

MAHARASHTRA STATE BOARD OF VOCATIONAL EXAMINATION, MUMBAI 51.

1	Name of Syllabus	C.C. IN INSTRUMENT MECHANIC (308202)																																																													
2	Max. No's of Student	25 students.																																																													
3	Duration	1 YEAR																																																													
4	Type	Full Time																																																													
5	No Of Days / Week	6 Days																																																													
6	No Of Hours /Days	7 Hrs																																																													
7	Space Required	Lab = 400 Sq feet Class Room = 200 Sq feet TOTAL = 600 Sq feet																																																													
8	Entry Qualification	S.S.C.																																																													
9	Objective Of Syllabus/ introduction	<ul style="list-style-type: none">• To develop professional competence in the field of electronics.• To train the students to acquire skills and mastery in the use of electronic circuits.• To train the students to test and operate the electronic instruments.• To prepare for self and wage employment.• To prepare competent electronic technicians for the small-scale industry.																																																													
10	Employment Opportunity	Wage Employment / Self Employment																																																													
11	Teacher's Qualification	Diploma/Certificate in concern subject																																																													
12	Training System	Training System Per Week <table><tr><td>Theory</td><td>Practical</td><td>Total</td></tr><tr><td>18 Hours</td><td>24 Hours</td><td>42 Hours</td></tr></table>						Theory	Practical	Total	18 Hours	24 Hours	42 Hours																																																		
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13	Exam. System	<table><tr><th>Sr. No.</th><th>Paper Code</th><th>Name of Subject</th><th>TH/ PR</th><th>Hrs</th><th>Max. Marks</th><th>Min. Marks</th></tr><tr><td>1</td><td>30820211</td><td>Electronic material, component, Microprocessor and Digital Electronics</td><td>TH I</td><td>3 hrs.</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30820212</td><td>Electronic Device, circuit, Analytical and Electronic Instrumentation</td><td>TH II</td><td>3 hrs.</td><td>100</td><td>35</td></tr><tr><td>3</td><td>30820213</td><td>Electronic instrumentation, Instrumentation and process Control</td><td>TH III</td><td>3 hrs.</td><td>100</td><td>35</td></tr><tr><td>4</td><td>30820221</td><td>Electronic material, component, Microprocessor and Digital Electronics</td><td>PR I</td><td>3 hrs.</td><td>100</td><td>50</td></tr><tr><td>5</td><td>30820222</td><td>Electronic Device, circuit, Analytical and Electronic Instrumentation</td><td>PR II</td><td>3 hrs.</td><td>100</td><td>50</td></tr><tr><td>6</td><td>30820223</td><td>Electronic instrumentation, Instrumentation and process Control</td><td>PR III</td><td>3 hrs.</td><td>100</td><td>50</td></tr><tr><td></td><td></td><td>Total</td><td></td><td></td><td>600</td><td>255</td></tr></table>						Sr. No.	Paper Code	Name of Subject	TH/ PR	Hrs	Max. Marks	Min. Marks	1	30820211	Electronic material, component, Microprocessor and Digital Electronics	TH I	3 hrs.	100	35	2	30820212	Electronic Device, circuit, Analytical and Electronic Instrumentation	TH II	3 hrs.	100	35	3	30820213	Electronic instrumentation, Instrumentation and process Control	TH III	3 hrs.	100	35	4	30820221	Electronic material, component, Microprocessor and Digital Electronics	PR I	3 hrs.	100	50	5	30820222	Electronic Device, circuit, Analytical and Electronic Instrumentation	PR II	3 hrs.	100	50	6	30820223	Electronic instrumentation, Instrumentation and process Control	PR III	3 hrs.	100	50			Total			600	255
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THEORY I
PART A
Electronic material, component, Microprocessor and Digital Electronics

Sr. No.	Unit	Scope and Limitation
1	DC Circuit	1.1 Concepts of electricity, various applications of electricity. 1.2 Current, voltage and resistance, potential difference, power, electrical energy and their units, advantages of electrical energy over other forms of energy. 1.3 Ohm's law. 1.4 Series and parallel combination of resistors, specific resistance, effect of temperature on resistance, co-efficient of resistance. 1.5 Kirchoff's laws, 1.6 Heating effect of current and concept of electric power. 1.7 Sources of voltage: Primary and secondary cells. Types of cells: Carbon zinc dry cell, alkaline cell, Zinc-chloride cell, mercury cell, silver-oxide cell, and lithium cell, lead acid wet cell (only brief idea and use).
2	Electrostatics	2.1 Coulomb's law, unit charge. 2.2 Electric flux and Gauss's Law, Electric field intensity and electric potential Concept of capacitance and capacitors, units of capacitance, types of 2.3 capacitors, constructional details and testing specifications Capacity of parallel plate capacitors, spherical capacitors, cylindrical 2.4 capacitor. Energy stored in a capacitor. 2.5 Concept of di-electric and its effects on capacitance, di-electric constant, 2.6 break down voltage. Series and parallel combination of capacitor. Simple numerical problems 2.7 of capacitor. Charging and discharging of capacitor with different resistances in 2.8 circuit, concept of current growth and decay, time constant in R-C circuits, simple problems.
3	Electro-magnetism	3.1 Concept of magnetic field production by flow of current, 3.2 Concept of $m f$, flux, reluctance, permeability, Analogy between electrical & magnetic circuits. 3.3 Faraday's Laws of electromagnetic induction, self and mutually induced $e m f$.

