1	Name of Course	**C.C. in Operation& Maintenance of Boiler & Steam Turbine (307103)**
2	Max.Nos. of Student	25 Students
3	Duration	6 Months
4	Type	Full Time
5	Nos Of Days / Week	6 Days
6	Nos Of Hours /Days	7 Hrs
7	Space Required	Laboratory = 1000 Sq feet Class Room = 200 Sq feet **TOTAL = 1200 Sq feet**
8	Entry Qualification	**S.S.C.+ Any Course in Chemical Group of MSBVEE**
9	Objective Of Syllabus/ introduction	Awareness of Safety precautions Knowledge of Engineering skill, use of tools in assembly Awareness of Chemical Plant. Awareness of Maintenance of Boiler & Stem Turbine in Chemical Plant. Awareness of Basic Fitting, Turning & Machining.
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which Develop, Maintain, Repair Operation & Maintenance of Boiler & Stem Turbine. Work as or with working experience will be in a position to start his own independent Business.
11	Teacher's Qualification	Diploma in Chemical Engg. With 3 year Teaching experience in Operation & Maintenance of Boiler & Stem Turbine
12	Training System	Training System Per Week

Theory	Practical	Total
12 Hours	30 Hours	42 Hours

13 Exam. System

Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks
1	**30710311**	Operation & Maintenance of Boiler & Steam Turbine	TH-I	3 hrs	100	35
2	**30710321**	Basic Fitting, Turning & Machining.	PR-I	3 hrs	100	50
3	**30710322**	Operation & Maintenance of Boiler & Steam Turbine	PR-II	6 hrs	200	100
		TOTAL			**400**	**185**

SYLLABUS

Operations and Maintenance of Boiler & Steam Turbine

Practical – II	Theory - I
Operation of various types of valves. Check valve, stop valve, by pass valve, Gate valve, beadle valve, steam valve etc.	Industrial fuels: Solid, liquid and gaseous Solid fuels -coal, peat, lignite, etc.. Properties of coal - coal preparation and cleaning, size of coal and storage of coal, Oxidation and deterioration of coal in storage.
Operation of fans and blowers like forced draft fans, induced draft fans etc including starting, stopping capacity adjustment etc.	Elementary principles of combustion and methods of firing different fuels I n boilers. Chemical re-action and factors affecting combustion such as temperature, surface area etc. The product of combustion specific heat of gases. Air supply and effects of excess and in sufficient primary and secondary air o n combustion. Ash fusion-analysis of the gases.
Operation of fuel (i.e. Coal/Oil/Gas) feeding mechanism including adjustment of flow of coal, Grate drive and draft regulation for proper combustion. Use of mechanical stoker.	Steam. its heating and power properties. Principles of steam and application in Modern Boilers. Steam preventing, escape of heat, lagging, stream distribution, charging of steam and water line, steam quality, condensate handling, traps etc. Wet steam saturated steam, super heated steam and their properties. Boiling point, temperature and pressure relations, sensible heat, latest heat super heat, reheat and total heat, Use of steam table and entropy chart.
Normal level control in Boilers. Operation and reading of gauge glass etc. Level control during the emergency operations and use of blow down valves.	Heat Transmission: Methods of heat transfer - conduction - transmission of heat through boiler plate and composite walls as well pipe coverings, convection - natural and forced, convection in liquids, heat transfer from condensing vapors - Boiler circulation and Radiation.
Reading and control of steam pressure and steam flow. Operation of super heater and re-heater. Control of super heat and reheat temperature.	Steam Generator. (Boiler) Internal pressure versus stress; elementary knowledge of Boiler drum construction and development and drum internals. Boiler metallurgy. Types of boilers. Fire tube boilers, locomotive boilers, cornish boiler, Lancashire boiler, water tube boilers, vertical tubular boiler, Economic boiler, Waste heat Boilers and Electric Boilers. Advantages of water tube boilers - Over fire tube boilers and bent tube boilers, over straight tube boilers. Difference between box

