC, DCS, and SCADA.</p>	<p>Digital power supplies Digital current sources power supply Electronics trainer Electronics IC trainer Digital MultiMeter and Analog multimeter</p> <p>L.C.R. (Source and measure) P.L.C. D.C.S. Computers to study different process application (4 no.) S.C.A.D.A.</p>
<p><u>22. Master Instruments</u></p>	<p>Study of master instruments.</p>	<p>Universal calibrator Temperature bath Dead weight tester RTD simulator Pressure calibrator Single limb monometer 24 V , 5 amp, DC Power supply Inverters</p>

<p>23. <u>UNIT OPERATION</u></p>	<p>To calculate overall heat transfer co-efficient for a shell &amp; tube heat exchanger To find out rate of evaporation of a vertical tube evaporator</p> <p>Separation of a lig. Mixture by distillation using packed tower Operation of spray extraction column</p>	<p>Heat exangers, evaporation, Distillation, extraction.</p>
<p>24. <u>UNIT PROCSS</u></p>	<p>Study expt. For urea, cement.</p>	<p>Manufacturing process for Urea , Ammonia , Sulpur Cement , Petroleum refining, glass.</p>

INSTRUMENT MECHANIC

LIST OF INSTRUMENTS AND EQUIPMENTS  
FOR INSTRUMENTATION LABORATORY

S. N	Name	Quantity
A) Electrical instruments		
01	Moving coil voltmeters (various ranges)	04 each
02	Moving coil ammeters (various ranges)	04 each
03	Moving millimeters (various ranges)	04 each
04	Moving milli voltmeters (various ranges)	04 each
05	Galvanometer, center-zero indicating	01 no.
06	Moving iron AC-voltmeters, various ranges	04 each
07	Moving iron Ac-ammeters, various ranges	04 each
08	Voltmeter dynamometer type AC & DC	02 nos
09	Ammeter dynamometer induction type AC & DC	02 nos
10	Wattmeter dynamometer type	01 no.
11	Power factor meter	01 no.
12	Hot wire instruments	01 no.
13	Clamp on AC-Ammeter	01 no.
14	Ohm meters multi-ranges	01 no.
15	Insulation testers (meager) 500 volts	01 no.
16	Watt hour meter	04 nos.
17	Frequency meter, vibrating reed type	01 no.
18	Ampere hour meter	02 nos.
19	Millimeter (AVO)	02 nos.
20	Calibration for ammeters, voltmeters, ohmmeters	01 no.
21	Calibration for wattmeter, energy meters	01 no.
22	Bridge for resistance, capacitance, inductance	01 no.
23	Workshop potentiometer, withgalvo & std. cell	01 no.
24	Regulated power supply with variable DC source	01 no.
25	Servo operated AC voltage stabilizer, 10 KVA	01 no.

	B) Humidity Instrument	
26	Hair hygrometer	02 nos
27	Wet & dry bulb thermometer type hygrometer	02 nos
28	Sling pyrometer	02 nos
	C) Pressure Instruments	
29	Manometer, well type	01 no
30	Barometer mercury	01 no
31	Barometer aneroid capsule	01 no
32	Gas pressure regulator	02 nos
33	Pressure transmitter	02 each
34	Draft gauge	02 each
35	Magnetic pressure gauge	02 each
36	Magnehelic gauge	02 each
	D) Fluid Flow Meter	
37	Quantity flow meter, simple tank type	02 nos
38	Reciprocating piston type flow meter	04 nos
39	Flow meter imeppler type	04nos
40	Bellows type gas flow meter	02 nos
41	Magnetic flow meter	02 nos
42	Nozzle type differential flow meter	02 nos
43	Taper tube rotameter	02 nos
	E) Level Instrument	
44	Hook type level indicator	02 nos
45	Float type level indicator	02 nos
46	Static pressure and air purge level	01nos
47	Show piece ultra-sonic level indicator	01nos
48	Variable capacitance type level indicator	01nos
	F) Temperature Instruments	
49	Mercury in steel thermometers, remote indicating	02nos
50	Vapor pressure thermometers	02nos
51	Optical pyrometer	01nos