4	AC theory	<p>4.1 Concept of alternating voltage and current, difference between AC and DC.</p> <p>4.2 Concept of cycle, frequency, period, amplitude, instantaneous value, average value, r.m.s. value and peak value, form factor (definitions only.)</p> <p>4.3 Series and Parallel resonance, Resonance frequency, Q – Factor, Band width, LR, RC, and LCR filters explanation with simple circuits only. Types of filters – L, T, and π.</p>
5	Electronic Components / switches / PCB	<p>5.1 Resistors: Carbon film, metal film, carbon composition, wound , Cermet and variable types (presets and potentiometers). Rheostat</p> <p>5.2 Special types of resistors: VDR, LDR, Thermistor.</p> <p>5.3 Concept of IC: – Various types of IC's various linear & digital IC's</p> <p>5.4 Inductors and RF coils: Types of Inductors, methods of manufacture, testing, Need of shielding, application and troubleshooting.</p> <p>5.5 Connectors, Relays, switches and cables: Different types of connectors, relays, switches and cables, their symbols, construction and characteristics, Function of Fuse, construction and application.</p> <p>5.6 Loudspeaker and Microphone: Types, applications and specifications of various types of Loudspeaker and microphone.</p> <p>5.7 Accessories for Basic circuit Assembly: Types of wires, lug / tag boards. PCB, types of PCB, Bread board.</p>
6	Transformer	<p>6.1 Principles of transformer, construction, voltage and current transformation.</p> <p>6.2 Current and voltage relationship, autotransformer and its uses, Instrument transformer.</p> <p>6.3 Voltage regulation and its significance.</p> <p>6.4 Need for isolation, Different types of transformers and specifications of all types of transformers.</p> <p>6.5 Losses in a transformer.</p> <p>6.6 Instrument Transformer: - Need of Instrument Transformer, Advantages of Instrument Transformer. Current Transformer and Potential Transformer, phase error, ratio error and burden. Use of Current Transformer and potential transformer for range extension in high voltage and current circuits.</p>
7	Soldering Technique	<p>7.1 Principle and working of simple soldering iron, Solder metal, Types of solders, flux, de-soldering and different soldering technique.</p>

THEORY I
PART B

Sr. No.	Unit	Scope and Limitation
1	Operational Amplifiers	1.1 Distinction between analog and digital signal. 1.2 Applications and advantages of digital signals. 1.3 Operational Amplifiers: Characteristics of an ideal operational amplifier and its block diagram. 1.4 Definition of differential voltage gain, CMRR, PSRR, slew rate and input offset current 1.5 Operational amplifier as an inverter, scale changer, adder, Subtractor, differentiator, and integrator. 1.6 Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier and their applications.
2	Number System	2.1 Binary and hexadecimal number system: conversion from decimal and hexadecimal to binary and vice-versa BCD representation. 2.2 Binary addition, subtraction, multiplication and division including binary points. BCD addition. 1's and 2's complement method of addition/subtraction.
3	Logic Gates	3.1 Concept of negative and positive logic. 3.2 Definition, symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates, NAND and NOR as universal gates. 3.3 Boolean algebra, De Morgan's Theorems. Various identities. Formulation of truth table and Boolean equation for simple problem. Implementation of Boolean (logic) equation with gates. 3.4 Logic family classification: Definition of SSI, MSI, LSI, VLSI, TTL and MOS families and their sub classification. 3.5 Codes: a) Concept of code, weighted and non-weighted codes, examples of 8421, BCD, excess-3 and Gray code. b) Concept of parity, single and double parity and error detection c) Alpha numeric codes: ASCII and EBCDIC.
4	Arithmetic circuits and Latches and flip flops	4.1 Half adder and Full adder circuit, design and implementation. 4.2 Half and Full Subtractor circuit, design and implementation. 4.3 4-bit adder/Subtractor. 4.4 Concept and types of latch with their working and applications. 4.5 Operation using waveforms and truth tables of RS, T, D, JK, and Master/Slave JK flip-flops. 4.6 Difference between a latch and a flip-flop.

