MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI

1	Name of Syllabus	**C.C. in Process Plant Electrical Maintenance & Repairing Of Equipment (307110)**
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 pass from Chemical group of MSBVEE
9	Objective Of Syllabus/ introduction	1. Awareness of Safety precautions 2. Knowledge of Engineering skill, use of tools in assembly 3. Awareness of Process Plant. 4. Awareness of Process Plant Electrical Equipment Maintenance & Repairing 5. Awareness of Electrical Equipment Maintenance. 6. Awareness of Basic Electrician, Electronics, Computer.
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which Develop, Maintain, Repair Process Plant. Work as or with working experience will be in a position to start his own independent Business.
11	Teacher's Qualification	Diploma/Certificate in concern subject
12	Training System	**Training System Per Week** Theory: 12 Hours; Practical: 30 Hours; Total: 42 Hours
13	Exam. System	

Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks
1	**30711011**	Process Plant Electrical Equipment Maintenance & Repairing	TH I	3 hrs	100	35
2	**30711021**	Basic Electrician, Electronics, Computer	PR I	3 hrs	100	50
3	**30711022**	Process Plant Electrical Equipment Maintenance & Repairing	PR II	6 hrs	200	100
		TOTAL			**400**	**185**

Process Plant Electrical Equipment Maintenance & Repairing

Topics	***Theory - I***	***Practical - II***
	Fundamental of electricity concept of circuits,definition units & effects of electric current,ohms law & kirchhops low, electric power energy common electrical accessories their specification, cable & wires ,mob. Battery, their testing & maintenance	Demonstration of Electrical Tools kits. Verification of ohm's law use of millimeter & wattmeter, Building /layout assemble of small ckts. Demonstration practice on fixing common Electrical accessories, identification measurement of wire, Overhauling battery
	Magnetic terms, electromagnetism, electromagnetic induction, faradays law Lenz's law, DC generator, types, characteristics armature reaction ,commutation, testing	Identification & testing cd generator, use of mugger, making load and no load characteristic curve of dc generator
	Dc motor, types their characteristic & use, starters, type of speed control method & their application Method of testing & repairing dc machine, troubleshooting, routine Maintenance	Identification & testing of dc motor, study of the character of dc motor, study of starter. Connection starting, speed control of starter of motor. Dissemble a dc machine
	Electrical wiring IEE rules, types of wiring, domestic & industrial wiring, accessories testing by mager, specification standard of conduits & accessories earthling laying diagram of industrial conduit wiring, colors code of cable	Practicing different type of wiring by using wiring accessories,
	Alternating current & related terms, generation of sine ware, phase, in phase out phase. Obstruction of A.C.'R'XL&XC impedance, power factor, average power, reactive power. Problems on ac cks. Concept of poly phase star & delta connection	Demonstration of sine ware, instantaneous values etc. study of the behavior of R, xL & XC in A.C.ckts.both in series &in parallel. Exact on poly phase ckts. Current, voltage &power measurement in poly phase ckts. Measurement of energy in single &poly – phase ckts

	Explanation of alternator. Prime/move type advantages, parts, regulation, and phase sequence, specification of alternators & practical of uses. three phase voltage generator, Test on alternator. General maintenance & routine test	Demonstration on alternators, parts voltage building, load character& regulation Troubleshooting of alternator
	Explanation & defecation of Transformer, classification- C.T.,P.T. Instrument &auto/VARIAC construction, parts working, E.M.F. equations efficiency, parallel operation &poly phase types connection ,cooling, protective devices. Special transformers. Routine test on transformers	Identification of transformers. connection of transformers efficiency of transformer, testing of transformer, parallel operation of transformer, use of C.T. & P.T. use of instrument transformer.
	Working principal of A.C. motor parts of A.C. motor types {single &three face} their characteristic & application of A.C. motor testing	Demonstrate single phase & three phase Induction motor, measuring speed current& torque. Dissemble of AC motor.
	Starters its necessity types basic control ckt, parts & function, BIS symbols pertaining to control & machine, rotary switch Maintenance service & trouble shoot. Of motor & starter	Demonstrate starters Contactor program of different type of starters, assemble & connect & run an induction motor identify F/R switch
	A.C. winding terms, armature winding terms, coil side, end coil &grouping of coils. Connection to adjacent poles, connected armature winding, alternator pole connection armature winding –Lap & wave connected	Making forma, coil insulation, slot insulation, insertion of coil in slots coil connection practice in single layer concentric winding

