110 – INSTRUMENT MECHANICS WORK

EXAMINATION STRUCTURE

The trade consists of the following trade related courses:

191 – General Metal Work

193 – Building/Engineering Drawing

194 – Basic Electricity

The trade will also be examined under the following components or subjects groupings:

1. 111 – Mechanical/Pneumatic Instruments (CIM 11, 15 & 18)
2. 112 – Electrical/Electronic Instruments (CIM 12, 13 & 14)

EXAMINATION SCHEME

111 – Mechanical/Pneumatic Instruments

The examination will comprise of two papers:

111-1 – PAPER I : This will consists of two sections, viz:

SECTION A: OBJECTIVE: this will be forty (40) multiple choice questions. Candidates will be required to answer all in 40 minutes. This section carries forty (40) marks.

SECTION B: ESSAY: this will be a written paper of seven (7) questions. Candidates are to answer five (5) questions in 2 hours. This Section carries sixty (60) marks.

111-2 – PAPER II: PRACTICAL: This paper will consists of two (2) practical/experimental questions and candidates are to answer all. The paper which is of three (3) hours duration carries 100 marks.

112 – Electrical/Electronic Instruments

This subject grouping consists of two papers:

112-1 – PAPER I : This will consists of two sections, viz:

SECTION A: OBJECTIVE: this will be forty (40) multiple choice questions. Candidates will be required to answer all in 40 minutes. This section carries forty (40) marks.

SECTION B: ESSAY: this will be a written paper of seven questions. Candidates are to answer five questions in 2 hours. This Section carries sixty (60) marks.

112-2 PAPER II: PRACTICAL: This paper consists of three (3) practical/experimental questions and candidates are to answer all in three (3) hours; and it carries 50 marks.

111 – MECHANICAL/PNEUMATIC INSTRUMENTS (CIM 11,15 & CME 18)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Safety Precaution** 1. Name three elements required to cause the existence of fire, the common causes of fire accidents in industry and state the method of fire fighting and fire prevention. 2. Demonstrate the use of the fighting equipment and apply safety wears required on different jobs. 3. Identify common electrical hazards. Some toxic fumes and gases found in industry and their causes.	1. Safety precaution a. Labour safety techniques. b. Elements that cause the existence of fire e.g. heat, oxygen and fuel. c. Common causes of fire accidents in industry e.g. Electrical (short circuit); Smoking/Naked Flame; Explosion etc. d. Personal safety wears e.g. Foot Wear; Goggles; Apron; Helmets; Gas Masks; Ear Muffs/Plugs etc. e. Major hazards in Industry and their causes e.g. electrical and toxic materials e.g. SO_2, H_2S, CI_2, Asbestos Dust, Tetra Ethyl Lead Fumes (Tcl) etc. f. Common electrical hazards in industry i. Shock - caused by exposed live wires. ii. Burns cause by sparks and exposed live wires. iii. Explosion caused by sparks.	Demonstrate the use of fire fighting equipment.
2.	**Pressure** 1. Define pressure and the types used in pressure measurements. 2. Select, name, identify and explain with the aid of labeled sketches, the working principle of pressure measuring devices. 3. Trouble shoot pressure instrument, measuring instrument, transmitting, pressure measure, instruments and common methods of pressure transmission in industry. 4. Calibrate and read pressure measuring instruments taking into consideration the environmental effects on the standard instrument. 5. Disassemble service and reassemble pressure measuring instrument with the aid of relevant manual making sure that component parts are replaced in their correct	1. Definition of pressure as force/unit area i.e. F/A and type used in pressure measurements; e.g. atmospheric pressure, gauge pressure, absolute pressure, differential pressure, vacuum pressure. 2. Pressure Measuring Instruments e.g. Barometer, Bellow Gauge, D. Pcell, Bourdon Tube Gauge, Diaphragm Gauge, Manometer, Compound Gauge. 3. Pressure Transmission e.g. Hydraulic Transmission, Pneumatic Cylinders,. 4. The working principles, components and functions of the components of the various types of pressure measuring instrument. 5. Common types of pressure measuring/calibrating devices e.g. Pressure Gauges, Bourdon Tube, Bellow, Diaphragm etc. 6. Reading and recording of pressure measuring instruments. 7. Bourdon tube gauges e.g. C-type, helical and spiral types. 8. Trouble-=shooting in pressure measuring/indicating instruments e.g. DP cell and methods of rectification.	