52	Standard tungsten strip filament lamp for calibration of optical pyrometer	02nos
53	Radiation pyrometer	01nos
	G) Rotational Speed & Circular Velocity Instruments	
54	Speedometer (four different popular make)	04 each
55	Tachometer centrifugal	02nos
56	Tachometer drag cup type	02nos
57	Tachometer electrical, synchronous	02nos
58	Stroboscope	01nos
59	RPM tester/techo. Tester	01nos
	H) Recorders and controllers	
60	Circular charts recorder ( potentiometer type)	02nos
61	Strip charts recorder (potentiometer type)	02nos
62	Secondary devices for measurement of temperature, pressure level and flow for above recorders	02nos
63	2-position controller (On-Off) type	02nos
64	Proportional controller	02nos
65	Proportional with reset type electronic controller	02nos

66	Pneumatic controllers for pressure, flow, temperature and level with associated equipment	02 nos.
67	Transmitters, pneumatic, hydraulic and electronic for above mentioned controllers, recorders, process simulator	02 nos.
68	Transistorized amplifier trainer	2
69	DIAC, LED, LCD, FET, UJT, MOSFET Trainer	1
70	Logic Gates trainer	2
71	Digital power supply trainer ( Half wave rectifier /full wave rectifier)	1
72	Integrated Circuits trainer IC 555 / 11556 / IC- 747	2
73	Op amp trainer	1
74	Digital ICs trainer with microprocessor, ALU, CPU, ROM, RAM, EPROM	1
75	Programmable logic system trainer	2
76	Exhaust fan	1
77	Vacuum lamp with accessories	2
78	Air compressor with accessories	2
79	Color monitor / TV with audio - video in & out	1
80	IC tester liner with accessories	1
81	Air vacuum chamber	1
82	Static electricity guard	1 x 16

MODULE: INSTUMENT MECHANIC

LIST OF TOOLS & EQUIPMENTS  
(FOR A BATCH OF 16 TRAINEES)

S.N.	Name of Tool	Qty. Required
1	Caliper outside spring 6"/15" cm	1 for instructor + 16 for trainees
2	Caliper inside spring 6"/15cm	"
3	Divider spring 6"/15cm	"
4	Center punch 4"/10cm	"
5	Prick punch 6"/15cm	"
6	Chisel cold flat 1"/2.5cm	"
7	Chisel cross cut 3"/8" X 1/8"	"
8	Chisel diamond point 3"/8"/10mm	"
9	Chisel half round 3/8"/10mm	"
10	Hammer ball pain 1lb handle	"
11	Hammer ball pain ½ lb handle	"
12	Hack saw frame adjustable with pistol gripe for 8"-12" blade by 20cm-30cm	"
13	Steel rule 12" English & metric /30cm	'
14	Screw diver set	"
15	Square engg. 6" blade /15cm	"
16	Scriber	"
17	Safety goggles	"
18	Soldering gun with stand	"
19	De soldering pump	"
20	Connector	"
21	Safety shoes	"
22	Neon tester	"
23	Magnetic point screw driver	"
24	Combination pliers	"
25	Long nose pliers	"
26	Insulator fine cutter	"

List of Work shop furniture

INSTRUMENT MECHANIC

s.n.	Name of item	Req.
1	Storage rack	2
2	Storage cupboard	2
3	Instructor table	1
4	Revolving chair	1
5	Stool	17
6	Trainee locker	1
7	Metallic black board	01
8	Fire fighting equipment	01
9	First aid box	01
10	Discussion table	02
11	Tool cabinet	01
12	Smoke detector	02
13	Book shelf	01

UPGRADATION OF ITI INTO CENTRE OF EXCELLENCE (COE)  
SECTOR / AREA - CHEMICAL GROUP  
**ADVANCE MODULE IN II YEAR**  
**CHAT- 04 LABORATORIES ASSISTANT**  
DURATION 24 WEEK  
**SYLLABUS**

