

1	Name of Course	CC in Analytical Instrumentation (308103)																																									
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 Instrumentation Group of MSBVEE																																									
9	Objective Of Syllabus/ introduction	Awareness of Safety precautions. Awareness of Analytical Instrumentation. Awareness of Instrumentation. Awareness of Repair & Maintenance of Analytical Instrumentation.																																									
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which Develop, maintain and repair Industrial Electronics & Instrumentation related machines or with working experience will be in a position to start his own independent Business.																																									
11	Teacher’s Qualification	Diploma in Instrumentation Engineering.																																									
12	Training System	Training System Per Week <table border="1"><tr><td>Theory</td><td>Practical</td><td>Total</td></tr><tr><td>12 Hours</td><td>30 Hours</td><td>42 Hours</td></tr></table>							Theory	Practical	Total	12 Hours	30 Hours	42 Hours																													
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13	Exam. System	<table border="1"><tr><th>Sr. No.</th><th>Paper Code</th><th>Name of Subject</th><th>TH/PR</th><th>Hours</th><th>Max. Marks</th><th>Min. Marks</th></tr><tr><td>1</td><td>30810311</td><td>Analytical Instrumentation.</td><td>TH-I</td><td>3 hrs</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30810321</td><td>Basic Electrical & Electrical Instrumentation.</td><td>PR-I</td><td>3 hrs</td><td>100</td><td>50</td></tr><tr><td>3</td><td>30810322</td><td>Analytical Instrumentation.</td><td>PR-II</td><td>6 hrs</td><td>200</td><td>100</td></tr><tr><td></td><td></td><td>TOTAL</td><td></td><td></td><td>400</td><td>185</td></tr></table>							Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks	1	30810311	Analytical Instrumentation.	TH-I	3 hrs	100	35	2	30810321	Basic Electrical & Electrical Instrumentation.	PR-I	3 hrs	100	50	3	30810322	Analytical Instrumentation.	PR-II	6 hrs	200	100			TOTAL			400	185
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SYLLABUS

Theory & Practical Analytical Instrumentation

Practical - II	Theory - I
1. Identification of different components of the UV-VIS spectrophotometer	Unit 1: Introduction to Analytical Instrumentation. Analytical instruments broad view. Elements of analytical instruments, basic definition Role of analytical instrumentation Applications of analytical instrumentation Quantitative and qualitative analysis Industries using analytical instrumentation.
2. To measure transmission and absorption of a solution using spectrophotometer	Unit –2 Balances Scan gauge pressure transducer, load cell Function of balance Measurement of balance, accuracy, error, readability, linearity Calibration of balances, primary & secondary standards.
3. Identification of different components of IR spectrophotometer	Unit –3 Vacuum Vacuum measurements, different vacuum units Pirani gauge, penny gauge meclaud gauge, Vaddum pumps, different types diaphragm pumps, diffusion pumps, oil pumps, turbo molecular pumps Vacuum oven, filtration systems.
4. IR pellet making and measurement of IR spectrum	Unit-4 density measurements Hygrometers, Density of gases Metering orifice, impulse wheel methods, specific gravity measuring systems. Viscometers
5. Identify the different modules of the LC	Unit-5 Liquid analysis Concept of PH, PH meter electrodes Concept of conductivity, conductivity meter, conductivity electrode Ion selective potentiometer Analyzers for measurement of ammonia, silica, sodium and dissolved oxygen

6. Identify the different parts of the HPLC pump and measure the flow rate.	Unit-6 Thermal analysis Basic principles of - Differential scanning calorimeter - Thermogravimetry - Thermo mechanical analysis - Differential thermal analysis
7. Identify the different parts of the HPLC detector	Unit-7 Environmental pollution monitoring Air pollution monitoring instrument –carbon monoxide, sulphuric oxide, nitrogen dioxide. Hydrogen and ozone Smoke monitor, visible emission monitoring System emission and absorption of radiation Einstein relation, pollution inversion Chemical Oxygen demand & Biological Oxygen demand equipment/instruments.
8. Identify the different parts of GC	Unit-8 X-ray methods. Introduction to X-rays Concept of x-ray tube and its schematic Types of x-ray tubes Different detectors, ionization chamber, Geiger counter, proportional counter, scintillation counter , CCD. Concept of x-ray absorption methods. X-ray fluorescence methods Bragg's law X-ray diffraction and diffractometers, types Concept of goniometer, types.
9. Visit to industry for special instruments like mass spectrometer and identify the different parts	Unit-9 Density measurements Hygrometers, Density of gases Metering orifice, impulse wheel methods, specific gravity measuring systems, Viscometers
10. Visit to industry for special instruments like XRD and identify the different parts	Unit: 10 Introduction to absorption and emission spectroscopy Nature of electromagnetic radiation Electromagnetic spectrum Concept of absorption & transmittance. Relation between incident radiation,. Absorption and radiant power Beer-lambert's law, Block diagram of instrument modules for measuring absorption of radiation. Definition of spectrophotometer Different types of spectrophotometers, brief function.