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	positions. 6. Couple or uncouple pressure instrument and replaced damaged parts with the appropriate part number in the catalogue.		
3.	**Flow and Flow Measuring Instrument** 1. Define flow rate and explain the working principles of flow rate meter and totalizer with the aid of labeled sketches. 2. Select the instruments used for flow rate, total flow and explain the difference between the function of the flow rate meter and totalizer. 3. Calibrate, read and record flow rate in units indicated on flow rate and total flow in units indicated on totalizer. 4. Disassemble, reassemble, trouble shoot, repair and service given measuring instruments with the aid of relevant manuals noting the position of the components and taking care that parts are fixed in their correct positions 5. Couple and uncouple flow measuring instruments to or from lines.	1. Definition of flow rate i.e. q = Q/t where q = flow rate in cubic meter/hour; Q = total flow in cubic meter units, t = time in hours and terms used in flow rate measurement. 2. Instruments used for measuring flow rate e.g. Turbine Flow meter; Rotating Vane Meters (assorted); Magnetic Flow Meter; Rota Meter; D.P. Cell (incorporating office plate, square root extractor and flow indicator); Pilot Tube; Parshall flume; Venturi Meter (flow tubes). 3. The totalizer/integrators as an instrument for measuring total flow. 4. Types of instrument used for measuring total flow e.g. Oscillating Piston – Water Pump; Volumetric Meter; Rotating Vanes – Petrol Station Pump Meter. 5. The working principles of the various flow rate meters. 6. Calibration of flow rate instrument: Weight Meter; V-Notch; Meter Provers. 7. Trouble shooting and methods of rectification e.g. Rotating Vane Meter; Magnetic Flow Meter; D.P. Cell. 8. Maintenance of flow rate meters by: a. changing of damaged parts b. cleaning of parts c. lubrication of moving parts.	
4.	**Level and Level Measuring Instruments** 1. Explain what is meant by level with respect to reference point of datum line. 2. Explain the working principles of the level measuring instruments and state their units. 3. Read and record levels indicated on the instruments with the appropriate units and state the limitations of each of the level measuring instrument. 4. Install, disassemble,	1. What are levels and the units for level measurement. 2. Instruments for the measurement of levels e.g. Dipstick, Sight Glass, Float Device, Content Gauge, D. P. Cell 3. Working principles of the level measuring instruments. 4. Maintenance of level measuring instruments. 5. Installation of level meters. 6. Servicing of sight glass and float device e.g. Changing of damaged components; Cleaning of Parts; Lubricating Moving Parts. 7. Limitation of level measuring instruments e.g. Dipstick cannot be used in pressurized vessel; Sight glass is fragile and measurable range is limited; Float	The level of measuring devices should be displayed.

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	assemble and service sight glass and float device on appropriate equipment and noting the relative position of components parts.	device is limited by friction.	
5.	**Temperature measuring Instrument** 1. Define temperature, state their units and convert one unit of temperature to another. 2. Explain working principles of temperature measuring instruments. 3. Calibrate thermometer, thermocouple and a resistance thermometer using ice bath and steam, note the resistance of melting point of ice and boiling point of water. (Boiling point of water at sea level is 100ºC) 4. Explain the working principles of a temperature transmitter with the aid of schematic diagram and give two examples of its application. 5. Install temperature measuring devices, read and record value with units on given instruments.	1. Definition of temperature and its units Fahrenheit etc. 2. Temperature measuring instruments e.g. Mercury, gas thermometer, resistance thermometer etc. components and limitations. 3. Working principles of temperature measuring instruments 4. Reading and recording of temperature. 5. Calibration of temperature measuring instrument. 6. Working principles and application of the temperature transmitter e.g. control of flow of fuel to heaters etc. 7. Installation of temperature measuring devices.	Calibrate a simple mercury thermometer, a thermoicouple, a resistance thermoimeter using ice bath and steam, taking into consideration that the boiling point of water at sea levels is 100º centigrade.
6.	**Speed and Speed Measuring Instruments** 1. Define speed, velocity and frequency with their units, convert frequency to angular velocity and linear velocity. 2. Describe instruments used for speed measurement, discuss their application, constructional details and their working principles (indicating the nature of speed measured). 3. Construct, calibrate, read and record speed measuring device observing safety rules. 4. Dismantle and reassemble	1. Definition of speed as distance or angle covered per units time: a. V = S/t where V = linear speed in meters or feet/second S = distance in meters or feet. t = time in seconds. b. W = Q/t where W = angular speed in radius Q = angle in radius t =- time in seconds. 2. Velocity as speed in a given direction and frequency as number of revolutions or cycle/second their respective units of measurement. 3. Relationship between speed, velocity and frequency and methods of conversion. Conversion of formula: $w = 2\pi F$ where f = frequency in Hertz or cycle per second. 4. Speed measuring instruments; working principles, constructional details and applications e.g. D.P. Cell; Pilot Tube,	Observe safety rules.