W.no. UNIT	PRACTICAL	THEORY
<b>1 to 4</b>  <b>Preparation , Estimation &amp; Analysis Of Inorganic Substances</b>	Preparation of Inorganic compounds like Sodium carbonate , sodium bicarbonate Copper sulphate, potassium nitrate etc To study balance one pan, two pan & digital. To determine flash point of given fuel. To determine physical constant of different liquids/solids. To determine of viscosity given oil To determine surface tension of given liquid. To determine the density of given liquid. To determine the strength of given acid by potentiometer titration using queen hydron electrode To determine the conductivity of given electrolyte. To analyze elements using electrolytic analyzer To determine the PH of given solutions by using PH-meter & lovibond comparator. Paleographic appt.	Inorganic estimations like - estimation of calcium in given tablet etc. Instrumental methods of analysis Balance , Flash point apparatus, Bomb calorimeter Melting / Boiling point apparatus Viscometer Surface tension apparatus  Pyknometer Microscope Potentiometer Conduct meter  Electrolytic analyzer Cl, H, N, and S Elemental Analyzer PH meter Lovibond comparator  Paleographic apparatus Calorimeter Spectrophotometer

<p><b>5 to 8 Preparation , Estimation &amp; Analysis Of organic Substances</b></p>	<p>Calorimeters appt. Spectrophotometer appt. To determine the concentration of solution by Flam photometer appt. Photo calorimeter appt. To determine the refractive index of given oil. To determine the % of optically active subs. In solutions like glucose/sucrose To determine the moister in given sample. To determine the carbon/sulphar content. To determine the % of various gases in given sample</p> <p>Preparations of, Acetanilide from aniline. Ethyl acetate. Sulphonic acid. Nitrobenzene. Chlorobenzen. Benzoic acid. Glucosazone. Soap preparation. Aspirin. Camphor Phenolphthalein</p>	<p>Photo calorimeter Flame photometer Refract meter (Oil)</p> <p>Polar meter (Sugar) Electrophoresis apparatus Moisture Balance Carbon- sulphur determination apparatus Orsat apparatus Gas - Liquid chromatography Preparation of aluminum silicate</p> <p><u>Organic preparations</u> ( Principle ,Reaction, Procedure and calculation of percentage yield /percentage purity ) i) Acylation ii) Esterification iii) Sulphonation iv) Nitration v) Oxidation vi) Reduction vii) Halogenations iii) Diazotization ix) Hydrolysis x) Osazone xi) Saponification xii) Preparation of aspirin iii) Preparation of camphor xiv) Preparation Phenolphthalein</p> <p>II .<u>Oil analysis :</u></p>
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<p><b>9 to 12</b> <b><u>Mole concept &amp; Quantitative analysis</u></b></p>	<p>To determine acid value, soap value, iodine value. of a given oil sample To estimate, Amt. of fat ,oil. Amt. N<sub>2</sub> by kneads method Amt . formally by iodo mettric method. Amt. of aniline ,phenol in a given solution.</p> <p>To analyze the , Given unknown compound by qualitative analysis To determine , % Composition of metals in given alloy. To determine, % Composition of metals in given ores.</p> <p>To analyze the given sample by following digital appt., Flame Photometer (Digital), Polarimeter, Polarograph, Chromatography, Spectroscopy - IR, NMR, UV. Spectroscopy. Moisture balance, Carbon, sulphar, determination appt. Gas analyzer ,smoke detector,</p>	<p>i) Acid value ii) Soap value iii) Iodine value</p> <p><u>III ., Estimation of organic substances :</u> i) Estimation of fat by Soxhlet's extraction method ii) Estimation of nitrogen by Kjedal's method iii) Estimation of formaldehyde by Iodometric method iv) Estimation of Aniline/Phenol</p> <p><u>IV . Analysis of organic compound to determine</u> a) Elements present b) Functional group c) Melting point / Boiling points d) Preparation of derivative e) Melting point / Boiling point of derivative</p> <p>Balance, eq. Weight, mol weight , at. Weight , sp,gravity, normality, acidity , basicity , concentration . <u>Quantitative analysis</u> A) Alloy analysis * Determination of %composition and purity of alloy * Brass, bronze, solder, stainless steel, gun metal, white metal, bell metal, duralumin etc. B) Ores analysis * Determination of % composition of ores</p>
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<p><b><u>13 to 16</u></b> <b><u>Instrumental</u></b> <b><u>methods of Analysis</u></b></p>	<p>PH-meter &amp; comparator Turbidity appt. Digital viscometer, Digital balance</p>	<p>* Hematite, magnetite, bauxite, copper pyrite, lime stone etc. <u>Instrumental methods of Analysis</u> Refract meter Polarograph Polarimeter (Digital) Chromatography - GLC,TLC,HPLC. Electrophoresis Flame Photometer (Digital) Spectroscopy - IR, NMR, UV. Spectroscopy. Moisture Balance Carbon, Sulphur, determination apparatus. Gas Analyser,and Smoke detector Flash point and fire point apparatus PH meter and comparator Turbidity apparatus Digital viscometer Digital balance</p>
<p><b><u>17 to 20</u></b> <b><u>Microbiology</u></b> <b><u>,Biochemistry &amp; Bio</u></b> <b><u>- Technology</u></b></p>	<p>Preparation Of Media Preparation Of Innocula Preparation Of Stains</p> <p>To determine size of micro-organisms Using electronic microscope. To determine thermal death time.</p> <p>To study of fermentation.</p>	<p>A)<u>Microbiology</u> a) Study and use of microscope , common laboratory equipment used in Microbiology b) Preparation of media c) Techniques of inoculations. d) Study of staining techniques e) Determination of size of microorganism f) Determination of Thermal death time of microorganisms g) Total plate count of given sample h) Preparation of alcohol in laboratory</p>