5	Multiplexer / De-Multiplexer and Counters	5.1 Basic functions and block diagram of MUX and DEMUX. Different types and applications. 5.2 Binary counters. 5.3 Divide by N ripple counters (including design), Decade counter. 5.4 Pre settable and programmable counters. 5.5 Down counter, up/down counter. 5.6 Synchronous counters (only introduction). 5.7 Difference between Asynchronous and Synchronous counters Ring counter with timing diagram.
6	Shift Register	6.1 Introduction and basic concepts including shift left and shift right. 6.2 Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out. 6.3 Universal shift register.
7	Memories	7.1 Basic RAM cell, $N \times M$ bit RAM, Expansion of word length and capacity, static and dynamic RAM, basic idea of ROM, PROM, EPROM and EEPROM.
8	A/D and D/A Converters	8.1 General principle of A/D and D/A conversion and brief idea of their applications. Binary resistor network and resistor ladder network methods of D/A conversion. Dual slope and successive approximation types of ADCs.
9	Microprocessor – 8085	9.1 Introduction: Microprocessors – evolution, importance and Application. 9.2 Architecture of a Microprocessor – 8085: Concept of bus and bus organisation. Functional block diagram and function of each block. Pin details of 8085 and related signals. Demultiplexing of address/data bus and memory read/write cycles. 9.3 Instruction Set for Intel 8085 Instruction and data format – opcode and operand and its word size Different addressing modes, Status flags and their importance. Data transfer, arithmetic and logical operation, branching, and machine control instructions. Use of stacks and subroutines. Assembly language programming. 9.4 Peripheral Devices: 8255 PPI and 8253 PIT, 8257 DMA Controllers, 8259 PIC, 8279 Programmable KB/Display Interface, 8251 Communication Interface Adapter (12 hrs)

PRACTICAL I
PART A

1. Safety precaution to be observed while working with electronic equipments and systems.
2. Drawing electrical symbols as per ISI specifications.
3. Verification of Ohm's law, using resistors in series and in parallel.
4. Measurement of electrical power consumption in simple AC/DC circuit by VI method.
5. Identification of various materials tools and devices.
6. Testing of resistor, capacitors, & semiconductors by Multimeter & colour coding method.
7. Testing of resistors, capacitors, & Inductors by LCR meter / Bridge.
8. Testing of RELAYS verifying conditions, such as normally "ON" and "OFF" etc.
9. Verification of Kirchoff's Laws.
10. To study the different types of Cable and connectors.
11. Characteristics of Thermistor
12. Characteristics of LDR.
13. To study the Loudspeaker and Microphone.
14. Study of AC and DC sources (power suppliers) available in the laboratory with their specifications.
15. Series & Parallel resonance circuit, determination of its resonant frequency, bandwidth.
16. Testing a transformer, continuity, installation and turn ratio.
17. Measurement of I/P and O/P resistance of power supply & verification of maximum power transfer theorem.
18. Prepare PCB art work and etching using any simple circuit
19. Study of different types of batteries.
20. Study of soldering practice.

RECOMMENDED BOOKS

1. Electronics Measurement and Instrumentation by AK Sawhney, Dhanpat Rai and Sons, New Delhi
2. Electronics Instrumentation by Cooper, Prentice Hall of India, New Delhi
3. Electronics Test and Instrumentation by Rajiv Sapra, Ishan Publications, Ambala
4. Electronics Instrumentation by JB Gupta, Satya Prakashan, New Delhi
5. Electronic components and Materials by SM Dhir, Tata McGraw Hill, New Delhi
6. Electronic Engineering Materials by ML Gupta, Dhanpat Rai and Sons; New Delhi.
7. Electrical Technology, Fifth Edition by Edward Hughes, Longman Publishers
8. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and Sons, New Delhi
9. Electrical Technology by BL Theraja, S Chand and Co, New Delhi
10. Electronic Material and components by K S Patil, BPB Publications.

PRACTICAL
PART B

1. Logic gates - AND, OR, NOT, NAND, NOR, EX-OR, and EX-NOR (Using IC's).
2. NAND or NOR gates as an Universal gates.
3. IC 741 (op-amplifier) as Inverter and non-inverter.
4. IC 741 (op-amplifier) as Adder and Subtractor.
5. Verification of truth tables of RS flip flop using NOR and NAND gates.
6. JK and Master Slave JK Flip Flop.
7. Half Adders - Subtractor (Using IC Logic gates)
8. Full adder - Subtractor (Using IC Logic gates)
9. To study details of counters IC's like 7490
10. Observe the output of decade counter 7490 on a seven segment display using a decoder
11. To construct and test 4/8 bit A/D converter using IC.
12. To construct and test 4/8 bit D/A converter using IC.
13. To study shift register IC's like 7495.
14. Study of Multiplexer using IC 74153.
15. Study of Demultiplexer using IC 74139.
16. Familiarization of 8085-microprocessor kit.
17. Writing and execution of ALP for addition and sub station of two 8 bit numbers.
18. Writing and execution of ALP for multiplication and division of two 8 bit numbers.
19. Writing and execution of ALP for arranging 10 numbers in ascending/descending order.
20. Writing and execution of ALP for 0 to 9 BCD counters (up/down counter according to choice stored in memory)