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	gas and air measuring devices noting the relative positions of component parts.	Tachometer. 5. Reading and recording of speed using; a. Tachometer for angular speed. b. Anemometer c. D.P. cell d. Orifice Plate etc. 6. Constructional and calibration of anemometer to measure gas and air and tachometer to measure the speed of an engine wheel or shaft.	
7.	**Cathode Ray Oscilloscope Instrument** 1. Label a given block diagram of a CRO, state the function of each part and advantage of CROI when used as a measuring device. 2. Obtain a spot trace and a continuous horizontal trace on a CRO. 3. Display a sinusoidal signal on the screen of a CRO and measure the amplitude, frequency and voltage.	1. The CRO: basic components, working principles, applications and limitation. 2. Methods of obtaining various traces and signals on a CRO. 3. Use of CRO in the measurement of amplitude frequency, voltages etc. 4. Terms used in labeling CRO: Electron Gun, Grid, Focusing Equipment, Deflection system, Screen. 5. Emphasis should be laid on terms used when labeling diagram of a CRO e.g. Electron Gun, Grid, Focusing Equipment.	Observe safety rules.

LABORATORY/PROCESS ANALYTICAL INSTRUMENTS(CIM 15)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Valves** 1. Give qualitative definition of pH and state both valves of neutral liquid, alkalinity and acidity with references to the neutral point. 2. describe and service the instrument used for the measurement of pH value and also measure pH values of different solution.	1. Qualitative definition of pH, alkalinity and acidity with references to the neutral point pH values of various materials and solutions. 2. The pH meters; its components, working principle and methods of application. 3. Maintenance of pH meters.	Measure pH values of different solutions with the aid of the pH meter.
2.	**Hygrometer** 1. Define humidity and describe the instrument used for measuring humidity. 2. Give the unity of humidity and measure relative humidity of the air in the laboratory.	1. Definition of humidity, relative humidity ratio (specific humidity). The units of humidity. 2. Instrument used for measuring humidity; basic components. 3. reading and recording of humidity with the aid of hygrometer.	Measure the relative humidity of the process air in the laboratory with the aid of hygrometer and record the reading.
3.	**Viscometer** 1. Define viscosity. Describe and identify the instruments used for measuring viscosity. 2. Measure the viscosity of some liquids and give unit of measurement.	1. Definition of viscosity and it limits. 2. The viscometer; its components, working principle, methods of usage. 3. Reading and recording of the viscosity of solutions using the viscometer – Water, Oil, Lubrication Oil, Fuel Oil etc.	
4.	**Tintometer** Explain colour in liquids, name, describe and identify the instrument used for measuring it.	1. Types of colour in liquid. 2. The tintometer; its components, principle and application, working principle.	Measure colour in liquids with the aid of the tintometer and record the readings.
5.	**Gas** 1. Name, describe and identify the instruments used for detection of presence of gases. 2. Use, care and maintenance of gas analysers.	1. Gas analysers; basic components working principles and method usage. 2. Geiger counter; working principle and applications. 3. Detection of gas presence using gas analysers. 4. Maintenance of gas analysers.	Use gas analyser to detect the presence of: a. Carbon dioxide (use the dioxide analyser). b. Oxygen (use oxygen analyser). c. Chlorine (use the chlorine analyser etc).
6.	**Liquid Separation** 1. Explain the principles of liquid separation and separate mixture of liquid in their separate vessel by using a centrifuge. 2. Maintain and care of centrifuge.	1. Centrifuges; major components, working principles and usage. 2. Maintenance of centrifuges.	Separate mixture of liquid in their separate vessel using the centrifuge.
7.	**Turbidity** 1. Define turbidity.	1. Turbidity, turbidity meter, its major components and usage.	