<p><b>21 to 24</b> <b><u>Water Management</u></b> <b><u>Technique</u></b></p>	<p>To study the metabolism of carbohydrate, proteins, lipids, nucleic acid .</p> <p>Study of Ph , Buffer.</p> <p>Study experiments</p> <p>To determine COD, BOD,PH of water. To determine hardness water. To determine TDS, To determine TSS, To Study Sterilization, Sedimentation. To study the cation &amp; anion exchanger</p>	<p>B) <u>Biochemistry</u></p> <p>Importance of biochemistry Structure, function and metabolism of carbohydrates, proteins, lipids, nucleic acid Protein biosynthesis, mechanism of enzyme action Bio chemistry of photo synthesis Basic concept of genetic engineering ] PH &amp; buffers</p> <p>C) <u>Biotechnology</u></p> <p>Cell Constituent, cell division, biochemistry of biological macromolecules Genetic recombination, structure of genetic code. Transcription and translation of genetic information Molecular mechanism of mutations, innunogenetic, hydro mass, plant tissue culture Life cycle of different kinds of living organism, structure and function of cell, genetic conservation Fermentation and formulation Biotechnology and society</p> <p>Sources of water Water pollutants-organic inorganic, sediments, thermal, Radioactive materials, biological pollution Sources of water pollution</p>
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	<p>resins To study ETP.</p>	<p>Water quality Treatment of water purification, sedimentation, coagulation, filtration, sterilization Physical and chemical methods of sterilization Physical - electricity, sound, light, heat Chemical-chlorination, electrolysis, reverse osmosis Water softening (removal of hardness) Boiling Clark's method Distillation Use of caustic soda Ion exchange Effluent Treatment system Effluent- types and sources Methods of treatment of effluents Effluent analysis (Ph, COD, BOD, TSS) Permissible standards Equipments used for effluents</p>
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## LAB ASSISTANT

### LIST OF TOOLS & EQUIPMENTS FOR LABORATORY

S. N.	Name	Req Quantity
01	Balances (Digital)	02 Nos
02	Flash point apparatus	02 Nos
03	Melting/boiling point apparatus	02 Nos
04	Digital viscometer	02 Nos
05	Surface tension apparatus	02 Nos
06	Pyknometer	02 Nos
07	Micro scope	05 Nos
08	Potential meter	02 Nos
09	Conductivity meter	02 Nos
10	Electrolytic analyzer and Cl, H, N, S	01 No
11	elemental analyzer	each
12	P.H.(Digital) meter	02 Nos
13	Lovibond comparator	02 Nos
14	Paleographic apparatus	02 Nos
15	Calorimeter	02 Nos
16	Spectrophotometer	02 Nos
17	Photo calorimeter	02 Nos
18	Flame photometer	02 Nos
19	Refract meter (Oil)	02 Nos
20	Polarimeter (Sugar)	02 Nos
21	Electrophoresis apparatus	02 Nos
22	Moisture Balance	02 Nos
23	Carbon- sulphur determination apparatus	02 Nos
24	Gas - Liquid chromatography	02 Nos
25	Preparation of aluminum silicate	02 Nos
26	Digital viscometer	02 Nos
27	Digital moisture balance	02 Nos
28	Digital PH meter	02 Nos
29	Digital flame photometer	02 Nos
30	C.O.D.,B.O.D.,T.S.S. analysis equipment	02 Nos
31	Turbidity meter	02 Nos
32	Spectroscopy- IR,NMR, UV spectroscopy	02 Nos