RECOMMENDED BOOKS

1. Digital Electronics and Applications by Malvino Leach, Tata McGraw Hill, New Delhi
2. Digital Logic Designs by Morris Mano, Prentice Hall of India, New Delhi
3. Digital Fundamentals by Thomas Floyds, Universal Book Stall
4. Digital Electronics by RP Jain, Tata McGraw Hill, New Delhi
5. Microprocessor Architecture, Programming and Applications with 8085 by RS Gaonkar
6. Operational Amplifiers and Linear Integrated Circuits by Ramakant A. Gaykwad

THEORY II
PART A
Electronic Device, circuit, Analytical and Electronic Instrumentation

Sr. No.	Unit	Scope and Limitation
1	Semi conductor physics	1.1 Review of basic atomic structure and energy levels, concept of insulators, conductors and semi conductors, atomic structure of Germanium (Ge) and Silicon (Si), covalent bonds. 1.2 Concept of intrinsic and extrinsic semi conductor, P and N impurities, doping of impurity. 1.3 P and N type semiconductors and their conductivity. Effect of temperature on conductivity of intrinsic semi conductor. 1.4 Energy level diagram of conductors, insulators and semi conductors; minority and majority carriers.
2	Semi conductor diode	2.1 PN junction diode, mechanism of current flow in PN junction, Drift and diffusion current, depletion layer, forward and reverse biased PN junction, potential barrier, and concept of junction capacitance in forward and reverse bias condition. 2.2 V-I characteristics, static and dynamic resistance and their calculation from diode characteristics, applications. 2.3 Diode as half wave, full wave and bridge rectifier. PIV, rectification efficiencies and ripple factor calculations, shunt capacitor filter, series inductor filter, LC filter and π filter. Comparison between three rectifiers. Types of diodes, characteristics and applications of Zener diodes. Zener and avalanche breakdown. 2.4
3	Introduction to Bipolar Transistor	3.1 Concept of bipolar transistor, structure, PNP and NPN transistor, their symbols and mechanism of current flow; Current relations in transistor; concept of leakage current. 3.2 CB, CE, CC configuration of the transistor; Input and output characteristics in CB and CE configurations; input and output dynamic resistance in CB and CE configurations; Current amplification factors. Comparison of CB, CE and CC Configurations. 3.3 Transistors as an amplifier in CE Configurations; d.c load line and calculation of current gain, voltage gains using d.c. load line. H-Parameters and their significance.
4	Transistor biasing Circuits	4.1 Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. 4.2 Different types of biasing circuits. 4.3 Transistor as a switch.

5	Amplifiers	<p>5.1 Introduction, Types of Amplifiers, Various Applications of Amplifiers. Transistor as an Amplifier, Amplifier using IC, Calculation of Voltage, Current and Power gain of an amplifier circuit.</p> <p>5.2 Explanation of phase reversal of output voltage with respect to input voltage.</p> <p>5.3 Concepts, Types of multistage Amplifiers, Construction, working, advantages, disadvantages, frequency response and applications.</p> <p>5.4 Basic principles and types of feedback Effect of feedback on gain, stability, distortion and bandwidth of an amplifier with negative feedback.</p> <p>5.5 Class A, Class B, Class AB, and Class C amplifiers, collector efficiency and Distortion in class A, B, & C. Comparison between them. Single ended power amplifiers, Graphical method of calculation (without derivation) of out put power; heat dissipation curve and importance of heat sinks. Push-pull amplifier, and complementary symmetry push-pull amplifier.</p> <p>5.7 Importance of impedance matching in amplifiers.</p>
6	Wave Shaping Circuits	<p>6.1 General idea about different wave shapers. RC and RL integrating and differentiating circuits with their applications.</p> <p>6.2 Diode clipping and clamping circuits and simple numerical problems on these circuits</p>
7	Oscillator	<p>7.1 Principle of oscillator, use of positive feedback in oscillator. Types of oscillators, R.C. Phase shift oscillator. Resonance circuit LC oscillator, Wein bridge oscillator, Colpitts oscillators, Hartley oscillators, and Crystal oscillators.</p>

THEORY II
PART B

Sr. No.	Unit		Scope and Limitation
1	Introductions	1.1	Selection of instruments for application in industries -on line instrumentation and laboratory techniques- a brief review, introduction to the subject, difference between analytical and other instruments.
2	Sampling Techniques	2.1	Sampling Systems for liquids and gases for analysis purposes, components, automatic sampling, and maintenance.
3	Gas Analysis	3.1	Gas analysis by chemical absorption, Orsat apparatus, carbon dioxide & monoxide and hydrogen measurements, Mathanometer, Gravimetric method of gas analysis.
4	Humidity and Moisture Measurement	4.1	Measurement of humidity, definition of wet and dry basis moisture content, laboratory methods and online measurement techniques, electrical methods, radioscopy technique, IR Techniques, moisture in gases.
5	Spectro chemical Analysis	5.1 5.2	Classification of techniques, Mass spectrometry, Principle Components, Applications to analysis of solids, Liquids and gases, Emission spectrometry components, Spectrograph, Applications, Absorption Spectrometry, Electromagnetic radiation spectrum, Schemes for UV, IR and near IR analyzers, Comparison of the methods, Examples of Absorption patterns.
6	Measurement of Circuit Components (R,L and C)	6.1 6.2 6.3	Inductance Measurement. Self-Inductance Measurement - Ammeter and Voltmeter method, Three Voltmeter Methods, Three Ammeter Method, General Four arms bridge network method, Maxwells' bridge method, and other bridges used for Self-Inductance measurement & their application. Mutual Inductance Measurement. Felici's Method. Capacitance Measurement – Wein bridge method, and other bridges used for capacitance measurement and their specific applications. Resistance Measurement : Ammeter voltmeter method, Potentiometer method, Kelvin's double bridge method, Wheatstone bridge method, Loss of charge method.