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	2. Measure and maintain turbidity meter.	2. Maintenance of turbidity meter.	

GRINDING (CME 18)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Grinding Machine** 1. Explain the working principles, the constructional details and the characteristics of a grinding machine. 2. Describe the various components of a grinding machine.	1. Working principles and the constructional details of a grinding machine: a. Characteristics of a grinding machine. b. Components of a grinding machine e.g. grinding wheel, workable wheel spindle etc.	
2.	**Grinding Operation** 1. Identify, state and describe the basic types, the constructional features, the functions and advantages of grinding machine in modern engineering production. 2. Differentiate between off-hand and precision grinding and state where each type is used.	1. Grinding operations and methods of grinding. 2. Types of grinding machine e.g. Hand Grinding, Portable Grinder etc. 3. Constructional features, functions and limitations of various types of grinders.	
3.	**Grinding Machines and their Accessories** 1. Explain the working principles of grinding machines, the cutting action of a grinding wheel and select the cutting speed for a grinding operation. 2. Describe how to maintain grinding machines.	1. How the grinding machine works e.g. Hand grinder, centreless grinder, universal grinder etc. 2. Cutting action of the grinding wheel. 3. Calculation of the wheel speed using the formulae $S = \frac{\pi DN}{1000}$ Where $\pi = 3.142$ D = Diameter of wheel in mm N = No. of revolution per minute S = speed of machine. 4. Factors governing the choice of grinding speed for a grinding machine. 5. Maintenance of grinding machines: a. Top up oil level b. Grease the machine etc. 6. Use of table in the selection of cutting speed.	Calculate the wheel speed, surface/feed speed to suit wheels and materials being ground and state the factors governing the choice of grinding speed for a grinding machine.
4.	**Grinding Wheels Composition and Classification** 1. Describe the composition, main components, the abrasive, and the bond of grinding wheel. 2. State the types of abrasive used, the type of work they are best suited, basic classification, characteristics and factors to consider in selecting a	1. Types of grinding wheel and their main components. 2. Composition of the various types of grinding wheel. 3. Uses of grinding wheel. 4. Types of abrasive used for grinding wheels: a. Silicon carbide – grinding of materials with low tensile strength such as aluminium ceramics etc. b. Aluminium oxide – grinding materials with high tensile such as heat treated parts.	

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	good grinding wheel. 3. Explain bond. The types of adhesives used and test a wheel for soundness. 4. Describe the shapes of grinding wheel, their spacing and select appropriate grinding wheel for a job.	5. Types of adhesives and bond e.g. organic and inaorganic i.e. Vitrafied, silicate, shellac, rubber and resinoid. 6. Classifications of a grinding wheel i.e. Grain size, strength and hardness e.g. Coarse abrasive grain size of 6 – 14. 7. Selection factors e.g. Wet or dry operation, The size of machine, materials to be ground etc. 8. Test for soundness.	
5.	**Safety** Explain basic safety rules to be observed in using grinding machines and apply safety rules.	1. Safety rules and measures during grinding operation e.g. Wear safety goggles or glasses; Avoid loose clothing; Keep away from grinding wheel in motion etc.	
6.	**Surface Grinder** 1. Describe and explain the use of surface grinder, its size, component parts, functions and the meaning of common terms used in machine shop. 2. Select appropriate work holding devices for a surface grinder, electromagnetic check and carry out surface grinding operation to angular and cylindrical surfaces.	1. The surface grinder, uses, components work holding devices (accessories), types of abrasives use, operating mode and methods of feed. 2. Terms used in a machine shop and their meaning e.g. Table speeds, Craft Feeds, In Feed, Coolants, Wheel speeds (as abrasive)	
7.	**Cylindrical Grinder** 1. Explain the use of cylindrical grinder in a machine shop. 2. Select appropriate work holding devices for a cylindrical grinder and carry out operation to external surfaces.	1. The cylindrical grinder uses, components work holding devices and accessories: a. Centres and the clog b. Work rest in case of a long work piece. Types of abrasives used. 2. Modifications of the cylindrical grinder e.g. Internal and external feed methods.	
8.	**Centreless Grinder** 1. Describe and explain the use of centreless grinder, its size components, specific functions and state its advantages and disadvantages over a cylindrical grinder. 2. Carryout centreless grinding operation, apply the appropriate coolant, grinding wheel, work rest blade and regulating	1. The centreless grinder, its uses, components and their specific functions, work holding devices and types of abrasive used. 2. Feed method. 3. Advantages and disadvantages of centreless grinder compare with other forms of grinder e.g. cylindrical grinder. 4. Cutting and cooling fluids.	Student should be able to explain the meaning of: a. Thrufeed grinding. b. Infeed grinding. c. End feed grinding. d. Combination of infeed and thrufeed.