	D.C. winding terms, pole & pitch, coil back pitch, front pitch – progressive& retrogressive winding	Winding practice in distributed type, testing for faults, Growler testing –baking impregnating & varnishing
	Transformer construction & core winding shielding, auxiliary parts-breather, conservator buchltzrely, other protective devices cooling of transformer. it oil testing & tap changing off load & on load its bushings & termination.	Cleaning maintenance of transformer-changing of silica gel. Conducting no load & short ckt tests. Testing 1ph & poly ph. transformer
	Explain & definition of Amplifier, How a transistor, Amplifiers, signals, pulse, shapers cascade system, expl and definition of oscillator, working principal ex placation of stage and types	Assembly & testing of a single stage amplifier and checking in an oscilloscope study of types of wave shapes. Study of oscillator ckt. Voltage measurement current and study wave shapes in scope
	Expl and working principal and practical application of UJT, FET, SCR Dias & Triac Motor speed control circuit using SCR power supply stabilizer	Study of simple ckts Contain UJT of triggering do FET as an amplifier Do power control by SCR & Triad & Dias Demonstration on power supply stabilizer
	Define converter inverter MG set description characters, specification running & Maintenance	Starting running and building up voltage & Loading of MG set, maintenance of MG sets
	Insulating material, their classification and their uses in industries, type of coupling, method of alignment, foundation for MG set, panels for electrical work.	Development of sequence of operation in detecting electrical & Mechanical Trouble in motors and generators, overhauling of AC and DC machine. Align MG set. Prepare foundation for MG set. Install & wire up a panel for MG set

	Substation, Accessories mounted in substation types of substation, over head poles and method of jointing aluminum conductor. Specification, advantages, Line Insulators , underground cable & joints sealing the cable at the junctions	Identify different accessories in sub station, Erect overhead service line Draw overhead line Making different type of joint in under ground cable
	Transmission Distribution & Generation. Circuit breakers, Electromagnetic clutches, method of maintenance & Servicing, Relays, Busbar system	Identify different accessories in sub station, Erect overhead service line Draw overhead line Making different type of joint in under ground cable
	Introduction of precision measuring instrument (ie megger earth tester, frequency meter, energy meter etc)and their use and safety introduction of pipe cutting used of pipe fitting element	Measuring technique of precision measuring instrument. Pipe threading by die stock
	Introduction of compressor Air Gauge and their use in plant safety valves. Pumps and their kind centrifuge and reciprocating pump use and their maintenance	Air Compressor Maintenance Pump Maintenance
	Fans F D Fans I D fans blowers injector and other bailer instrument motor maintenance and motor pump coupling Alignment	Fan and blower injector repairing motor maintenance
	Gear Boxes different types of gear box its use and maintenance gauge Temperature measurement thermo meter Thermo Couple Pyro meter	Gear Box Over hauling Repairing of Thermo couples
	Metal – Physical and mechanical properties ferrous and Non Ferrous Metal Ferrous and Non ferrous Allows	Maintenance of Ferrous
	Pressure gauge their use and safety flow measurement gauge use and their safety measurement speeds	Different types of Gauge Maintenance
	Revision & Test	Project Work
	Examination	Practical Examination