7	Cathode Ray Oscilloscope	7.1 Need of C.R.O. in electronic measurements. 7.2 Block diagram of a general-purpose cathode ray oscilloscope. Cathode Ray Tube – Internal Structure, Electron Gun, Electrostatic 7.3 Focusing, Electrostatic deflection, CRT screen, CRT gratitude. Time base generator – necessity of time base signal. 7.4 Basic C.R.O. Circuits: Vertical (y) deflection system, Horizontal (x) deflection system, synchronization, Blanking Circuit, Intensity Modulation, Positioning Control, Focus Control, Intensity control, Calibration Circuit Astigmatism. 7.5 Application of CRO: Measurement of Voltage, Current, Frequency, Phase difference. 7.6 Special Purpose C.R.O. : - - Multiple beam oscilloscopes, - Multiple trace Oscilloscope. - Storage type oscilloscope. 7.7 Generator: Types of AF generator, RF generator, function generator, and pattern generator. Block diagram and brief description of each block. Applications of each.
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PRACTICAL II

PART A

1. To study the semiconductor devices.
2. a) P-N Diode Characteristics.
b) Study diode as a clipping and clamping.
3. Transistor characteristics - CE,CB and CC.
4. Study of half wave rectifier with or without filters.
5. Study of full wave rectifier with or without filters.
6. Study of bridge rectifier with or without filters.
7. Zener diode Characteristics.
8. Study of Zener as a voltage stabilizer.
9. Line regulation and measurement of percentage of regulation.
10. Load regulation and measurement of percentage of regulation.
11. Study of single stage CE amplifier with potential divider biasing. Measure the voltages and hence calculate the gain.
12. RC coupled amplifier: obtain the frequency response and calculate the gain.
13. Study of Push pull power Amplifier.
14. Study of commercially available audio amplifier IC (CA 810 or equivalent.).
15. Demonstration experiment of negative and positive feedback concept.
16. Study the integrating and differentiating circuit.
17. Measurement of frequency of Hartley oscillators.
18. Measurement of frequency of Colpitts oscillators.
19. Measurement of frequency of R-C Phase shift oscillators.
20. Measurement of frequency of Wein bridge oscillators.

RECOMMENDED BOOKS

1. Basic Electronics and Linear Circuit by NN Bhargava and Kulshreshta, Tata McGraw Hill, New Delhi.
2. Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi
3. Electronic Components and Materials by SM Dhir, Tata McGraw Hill, New Delhi
4. Electronics Devices and Circuits by Millman and Halkias; McGraw Hill.
5. Principles of Electronics by Albert Paul Malvino; Tata McGraw Hill, New Delhi
6. Electronic Devices and Applications Nair, Prentice-hall, New- Delhi,
7. Electronic Devices and Circuit Theory Boylestad & Nashelsky, Prenticehall, New- Delhi, 8th Edition
8. Electronic Devices and Circuits Bell, Prentice-hall, New- Delhi, 4th Edition
9. Functional Electronics K.V. Ramanan
10. Engineering Electronics John D. Dyder
11. Electronic Devices & circuits Mottershead, Allen, Prentice Hall, India, New Delhi
12. Integrated Electronics Millian & Halikyas
13. Electronic devices & circuits, volume- I G.K. Mittal, Khanna Publishers, New Delhi, 22nd 1999
14. Laboratory manual for electronic devices and circuits Bell, Prentice-hall, New- Delhi, 4th Edition
15. Electrical Devices & Circuits Bogart, T.F., Universal Book Staff, New Delhi, 1st , 1991

PRACTICAL II

PART B

1. Find out concentration of (Na or K) by flame photo meter in the given sample.
2. To measure transmittance and absorption of a solution using Single beam spectro photo meter.
3. To study water analysis kit & measure pH, temperature, conductivity, dissolved O₂ of a given solution.
4. To measure the conductivity of solution indicator controller.
5. To study the analysis of fuel gases.
6. To study ion selective electrode.
7. Study of silica analyzer and zirconia based oxygen analyzer.
8. Study calibration technique of analysis.
9. Study gas/liquid chromatograph.
10. Self-inductance Measurement by – Maxwell's Bridges method.
11. Mutual Inductance Measurement by Felicia method.
12. Low-resistance Measurement by – -Ammeter Voltmeter method. -Potentiometer method. -Kelvin's double bridge method.
13. Medium Resistance Measurement by –Wheat Stone bridge method.
14. Study and use of C.T. & P.T.
15. Study of front panel of C.R.O.
16. Voltage measurement & Current measurement on C.R.O.
17. Frequency & Phase measurement on C.R.O.
18. Study Digital Instruments – Digital Voltmeter, Digital Panel Meter
19. Study Digital Frequency Meter
20. Study Digital Storage Oscilloscope.