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	wheel.		

112 ELECTRICAL/ELECTRONIC INSTRUMENT I (CIM 12, 13 & 14)

ELECTRICAL/ELECTRONIC INSTRUMENT I (CIM 12)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Grinding Machine** 1. Describe the electrical/electronic devices with the aid of sketches. 2. Select and identify instruments used for measuring resistance, current and voltage. 3. Explain the working principles of resistance measuring instruments current measuring devices and voltage measuring instruments. 4. Explain the errors associated with measuring instruments and the terms applied to manipulation of meter ranges. 5. Set up given resistance measuring instruments, current measuring instruments, voltage measuring instrument and use them to measure resistance, A.C. and D.C. of both current and voltages 6. Dismantle disassemble and repair meter, note the relative positions of parts and taking into consideration the use of shunts and multipliers.	1. Basic electrical/electronic devices; their components and working principles e.g. push buttons, relays, reed relays, contractors, fuses circuit breakers, switches and mercury switches. 2. Types of resistance measuring instruments; their major components, working principles, limitation and degree of accuracy e.g. Ohmmeter, Decade Box, Wheatstone Bridge etc. 3. Types of current measuring instruments; their major components, working principles, limitations and degree of accuracy e.g. Galvanometer, Ammeter etc. 4. Types of voltage measuring instruments, their major components, working principles, limitations and degree of accuracy e.g. Voltmeter, potentionmeter, multimeter etc. 5. Errors and degree of accuracy; - errors associated with smeasuring instruments e.g. Zero error, Parallax, Range etc. 6. The use of shunts and multipliers in the manipulation of meter ranges. 7. The use of current/voltage measuring instruments in the measurement of A.C. and D.C. currents and voltage respectively.	1. The electrical/electronic components and devices should be displayed. 2. Set up the different measuring devices and measure accurately and application quantity. 3. NOTE: Health kit instruments may be used in this exercise.
2.	**Temperature** 1. Identify the materials used for resistance thermometer and explain its working principle, the relationship between temperature and resistance and the range of temperature that can be measured by resistance thermometer. 2. State the fundamental interval and express thermometer coefficient of resistance over the interval.	1. Resistance thermometer, components materials, working principles, range of temperature construction materials should be platinum nickel, copper. 2. Relationship between temperature and resistance as applied to resistance thermometer, fundamental interval and temperature coefficient of resistance. 3. Simple calculations on temperature coefficient using the formulae: Ro =RT – Rt (T-t)Rt Where RO = Temperature coefficient; RT = Resistance at T. temperature Rt = Resistance at temperature. 4. Experimental determination of	Perform experiments to determine the temperature coefficient of resistance for different metals.