Practical: - Basic Electrician, Electronics, Computer

Topic	*Practical - I*
Basic Electrician, Electronics, Computer .	Demonstration of use of safety equipments and artificial respiration. Use of hand tools, join practice with single and multi – stand conductors of different wires. Joining practice of bare conductors – soldering practice on printed circuit boards- Demonstration & practice on soldering the aluminum conductor, cable joints. Use of aluminum flux and Alca 'p' solder. Demonstration and practice of crimping of various wires.
	Making of a simple circuit with a lamp and battery. Study and use of multi maters - measurement of current, voltage, resistance in DC\AC circuits. Demonstration & verification of ohm's law – series circuits – parallel circuits. Demonstration in circuits –use of tong tester and megger .
	Simple wiring practice with distribution boards, junction boxes, main switches two way and intermediate switches. Identification of different parts of dc generators-testing and measuring the field and armature resistances. Identification of different parts of ac motors-testing and measurement on induction motors- demonstration on alternators. Identification and testing of transformers. Grouping & testing of cells for a specified voltage & current-preparation of battery charging.
	Identification of different type of capacitors- testing of capacitors – identification and testing of assorted diodes, PNP\ NPN transistors – uni-junction transistor, field effect Transistor & silicon controlled rectifier Ics etc. - demonstration on rectifiers – identification of Ics
	Booting the computer ,opening windows menus, using the mouse, refresh computer desktop using right click of the mouse, create a directory in Expand Linux, format a floppy , create a file using notepad, save the file in floppy, copy the file into hard disk, copy a file from hard disk to floppy, create a directory in floppy, create a directory in hard disk, use my documents , use start menu for opening an application , to open a document recently written, change control panel settings for familiarize with keyboard and keys.
	Techniques of changing desktop wall paper, changing desktop screen properties, control panel, user accounts, customizing icon, writing a sample text using notepad, using paint for drawing figures to get accustomed with mouse. Saving a file. Using windows explorer ,install a software , remove a software, add new changing the regional settings of the system (like a printer , change the system date and time, changing the regional setting of the system like country, currency, date format, using start menu, creating desktop short cuts.

	Open internet explorer, change the settings in IE, customize internet explorer for default applications, enable cookies, change the security settings, setup an internet connection, user ID and password saving in the computer for future usage, setup outlook express for an Email account, setup server authentication settings, receive and send Email from the account. Search using yahoo and Google for certain topics, download file. Setup the net meting using MSN and yahoo messenger.
	Open MS WORD, create a new file, save a file, open an existing file, save as a text file, type a paragraph, set for left and right margins, change the letters from upper to lower case vice versa, cut a paragraph, copy a paragraph, setup tab positions, draw a simple table, insert rows, insert columns, erase rows, erase columns, search the document for spelling corrections, print the letters in a printer attached in portrait and landscape. Open excel and workout the following to understand the theory commands. Prepare a salary bill for ABC organization with column A for names, column B for basic salary, column C for DA, column D for addition of B & C to get the full salary, add the column D into a new cell as TOTAL amount. Print the sheet using set print areas with margins, and use scale factor for reduction and enlargement, use portrait and landscape.