	type header and sectional header. Types of water walls used for furnace and their purpose. Use and types of baffles. ,Feed water temperature Elementary furnace design - water circulation. Effects of high temperature o n boiler steel.
Operation of water softener equipment including feed water softener. Clarificulators precipitators, filters, chemical dosing etc. Pre and post chlorination system. Reactivation of I on exchanges etc.	Boiler Auxiliary Plant. Boiler mountings and fittings; Description and use of safety valves, Blow down valves, check valves, combination stop and check valves, gauge glasses (mounted and remote type) draught pressure gauges, fusible plugs, re-heater, chain grate and spreader stoker etc. Different types of drum water level gauges and flame indicators. Use and advantage of televised viewers, for drum water level and furnace flame.
Correct use of various types of cocks, mountings and accessories used on Boilers. Firing and raising, steam and blow down in Boilers - precautions to be taken - procedure to be	Burners and Firing. Types of pulverized fuel burners and their control function dof each component of the burner - purpose of primary and secondary air supply methods of transporting pulverized fuel from coal mills to
observed before starting, firing and when raising steam.	burners. Arrangements of burner for tangential firing, horizontal front firing, single down shot and double down shot firing etc. Causes and remedy of fires in coal burners pipes. Safety precautions to be adopted in cases of fires causes, effects and preventions of furnace explosives. Importance of furnace purging an d how it is achieved, types of oil burners in sue. Injection of oil steam, mechanical atomization of oil, study of typical oil burners and purpose of each component. Types of oil iquition torches - their function and use. Description and use of spark ignitors and oil swebs of oil torches. Gas firing system.
Operation of boiler feed pumps - starting and stopping, including emergency operation. Purpose of balance chamber, leak off and recirculation line. Checking and correctness of pressure gauge.	Stocking and boiler operation. Methods of hand and mechanical firing water level- glow down - cleaning fires - banking up fires - cleaning heating surface - case of refractories - carbon losses clinker formation -difference between the use pulverized fuels in boilers and firing on grates, Emergency operations explosion hazards feed pumps failure. I.D. or F.D.. fan failure, Grate or stocker failures and fuel oil pump failure.

Internal conditioning of Boiler water by checking the TDS and alkalinity by blow down to prevent sealing, priming, carry over and caustic gauging. Conditioning of steam and condensate cycle. Importance of silica in high pressure Boilers and hw it is controlled.	Super Heater, Re-heater and De-Super heaters.
	Different types of super heaters and their function -Location of super heaters in high temperature and high pressure boilers. Requirement of a super heater. Methods of controlling super heat temperature of steam. Effects of temperature on super heater tubes. Purpose and general application of De-super heaters. Advantage and disadvantage of two general types of De-super heater. Importance of drains and vents in super heaters.
Periodic cleaning and filling the boiler with demineraled or condensate for prevention of scale or other deposits on heating surfaces.	Soot Blowers. Purpose and types of soot blowers. Fixed and Retarding types and their use. Precautionary measures taken while soot blowing. Methods of soot blowing and cleaning boiler furnace dur9ing operation.
Periodical inspection of Boilers - preparation of boilers for testing - Hydraulic test and steam test. Precautions to be taken before entering or allowing persons to enter a boiler which is connected to another boiler on the steam.	Feed Water Regulator and boiler feed water pumps. Method of regulating feed water to boiler. Description and use of bailes type of feed water regulation valve and purpose of by-pass valve in the system. Different types of feed water pump s. Constructional details of multistage pump. Use of re-circulation line and balance chamber. Purpose of balance drum and of pump waiming line and speed control.
Correct method of firing and combustion control for prevention of smoke. Testing the correctness of gauge glass and cocks by blowing through them.	Water Treatment. Object of feed water treatment -water analysis water of high pressure boilers. Impurities in water and their harmful effects. Effects of other suspended matter such as oil, alkalinity, hardness etc. In feed water - total dissolved solids - methods of purification - use of Deacrators - priming and foaming -scale formation and corrosion. Chemical cleaning of boiler, softening and demineraliser plant.
Priming of Boiler - the danger of water logging steam pipes and precautions to be observed in runn9ing. Replacement of gauge glass.	Boiler Inspection. Knowledge of Indian boilers Act and rules,. Isolating Boiler for cleaning and inspection. Offering boiler for hydraulic test and open inspection.