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
		temperature coefficient of resistance.	
3.	**Thermocouple** 1. Name and identify the materials used for thermocouple, example for the combination of these materials and indicate the temperature. 2. Explain the principles of thermocouple, the terms related to thermocouple and how the e.m.f. generated by thermocouple can be boosted for industrial use stating the equipment used for the conversion.	1. Thermocouples; basic components, materials, e.g. Platinum, radium etc. Working principles, range of temperature. 2. Electromotive force (e.m.f.); the relationship between e.m.f that can be generated by a thermocouple. 3. Methods for boosting the e.m.f. generated by a thermocouple. 4. The wheatstone bridge and how it is used to measure the change in resistance with temperature. 5. Terms related to thermocouple; a. Hot junction b. Cold junction c. Cold junction compensation.	Perform an experiment to show the relationship between thermal e.m.f and temperature.
4.	**Time Measuring Devices** 1. Identify instruments used for the measurement of time, state the unit of time and explain the terms related to time measuring devices. 2. Explain the working principles of R.C timers and electronic times. Install given timers to appropriate systems, set it to achieve defined objectives according to instruction, read and record time with given timers indicating the reading unit on timer.	1. Types of instrument for measuring time. 2. Working principles of time measuring instrument. 3. Reading and recording of time with given time. 4. Unit of time and the basic terms used e.g. a. On/off i.e. something is on when it is engaged and off when it is disengaged. b. Reset i.e. Reactivating of the timer from off position to on position. c. Time delay i.e. the period of disengagement between two successive periods of engagement. d. Repeat time i.e. Time of complete cycle of events. 5. Installation of timers. 6. Trouble shooting and rectification of faults.	Trouble-shoot given timers to locate and rectify faults.
5.	**Electrical Component** 1. Indicate and identify electrical components, their conventional symbols, physical conditions and necessary precautions to be taken during repair and construction. 2. Explain the principles of operation and state basic application of each component. 3. Draw labeled schematic diagrams of rectifier circuits, filter circuits, explain their operational principles and their	1. Electrical components and their conventional symbols e.g. Triode, pentode, thermionic diode, Zener diode, transistor etc, principles of operation and applications. 2. Rectifiers; rectifier circuit such as half wave, full wave, bridge rectifier, working principles, functions, advantages and disadvantages. 3. Power supply unit; basic components, working principles, applications and power supply unit construction incorporating: a. Transformer b. Bridge rectifier c. L.C. filter circuit d. Zener diode. 4. The use of oscilloscope in checking	1. Trouble shoot a given power supply unit to find and rectify faults. 2. Observe necessary safety precautions.

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	purpose in power suppliers. 4. The use of oscilloscope in checking voltage wave form at specific stages e.g. a. Primary tappings of the transformer. b. Secondary tappings of the transformer. c. Input of the filter d. Across the Zener diode. 5. Trouble shooting in power supply units and methods of rectification.	voltage wave form at specific stages e.g. a. Primary tappings of the transformer. b. Secondary tappings of the transformer c. Input of the filter d. Across the Zener diode. 5. Trouble shooting in power supply units and methods of rectification.	

ELECTRICAL/ELECTRONIC INSTRUMENT I (CIM 12)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Watt Meters** 1. Identify the instruments used for power and energy measurement and also read and record powers and energy from appropriate meters. 2. Explain the working principles and construction of the A.C. and D.C. wattmeter and distinguish between them.	1. Power/energy measuring instruments e.g. Wattmeter, watt hour demand meter, basic components, construction and working principles. 2. A.C. and D.C. wattmeter; basic components and working principles e.g. kilowatt hour. 3. Reading and recording of power and energy.	Read and record power and energy from appropriate smeter.
2.	**Frequency Measuring Device** 1. Explain the functions and working principles of a signal generators, use it to produce wave-forms on the oscilloscope. 2. Identify the instruments used for measuring frequency, use them to measure frequency of wave form and define the terms related to wave form with simple calculation involving the terms. 3. Explain the working principles of the cathode ray tube and oscilloscope with the aid of labeled sketches. 4. Apply the oscilloscope for measuring frequency and amplitude and calculate r.m.s. voltage, average value and period from wave-form result.	1. Signal generators, basic components, working principle and application. 2. Terms used in defining wave forms e.g. Frequency, wave length, pitch, period, amplitude, resonance, bandwidth and simple calculations involving the terms. 3. Frequency measuring devices, basic component working principles and application. NOTE: Oscilloscope carries very high voltages and therefore should be handled with necessary precautions.	Use frequency meter and oscilloscope to measure frequency of wave form and compare the results.
3.	**Measuring Level** Identify and describe the working principles of level measuring instrument.	1. Level measuring instrument e.g. a. capacitance probe b. resistive probe c. electronic DP cell d. load cells basic components, working principles i.e: dismantling and cleaning the parts; assembling and calibrating the instruments. 2. electrical/Electronic.	Dismantle level measuring devices to study their basic components and exact position, and cleaning of the parts.
4.	**Electronic Amplifiers** 1. Explain the working principles, construction functions of component	1. The electronic amplifiers; its circuit, components, working principles, applications and limitations. 2. Methods of feeding signals into amplifier.	Feed in signal into an amplifier with a signal generator and monitor the output with an oscilloscope,