List of Tools and Equipments for Mechanical Maintenance

Sr	Particulars	Quantity
1	**2**	**3**
1	Measuring tape 3 meter	16
2	Inside spring caliper 200 mm	16
3	Outside spring caliper 200 mm	16
4	Ball pin Hammer - 200 gm	16
5	Fix spanner 23 mm set 9 spanner	16
6	Ring spanner 6 to 23 mm	16
7	Chisel cold flat 20x150 mm	16
8	Steal scale 300 mm engineering	16
9	Try square 200 mm	16
10	Screw driver 300 mm	16
11	Centre punch 100 mm x 100 mm	16
12	Scriber 150 mm	16
13	Bradawl 200 mm	16
14	Odd leg caliper spring type 200 mm	16
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
65	Die set metric	01
66	Bench vice 150 mm	08
67	Pipe vice 100 mm	02
68	Internal circlip plier straight 150 mm	04
69	External circlip plier spring type 150 mm	04
70	Water pump plier slip joint 250 mm	04
	General Machinery	
1	Gland type centrifugal pump with closed impeller Dis. Cap- 1m^3/hr with suitable ISI motor	02
2	Mechanical seal type centrifugal pump with open impeller Dis. Cap- 2 nfVhr with suitable ISI motor	02
3	Gland type four stage centrifugal pump semi open impeller Dis. Cap- 3 m^3/hr with suitable ISI motor	02
4	Stainless steal centrifugal pump Dis. Cap- 3 m^3/hr with suitable ISI motor	01
5	Water ring type vacuum pump Dis. Cap- 3 m^3/hr with suitable ISI motor	02
6	Reciprocating type vacuum pump Dis. Cap- 4 m^3/hr with suitable ISI motor	01
7	External gear pump (Herring bone gears) Dis. Cap- 4 mP/hr with suitable ISI motor	02
8	Internal gear pump (Spur gear) Dis. Cap- 3 nvVhr with suitable ISI motor	01
9	Two stage double acting Air Compressor with all accessories like receiver, safety devices etc. with suitable ISI motor	01
10	Single stage air compressor with all accessories with suitable ISI motor	01

11	Single stage double acting refrigerant compressors with safety devices with suitable ISI motor	01
12	Centrifugal compressor with all accessories with suitable ISI motor	01
13	S.S. Ball valve single piece construction 1"	04
14	C.S. Ball valve one piece construction %" & two piece construction 2"	04 each
15	C.S. gate valve 2" & 4"	02 each
16	C.S. globe valve 3"	02
17	Non return valve %", 1", 4"	02 each
18	Diaphragm valve 1"	02
19	S.S. Needle valve 1%"	02
20	Two pass cast steal U tube type heat exchanger with M.S. shell size dia 12", no of tubes 24, dia %"	02
21	Six pass straight tube type heat exchanger with M.S. shell size dia 16", no of tubes 36, dia 1"	01
22	Four pass straight tube type heat exchanger with M.S. shell size dia 10", no of tubes 16, dia %"	01
23	S.S. plate type heat exchanger having four plates size 36"	01
24	Choke removal pump with accessories	01
25	Flanges as per I.S. Code size 12 mm, 19 mm, 25 mm, 50 mm	05 each
26	Collar type flanges size 50 mm, 75 mm & 100 mm	04 each
27	Bearing puller	02
28	Ball bearing 6004, 6110, 6212, 6420	01 each
29	Roller bearing of different sizes	01 each
30	Taper roller bearing	02 each
31	Needle roller bearing	02 each
32	Flange coupling size 100 mm, 150 mm with rubber bushes	01 each
33	Tyre coupling size 150 mm	02
34	Spider type coupling 75 mm, 100 mm	02 each
35	Knuckle joint size 6"	02
36	Kotter joint	01
37	Different types of chains	01 meter
38	Gear Box reduction type ratio 1:4 rack & pinion	01
39	Gear Box reduction type ratio 1:10 rack & pinion	01
40	Lapping plate along with lapping paste of different grades	01
41	Hydraulic pump with pressure gauge upto 20 kg/cmP	01
42	Power hacksaw machine of blade size 600 mm	01
43	Pedestal Grinder with coarse and fine grinding wheels size 300 mm	01
44	Angle hand grinding machine	01
45	Strainer Y-type	02
46	Strainer bucket type	01
47	Spring loaded safety valve capacity 5 kg/cmP	01
48	Chain pulley block one tonne	01
49	G.I. Wire rope dia 12 mm	20 meter
50	D shackles	04
51	Root blower	01
52	All geared Lathe machine admit between centres 1500 mm with all accessories	01
53	Drill machine cap. 20 mm geared with all accessories	01
54	All geared shaping machine cap. 450 mm with all accessories	01