Adjustment of safety valves for correct blowing -pressure. Detection of false water level and knowledge of alarm devices.	Knowledge of modern packages types boilers and automatic boilers, their advantages over other boilers. Different types. Efficiency of Boiler (Overall and thermal).
Boiler safety precautions. Observation of easing a safety valve. Use of blow down cock or valve.	Boiler Testing. Losses due to incomplete combustion, loss due to escape of solid combustible matter with ash, soot, etc. Loss due to escape of combustible gases.
Cleaning of oil torches. Adjustment of high steam and low water safety valve. Renewal of fuseable plus. Use of spark ignitors and oil pumps for oil torches	Knowledge of different methods of fixing tubes by expending with ferrules, changing of gland packings, ,grinding and adjusting cooks and valve etc. Study of Boiler Act/ Rules 1923
Study of turbine-construction of different parts. Study of steam cylinder, steam chest, diaphragms rotor blades, discs, glands, coupling, bearing etc	Steam turbine-fundamental principals, impulse and reaction, their meanings, examples of impulsive and reactive forces, conversion of heat energy in a steam turbine, condensing and non- condensing turbines, mixed pressures, back pressures and pass out machines compounding, pressures compounding and velocity compounding
Study, Operation and adjustment of turbine governor, different types, method of working of synchronizing governor, over speed governor, speed limit governor and emergency shut off devices. The trainee must get a through practical idea of manual remote control of governors	Classification of steam turbine. According to - 1-Blading or nozzle arrangement impulse reaction and impulse reaction, delaval curties, reteau, zeely parsons systems. 2-Service and steam conditions: high pressure, non-condensing, exhaust steam turbine. 3-Kinds of stage: single, Double or multiple velocity stages only, reaction stages only, pressure stages only, pressure and velocity stages. Reaction and velocity stages compounding, pressure compounding, velocity compounding. Direction of flow: axial, tangential and radial. Division of flow: single, double, semi-doubles, Types of construction: horizontal or vertical.
Classification of steam turbine. According to - 1- Blading or nozzle arrangement impulse reaction and impulse reaction, delaval curties, reteau, zeely parsons systems. 2- Service and steam conditions: high pressure, non-condensing, exhaust steam turbine. 3-Kinds of stage: single, Double or multiple velocity stages only, reaction stages only, pressure stages only, pressure and velocity stages. Reaction and	Nomenclature and parts of a turbine, simple features of construction and functions of nozzles, blades, rotors, discs, cylinders, steam chest, diaphragms, glands, coupling, bearing, thrust balancing, reduction gear, lubrication system, governors, pressure regulators, protective devices etc. Turbine plant auxiliary: condensers including air ejectors- types, surface condenser, jet condenser function and construction.

velocity stages compounding, pressure compounding, velocity compounding. Direction of flow: axial, tangential and radial. Division of flow: single, double, semi-doubles, Types of construction: horizontal or vertical.	
Operation of steam pressure reducing station and H.P.,L.P. by pass station.	Governing mechanism and regulating systems both hydrodynamic and mechanical system: Principal of governing, nozzle and throttle governing, by-pass governing, stability and sensitivity of governors, their construction and method of working, over speed governors, speed limit governors, emergency shut off governors, oil relay, compound oil relay.
Turbine troubles and remedies-study of abnormalities during operation and remedical measures. Troubles, such as loss of vacuum, air leakage, low oil pressure, hot bearing etc. vibration-their causes and remedies	Turbine plant operation: general instruction for starting and stopping a steam turbine, running up turbines from cold and warm and hot conditions, steady load operation, effect of load changes, emergency operations, shutting down, care to be taken when removing and applying load to turn-alternators, routes care and inspection during normal operation, isolation for maintenance, defects in glands and bearing, loss of vacuum, causes and remedy, condenser tube leakage, air leakage detection.
Condensers- water flow, steam flow, constant water level control starting a condensing plant and stopping it. Care and precautions to prevent loss of vacuum, causes of loss of vacuum, remedies,	Turbine troubles and remedies: Vibration of shaft, disc, blade, internal defects of material, failure due to faulty machining of rotor, discs, critical speed damage due to unbalance of rotating parts- avoiding it. Failure of