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
	parts of amplifiers, their uses and describe the characteristics of different types of amplifiers. 2. Draw labeled schematic diagram of simple amplifier circuit using the thermionic valve and transistors. 3. Feed in signal into amplifier with a signal generator and compare in-put signal with the output signal. 4. Test the amplifiers for proper operations by feeding signal into it and measure voltages at various points of a given amplifier.	3. Type of amplifiers; basic characteristics and uses e.g. audio amplifiers, power amplifiers, operational amplifiers. 4. Reading and recording of voltage at various parts of a given amplifiers. 5. Determination of the gain of the amplifier.	compare the input signal with the output signal and determine the gain of the amplifier using the formulae. Gain = Output Voltage / Input Voltage
5.	**Electrical electronic Transducers** Name, identify and explain the function of the different types of transducers and state their application and standard range of variable in them.	1. Transducers; working principles and functions. 2. Types of transducers and their applications. a. Voltage to pressure (E/P) b. Pressure to current (P/I) c. Voltage to current (E/I) 3. Standard range of variable in the transducers e.g. a. E/P-10v/0.2kg/CM2-1kg/Cm2 b. I/P mA-20mA/0.2Kg/Cm2-Cm2-1kg/Cm2 c. E/10-10v/mA-20mA	
6.	**Electro-Magnetic Solenoid** Explain the principle of the operation of electromagnet, solenoid and give example of the use of the solenoid instrumentation.	1. The electromagnetic solenoid: working components, principles and operations, applications and limitations. 2. Use of solenoid in instrumentation e.g. a. Opening and closing of solenoid values. b. Control valves. c. Control of power cylinders etc.	

AUTOMATIC CONTROLS (CIM – 14)

S/N	TOPICS/OBJECTIVE	CONTENT	ACTIVITIES/REMARK
1.	**Automatic Control** 1. Describe and explain the meaning of the terms used in automatic controls, the modes of control and actions. 2. State and define the deviation, the equation for proportional control action and draw graph to show the relationship between output (Po) and deviation (d)	1. Automatic control terms; their meaning and usages, e.g. control, regulate, signal, feedback, feed forward, primary, primary element, secondary element, on/off, final control element etc. 2. Modes of control e.g. a. open loop b. close loop c. two step control d. multi step control 3. Use of rigs to demonstrate control modes. 4. Definition of deviation as (Po-Pi) i.e. change in output (Po minus change in input (Pi) 5. Equation for proportional control action i.e. Po – Kd Where Po -= change in output D = deviation K = a factor = po/d. 6. Graph of the relationship between output (Po) and deviation (d) 7. Use rigs to demonstrate each of the control.	Modes, taking note of the difference between individual modes.
2.	**Control Action** 1. Use rigs to demonstrate the control actions and explain both integral action and condition which will necessitate the use of control actions. 2. Draw graph to show the effect of integral action when used in conjunction with proportional control action.	1. Control action viz: a. proportional action (P) b. integral action (Reset) (I) c. derivation action (Rate) (D) d. P + 1 e. P + 1 + D 2. Simple equation and graphs of control action and the need for control action.	1. Emphasize the meaning of integral action and the conditions in a control system which will necessitate each of the control actions. 2. Draw graph to show the effect of integral action when used in conjunction with proportional control action.
3.	**Control elements and system** 1. State and describe control elements, their functions in control system and explain with a labeled sketch the operation of control element. 2. Calibrate and carry out repairs on control elements taking into consideration the safety precautions involved.	1. Control Elements their functions and working principles e.g. Relay, Rest Below, Flapper and Nozzle etc. 2. Maintenance of control elements calibration of control elements and system e.g. Receiver, Transmitters (Pneumatic & Electronic). 3. Setting up control loops for the control of: a. Temperature b. Flow c. Level d. Pressure e. Speed.	Set up control loops involving the use of some of the control elements to control the following: a. Temperature b. Flow c. Level d. Pressure e. Speed