Reference Books:

1. Khandpur R.S., Hand book of Analytical Instrumentation, TMH
2. Patranabis, D., Principles of Industrial Instrumentation, TMs Publication, New Delhi.
3. Jones, E.B., Instrument Technology Vol.II, Analytical Instruments, Butterworths Scientific Publication, London.
4. O Riggins, P.T., Basic Instrumentation in Industrial Measurement, Mc-Graw Hill Book Co.
5. Holman, J.P. Experimental Methods of Engineers, Mc-Graw Hill Book Co., Int. Student edition.
6. Electronic Instrumentation & Measurement Techniques Cooper W.D. & Helfride A.D., Prentice Hall of India, New Delhi.
7. Electronic instruments and instrumentation technology Anand, Prentice Hall of India, New Delhi, 2004.
8. Electronic Instrumentation & Measurement Bell, Prentice Hall of India, New Delhi, 2004.
9. Instrumentation Measurement Devices & Systems Rangan C.S., TMH Publications, New Delhi.
10. Electrical Measurement & Measuring Instruments Golding & Widdis.
11. A Course in Electrical and Electronics & Instrumentation Rambhadran S., Khanna Publishers, Delhi.
12. Electrical & electronic measurement and instrumentation A.K. Shawney, 11th edition, 2000
13. Electrical Measurements & Measuring Instruments Sauryanarayana, Tata McGrawHill Publications, New Delhi.

THEORY III
PART A
Electronic instrumentation, Instrumentation and process Control

Sr. No.	Unit	Scope and Limitation
1	Power supplies	1.1 Block diagram of load and line regulation, DC or average value, ripple and output frequency. 1.2 Concept of voltage regulation using transistor (series and shunt type). Block diagram and brief description of each block. 1.3 Fixed and adjustable types. IC regulators (like 7805, 7905, LM 317), and variable voltage regulator like (IC 723). 1.4 Protection Techniques— Short Circuit, Over voltage and Thermal Protection. 1.5 Introduction to S.M.P.S. and its advantages (with the help of block diagram). 1.6 Circuit diagram of typical S.M.P.S.
2	Meters	2.1 Measurement, method of measurement, types of instruments. Specifications of instruments: Accuracy, precision, sensitivity, resolution, range, errors in measurement, sources of errors, limiting errors. 2.2 Galvanometer, DC Ammeter, DC voltmeter, Ohmmeter Series and shunt type. Principle of working of above types. Analog multimeter. 2.3 Range Extension of Ammeter and Voltmeter.
5	Multivibrator Circuits	5.1 Working principle of transistor as switch. 5.2 Concept of multi-vibrator: astable, monostable, and bistable and their applications. 5.3 Block diagram of IC555 and its working and applications of IC555 as monostable and astable multi-vibrator.
6	Displays and Recorders	6.1 Displays: - Analog indicators/displays 6.2 Digital indicators/displays: - 1. Cold cathode displays 2. Fluorescent displays 3. Light emitting diodes 4. Liquid crystal diodes 5. Alpha-numeric display 6. Dot matrix display 7. Seven segment display Nixie Tube Recorders: - Analog Recorder, Graphic Recorder, Optical oscillograph, Strip Chart Recorder (Null & Galvanometer). - X-Y Recorder, Ultraviolet Recorder, Magnetic Tape Recorder.

7	DC Motor	<p>7.1 Principles, significance of back emf, types of motors and their constructions.</p> <p>7.2 Motor characteristics for shunt and series, speed control of DC motors and factors controlling the speed.</p> <p>7.3 Single Phase Motors: Principles, construction, working speed control, starting and applications of the following motors: a) Induction motor a) Universal motor.</p> <p>7.4 Stepper Motor and Servo Motor: Types, construction, working and their applications.</p>
8	Other semiconductor devices	<p>8.1 Structure, working and application of Diac, SCR, Triac, and UJT. Their characteristics.</p> <p>8.2 Structure, working of FET (N channel and P channel). Features of F.E.T. and applications and characteristics. CMOS – merits & demerits. Comparison of JFET, MOSFET and BJT. FET amplifier circuit and its working principle.</p> <p>8.3 Structure, working of MOSFET (depletion and enhancement type). Features and applications and characteristics.</p>
9	Special devices	<p>9.1 Special purpose diodes: Tunnel diode, Schottky, Varactor, Photo, diode, Switching (step recovery), Gunn diode, PIN diode, Laser diode, and Op-to coupler.</p>