33	Chromatography equipment (paper column, thin layer) if available indigenously	1
34	Sensitive Balance Electronics	5

35	Two pan analytical balance with rider.	5
36	Pump vacuum	1
37	Pump vacuum mounted on moving tables	2
38	Electric drying oven (200 deg C)	2
39	Potential metric titration apparatus	2
40	Gas chromatographer ( Digital type )	01
41	Automatic Titration ( computerized )	02
42	Furnace (muffle ovens 1100 deg C 300X300X450 mm	1

43	Magnetic stirrer (with heating plate ) 4 liter capacity	2
44	Gas fuming chamber with exhaust	02
45	Refrigerator compression type 165 liter	1
46	Stirrers with motors 230 V Ac, capacity 5-7 liters	8
47	Electric heating plates (for sox lets)	2
48	Heating mantles (universal)	6
49	Borer for stoppers with sharpener	1
50	Cork press	1
51	Bunsen burners	30
52	Steam generator (copper) for steam distillation	10
53	Hot water funnel	10
54	Extraction thimbles	60
55	Vernier Caliper	16
56	Micrometer	16

List of Work shop furniture

LAB ASSISTANT

s.n.	Name of item	Req.
1	Storage rack	2
2	Storage cupboard	2
3	Instructor table	1
4	Revolving chair	1
5	Stool	17
6	Trainee locker	1
7	Metallic black board	01
8	Fire fighting equipment	01
9	First aid box	01
10	Discussion table	02
11	Tool cabinet	01
12	Smoke detector	02
13	Book shelf	01
14	Laboratory table with lockers	1 x 16
15	Gas connection	1 x 16
16	Water connection with wash basin	1 x 16
17	Reagent bottle rack	6

## **GENERAL EQUIPMENT AND OFFICE FURNITURE**

S.No.	Name of the Item	Qty. Required
1	Latest PC with modem	01
2	Printer Epson LQ 1150	01
3	Scanner	01
4	Photo copy machine	01
5	Computer Table	04
6	Table for photo copy machine	01
7	Steel cupboard	15
8	Principal table (Size : 6'x4')	01
9	App. Adv. Table	01
10	Surveyor table	01
11	Clerk Table	08
12	Revolving chair best quality	03
13	Revolving chair	08
14	Rack 6'x4'	03
15	Inverter for office	02
16	Conference Mike System	01 Set
17	Intercom system for 20 lines	01 Set

**INDUSTRIES INVOLVED IN PREPARATION OF SYLLABUS**

<b>NAME OF INDUSTRIES WHICH IS SELECTED BY IMC</b>
Sandoz Pvt. Ltd. M.I.D.C. Mahad
Vinyal Chemical Pvt. Ltd. M.I.D.C. Mahad
Viniti Organic Pvt. Ltd. M.I.D.C. Mahad
Exonable Pvt. Ltd
Gharada Chemicals Pvt. Ltd. M.I.D.C. Mahad
Denosil Pvt.Ltd. M.I.D.C. Mahad
Color Chem Ind Pvt. Ltd. Roha
Kopran Ltd. M.I.D.C. Mahad
Haikal Pvt. Ltd.
Exon Pvt. Ltd. M.I.D.C. Mahad
Silvolykal Pvt. Ltd. M.I.D.C. Mahad
Savita Polymer Pvt. Ltd. M.I.D.C. Mahad
Shrihari Chemicals M.I.D.C. Mahad
E.B.P.L. Pvt. Ltd.
FDC Pvt. Ltd. Roha
Vashity Detergent, Lote Parsuram M.I.D.C. Khed
Sudarshan Chemical Roha / Mahad
Unichem Industries Roha
Reptacos Bright Pvt. Ltd. Roha
Thermex Co. Ltd. Khopoli
IPCL, Nagothane

**Sd/-**  
**(S.S. Bhonsale)**  
 G.M. Sandoz Pvt. Ltd., M.I.D.C. Mahad  
 Chairman  
 I.M.C.  
 Industrial Training Institute

**Sd/-**  
**(S.M. Sadamate)**  
 Principal  
 Industrial Training Institute  
 Mahad Raigad