Basic Fitting, Turning & Machining

Practical - I
Physical introduction to measuring instruments- Handling of Instruments- Exercise in the use of liner measuring instruments Such as steel rule of different ranges. Out side calipers, in side Calipers for measuring inside. Outside measurement, in side measurement, depth gauge.
Measurement of flat rectangular objects, cylindrical objects. Hollow components, threaded components. Exercises on external & internal measurements using micrometers & Height gauges
Introduction to safety including fire equipments & their uses. Familiarize with Fitter's hand tools. Filling a flat surface of mild steel & cast iron. Check for flatness straightness & squareness.
Simple blue print reading. Mark out according to simple to simple blue print. Hack sawing to dimension. Filing flat & square to size to an accuracy of +0.1mm. Marking & punching of stepped & angular components & finishing of stepped & angular components & finishing the part to the required shape & size to an accuracy of +0.1mm.
Exercise on angular measurement using combination set & vernier bevel protector. Center drilling, reaming, counter sinking, counter boring and tapping for various sizes of mild steel and tapping on various size of mild steel material.
Fitting exercise-simple to complex (Involving drilling, tapping, reaming, counter boring & slide fitting).
Introduction to the trade area & the type of jobs made by the trainees in the workshop. Safety on handling tools & equipment related to the trade. Setting up of arc & gas apparatus. Lighting & adjustment of oxyacetylene flame & fusion runs with & without filter rode on 2 to 3 mm thick M.S sheet(in flat position in gas) . Striking & maintaining of arc & drawing shot heads of M.S. plate 10 to 12 mm thick (in flat position in arc).
Lap, fillet & fillet joints on MS sheet 3mm in flat position (gas). Oxyacetylene cutting hand & machine square & level on 12 mm MS plate. Brazing on MS & Copper.
Manufacturing process and their importance in Industries. Safety precautions followed on shop floor Vernier caliper and micro-meter, construction, parts, principles, application making the jobs. Different types cutting tools, grinding practice on pedestal machine.
Introduction of shaping, planning and slotting- construction, types, parts, function and used, shaping rectangular block as per sketch.
Introduction to milling machine demonstration on working principle, setting of jobs, setting of cutter in arbor setting of vice on table. Step milling using side and face cutter checking with micro-meter. Slot Mill using slot milling cutter. Face mill using face milling cutter.
Setting of indexing head on milling, table and mill a hexagon on a round bar using direct indexing method. Spur gear cutting on horizontal milling machine using simple indexing methods. Checking with gear tooth Vernier calipers. Milling a rack by linear indexing method
Introduction of engine lathe and parts, holding the job in three & four jaw chuck. Facing and plain turning operations use of measuring tools required for turning.
Facing, Plain and Turning. Taper Turning by compound rest slide methods. Setting threading tool and cutting the external "V" threads.
Perform centre drilling, boring, parting off, Knurling, grooving, chamfering operations.
Balancing and truing of grinding wheel. Mounting and dressing of grinding wheel. Re sharpen of plain turning tool on Pedestal grinder to an accuracy of one degree; check the tool angle using bevel protector.

List of tools and Equipments

Sr.	Particulars	Quantity
1	**2**	**3**
1	Measuring tape 3 meter	10
2	Inside spring caliper 200 mm	10
3	Outside spring caliper 200 mm	10
4	Ball pin Hammer - 200 gm	10
5	Fix spanner 23 mm set 9 spanner	10
6	Ring spanner 6 to 23 mm	10
7	Chisel cold flat 20x150 mm	10
8	Steal scale 300 mm engineering	10
9	Try square 200 mm	10
10	Screw driver 300 mm	10
11	Centre punch 100 mm x 100 mm	10
12	Scriber 150 mm	10
13	Bradawl 200 mm	10
14	Odd leg caliper spring type 200 mm	10
15	Out side spring caliper 400 mm	02
16	Inside spring caliper 400 mm	02
17	Ball pin hammer 400 gm	04
18	Flat chisel cold 25 x 200 mm	02
19	Cross cut chisel 150 mm	02
20	Sledge hammer 2 kg	01
21	Cross pin hammer 400 gm	02
22	Mallet	02
23	Teflon hammer	01
24	Vernier caliper 200 mm digital type	01
25	Vernier caliper 150 mm digital type	01
26	Micrometer 0-25 mm	01
27	Depth meter 0-300 mm	01
28	Slip gauge set	01
29	Feeler gauge leaf type 26 blades eng. & metric	02
30	Radius gauge leaf type 1to 15 mm	01
31	Digi matic thickness gauge	01
32	Universal Bevel protector	01
33	Pipe wrench 200 mm	02
34	Pipe wrench 300 mm	02
35	Adjustable wrench 250 mm	02
36	Combination pliers 200 mm	08
37	Long nose pliers 200 mm	04
38	Flat file bastard 250 mm	08
39	Flat file smooth 250 mm	08
40	Flat file rough cut 250 mm	04
41	Flat file rough cut 300 mm	08
42	Half round file smooth - 250 mm	04
43	Half round file rough - 250 mm	04

44	Round file smooth - 200 mm	04
45	Round file Smooth - 200 mm	04
46	Triangular file - 150 mm	04
47	Square file - 200 mm	04
48	Needle file set	04
49	Allen key 12,14,15,16,18,20,22 mm	02 each
50	Ring spanner 25x28, 24x26	02 each
51	Torque wrench	01
52	Tap set B S W	01
53	Die set B S W	01
54	Box spanner socket set 12.7 mm square drive hexagonal sockets set of size 10,11,12,13,14,15,16, 17,18,19, 21, 22,23,24,26,27,28,29,30,32,33,34 with accessories	02
55	Anvil big size	01
56	Surface plate 400x400 mm	01
57	'V' Block	02
58	Hack saw frame adjustable 300 mm	08
59	Grease gun	02
60	Oil cane 500 ml	02
61	Screw Driver 400 mm	02
62	Screw Driver 300 mm	02
63	Try square 300 mm	02
64	Tap set metric	01