THEORY III
PART B

Sr. No.	Unit	Scope and Limitation
1	Signal Conditioner & Signal Analysis	1.1 Need & Purpose of Signal Conditioning in Instrumentation AC & DC Amplifier, Chopper, Voltage Controlled Oscillator (VCO) Modulator (AM, FM, PM) & Demodulator, Function Generator, A/D & D/A Converters and Frequency Divider. 1.2 Wave Analyzer, Frequency Selective, Heterodyne Wave Analyzer Harmonic Distortion Analyzer ,Tuned Circuit Harmonic Analyzer, Heterodyne Harmonic Analyzer, Wave Meter, Fundamental, Suppression Harmonic Analyzer, Spectrum Analyzer 1.3 Applications Wave & Harmonic Analyzer. 1.4 Frequency Counter Time Interval Measurement: - 1Simple Freq. Counters. Period Measurement. 1.5 Active Filter: - 1An introduction to Active Filters, Chebyshev Filters, Butterworth Filters, Sallen Key Filters. 1.6
2	Introduction to instrumentation & process control	2.1 Need of instrumentation & control. 2.2 Block diagram of a general instrumentation system and their broad functions 2.3 Block diagram of instrumentation system for measurement of various nonelectrical parameters.
3	Transducers	3.1 Classification of transducers. 3.2 Types of errors in transducers. 3.3 Application of transducers for the measurement of Length, Thickness, Displacement, Velocity, Force, Weight, Torque, Pressure, Level, Temperature, Strain, P.H. measurement, Speed etc. 3.4 Selection of transducer for specific application.
4	Control system	4.1 Role of control system in instrumentation 4.2 Open and close loop control system 4.3 Different types of control system such as ON-OFF, Step, Continuous, PID control etc. 4.4 Servomechanism and regulators with suitable examples 4.5 Control components 4.6 Construction. Working principle, merits and demerits and 4.7 Applications of following control components - AC, DC servo motor, Synchros, AC, DC tacho generators, Stepper motor, Solenoid valve, motorized valve, servo valve, Control transformer, Servo voltage stabilizer.

5	Programmable Logic Controllers (PLC)	5.1 Electrical control system: control sequence, connections for controlling sequences. 5.2 Introduction to PLCs: need of PLC, function of PLC, advantages of PLC compared to Hard-Wired connections, components of PLC. 5.3 Programmable controllers: types of PLC, specification of a PLC, block diagram. 5.4 PLC programming: programming device, PLC programming methodologies, ladder diagram, features of different PLC programming. 5.5 Ladder diagram: types of ladder diagram, symbols, frame work of a ladder diagram, draw equivalent wiring diagram for a ladder diagram (simple circuit). 5.6 Programming the PLC: I/O numbering system, properties of ladder logic programmers, simple ladder logic diagram. 5.7 Boolean logic programming: various Boolean function set and mnemonics, features of Boolean logic programming, 5.8 Function block: features of function block programming, significance of function. 5.9 Block, function chart programming. 6.1 PLC configuration: open-loop and closed loop control circuit, PLC counter, timer. 6.2 Communication between PLC-PLC and PLC counter.
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PRACTICAL III

PART A

1. Study of different types of motors.
2. Use of PMMC movement to construct multi range ammeter
3. Use of PMMC movement to construct multi range voltmeter.
4. Study Series and shunt type regulated power supplies.
5. Build and study a fixed and variable DC voltage supply using 3 pin IC and test it.
6. Study of SMPS.
7. Study speed control of dc motor using transistor/ thyristor.
8. Identification of special purpose of diodes.
9. Study and test the Diac, SCR, and Triac.
10. Study and test the FET, JFET, & MOSFET.
11. SCR, Characteristics
12. FET Characteristics.
13. Familiarization of ammeter, voltmeter, multimeter (analog, digital) and understanding their Specifications.
14. Study of Displays –Cold cathode displays, Fluorescent displays, Light emitting diodes, Liquid crystal diodes, Alpha-numeric display.
15. Study seven segment decoder driver circuit.
16. Study Astable multivibrator using IC 555.
17. Study Monostable multivibrator using IC 555.
18. Study stepper motor with forward and reverse direction circuit
Industrial visits .

RECOMMENDED BOOKS

1. Electronic Instrumentation & Measurement Techniques Cooper W.D. & Helfride A.D., Prentice Hall of India, New Delhi.
2. Electronic Instruments and instrumentation technology Anand, Prentice Hall of India, New Delhi, 2004.
3. Electronic Instrumentation & Measurement Bell, Prentice Hall of India, New Delhi, 2004.
4. Instrumentation Measurement Devices & Systems Rangan C.S., TMH Publications, New Delhi.
5. Electrical Measurement & Measuring Instruments Golding & Widdis.
6. A Course in Electrical and Electronics & Instrumentation Rambhadran S., Khanna Publishers, Delhi.
7. Electrical & electronic measurement and instrumentation A.K. Shawney, 11th edition, 2000
8. Electrical Measurements & Measuring Instruments Sauryanarayana, Tata McGrawHill Publications, New Delhi.

PRACTICAL III

PART B

- 1) Displacement measurement using LVDT.
- 2) Weight measurement using Strain Gauge Bridge.
- 3) Study different types of wave analyzers.
- 4) Speed measurement of motor using magnetic proximity switch.
- 5) Speed measurement of motor using photoelectric pickup.
- 6) Temperature measurement using thermocouple.
- 7) Temperature measurement using resistance temperature detector.
- 8) Temperature measurement using thermister.
- 9) Performance of piezo electric transducers.
- 10) Displacement measurement with help of light dependent resistor.
- 11) Displacement measurement using inductive pick up transducer.
- 12) Pressure measurement using load cell.
- 13) Liquid level measurement using capacitive type transducer.
- 14) Proportionate mode of control.
- 15) Proportionate + integral type control.
- 16) Proportionate + integral + derivative control.
- 17) Performance of data acquisition system.
Industrial visits (Package sorting machine, Injection molding machine, Inline bottle filling, Batch process paint filling machine, etc)

RECOMMENDED BOOKS

- 1 Instrumentation for Engineering Measurements Cerni & Foster; Tata McGraw Hill, New Delhi 5th, 1986
- 2 Electronic Instrumentation & Measurement Techniques Cooper; Prentice Hall, New Delhi 8th, 2000
- 3 Instrumentation for Engineering Measurements Dally, J.W. & Others; John Wiley & Sons, New York 1st, 1984
- 4 Introductions to Instrumentation and Control Ghosh, A.K.; PHI, New Delhi 1992
- 5 Process Control Instrumentation Technology Johnson, McGraw Hill, New York 1992
- 6 Instrumentation, Measurement & Feedback Jones; McGraw Hill, New York 1st, 1994
- 7 Electronic Instrumentation Kalsi, J.S.; Tata McGraw-Hill, New Delhi 1995
- 8 Handbook of Bio-Medical Instrumentation Khandpur; Tata McGraw-Hill, New Delhi 2001
- 9 Electronic Instrumentation Malvino; Tata McGraw Hill, New Delhi 2nd, 1987
- 10 Instrumentation Devices and Systems Rangan, C.S., et al; Tata McGraw Hill, New Delhi 1990
- 11 Electronic Measurements & Instrumentation Rao & Sutrave; Nirali Prakashan, Pune 2nd, 1988
- 12 A course in Electrical & Electronic Measurements & Instruments Sawhney; Dhanpat Rai & Sons, New Delhi 11th, 2000
- 13 Industrial Instrumentation and Control Singh, S.K.; Tata McGraw Hill, New York 1991

List of Materials and Instrument for Electronic Instrumentation Lab

Sr. No.	Name of the equipment with Specifications	Quantity
1	Combination Pliers 15 Cms insulated	20
2	Long nose insulated pliers 15 Cms	20
3	Side cutter 15 Cms	20
4	End Cutting nipper insulated 15 Cms	20
5	Tweezers 10 Cms	20
6	Neon glow tester	10
7	Screw driver set of 6	10
8	Watch maker screw	05
9	Allen Key	01
10	Drill beat set	01
11	Hacksaw 20-25cm (adjustable)	01
12	Junior saw 20cm	01
13	File flat 20cm 2nd cut	01
14	Soldering iron 25 Watt	10
15	Temperature controlled soldering station 15 Watt	01
16	De-soldering pump	10
17	Wire gauge set	01
18	Tweezers 10 Cms	10
19	Adjustable spanner/slide wrench (15-20cis)	01
20	Wire stripper	10
21	Electric drill machine 10mm	01
22	Digital multimeter	10
23	Analog multimeter	10
24	Voltmeters 0-1V / 0-10V / 0-50V / 0-100V	02 Each
25	Ammeters 0-10 mA / 0-100 mA / 0-500 mA / 0 – 1 A	02 Each
26	Watt meter 5/250V	01
27	Regulated power supply 30V/1A	10
28	Oscilloscopes 20 MHZ	04
29	Digital Storage CRO	01
30	Digital frequency counters / Meters	02
31	Function Generator	01
32	Digital LCR meters	02
33	Digital trainers	02
34	Digital IC Tester	01
35	Logic Probes	05
36	Dimmerstat, 2 Amps	02
37	Servo Motor	01
38	DC Motor	02
39	Tachometer	01
40	Different types of displays	02 each
41	Work table/Bench	01
42	Microprocessor kit (8085)	10

List of Equipment for Electronic Instrumentation Lab

Sr. No.	Name of the equipment with Specifications	Quantity
1	Battery Charger	01
2	Pulse Generator	01
3	DOL Starter	01
4	DOL Starter with forward/reverse control	01
5	On delay Timers, off delay timers	01
6	Earth Leakage circuit breakers	01
7	Dimmerstat, 8 Amps	01
8	Counters	01
9	Temp. Controllers	01
10	Smoke Detector	02
11	Single phase Preventer	01
12	Servo Motor	01
13	Strain Gauge, L V D T	01
14	Three phase motor speed controller /Trainer	01
15	PH Meter	01