11. Visit to industry for special instruments like DSC/TG and identify the different parts.	Unit-11 UV-VIS spectrophotometer. Different types of radiation sources, (Deuterium discharge lamp, Incandescent lamp) Different types of detectors (Photo diode/transistor, photo multiplier) Explain about filters(absorption filters, interference filters) Functions of monochromator, prism, grating. Function of slits Sample handling, cuvettes Optical schematic of single beam /double beam spectrophotometers.
12. To find the conductivity ;of the given liquid using conductivity meter	Unit-12 Infrared spectrophotometer. Basic principle of IR spectroscopy Vibration of molecules Types of IR radiation sources, nichrom coil Types of detectors, Thermal detectors Sample handling, gases, liquids, film, pellet, pellet preparation. Optical schematic of IR spectrophotometers Fourier transfer concepts & FTIR
13. To find the PH of the given liquid using PH meter	Unit-13 Flame emission spectroscopy/fluorescence spectroscopy Flame emission spectroscopy Basic principle, concept of nebulisation, burners Schematic of flame emission spectrophotometer. Fluorescence spectrophotometer. Basic principle Basic components of fluorescence instrumentation Different sources Schematic of fluorescence spectrophotometer.
14. To calibrate the PH meter	Unit-14 chromatography Introduction to basic principles Classification of chromatography Paper and thin layer chromatography Glass column separations Liquid chromatography(LC) Block diagram of general instrumentation of LC Concept of mobile phase and stationary phase. Function of solvent delivery systems-HPLC pumps Sample introduction, syringe injection, Separation columns , different types Different detectors-UV, fluorescence, PDS, RI, ELSD.

15. To study the different ion selective electrodes	Unit-15: Gas chromatography(GC) Basic components of GC, Schematic diagram Function of sample injection systems Column oven Types of detectors, FID, TCD, ECD Basic of FID
16. To find out humidity of the room using hygrometer and comparing with standards	Unit-16 Mass spectrometer(MS) Basic principles Different components of MS Different ionization techniques, EI, CI Types of detectors-channel electron multiplier Vacuum system Types of mass spectrometers, magnetic deflection, TOF , Quadraploe Concept of interfacing chromatography & mass spectrometry (LC-MS & GC-MS)
17. To study water analysis kit & measure PH, conductivity, dissolved O2 , temperature	Unit-17 Basic principles and instrumentation of - refractometry - Interferometry - Polarimetry - Optical rotation dispersion - Capillary electro phoresis
18. To study the analysis of fuel gases	Unit –18 Gas analysis IR and UV absorption analyzers Paramagnetic oxygen analysis Thermal conductivity analyzers Chemiluminescence analyzer.
19. To measure the viscosity of given fluid using viscometer	Unit-19 Indicators and recorders Single point indicator, multipoint indicators, analog and digital indicators Analog and digital recorders, strip chart recorder, x-y recorder, circular recorder, single and multipoint recorders.
20. To study the communication (serial, Iaa, IEEE, optical)system between computer and instrument	Unit-20 Computer aided analysis Computer organization-hard ware(ALU, control unit, CPU, Memory, IO units, Buses) Basic computer block diagram Computer organization-software(machine language, assembly language, high level language, OS translators Computer – instrument interface Different communication systems between computer-instrument, IEEE , serial, parallel, LAN< RS-232, optical link.

21. To measure the weight using balance and check the accuracy , repeatability, readability & Linearity.	
22. To measure the vacuum of a vacuum pump using vacuum gauges.	

List of Instruments/Equipment Analytical Instrumentation

Sr. No.	Name of the Equipment	Quantity
1.	UV-VIS Spectrophotometer & computer with s/w	1 No.
2.	FTIR spectrophotometer & Computer with s/w	1 No.
3.	KBr press for pellet making	1 No.
4.	HPCL system (modular system) & computer with s/w	1 No.
5.	GC & Computer with s/w	1 No.
6.	Conductivity meter	2 Nos.
7.	pH meters	2 Nos.
8.	Ion selective meter	1 No.
9.	Dissolved O ₂ meter	1 No.
10.	Hygrometers	3 Nos.
11.	Water analysis kit	1 No.
12.	Gas analyzers	1 No.
13.	Balances	2 Nos.
14.	Vacuum gauges	2 Nos.
15.	Vacuum pumps	1 No.
16.	Colodimeters	1 No.

Practical – I

Basic Electronic & Electronics Instrumentation

Practical
<p>Identification of hand tools, Safety Precautions while working in Electronics Lab & Electric Shock First Aid, and various measuring instruments, soldering- de- soldering Practice on wire, chassis and on PCB.</p> <ul style="list-style-type: none">• Identification specification & testing of various kind of resistances, & capacitors, Measurement by colour code• Familiarize with various types of switches.• Construct circuit with SPST, SPDT, and DPDT switches.• Familiarize miniature and micro switches, reed switches & latches, sockets –connectors & plugs, fuses, terminals, tags, legs & thimbles, Relays and their contacts,• Familiarization with various types of variable resistors, the mister, LDR, VDR.• RC time. Constant
<p>Forward and reverse characteristics of P N junction diode & Zener Diode.</p> <ul style="list-style-type: none">• Plotting of various characteristics of Transistor• Biasing method of Transistors• Identification, Specification testing of Junction Diode & Transistors, LED, Zener Diode• Fabrication and assembly of Full wave rectifier Ckt using Diodes, Adding to Pie Filter,• Adding to Series Regulated Ckt using Zener & Series Transistor,• Build of voltage Divider , Doublers
<p>Assemble and observe the outputs of mono stable, bi stable and A-stable multi vibrators using transistors and 1C555.</p> <ul style="list-style-type: none">• Assembles and observe the output of two input, two output bi stable multi-vibrator, .• Assemble Astable multi-vibrator as a VCO.• Construct and measure the output of simple inverter, SMPS.& UPS• Characteristics of transistor As switch identification and Testing of FET,• Common Source and common drain Configuration,• Study of switching action of JFET CMOS BMOS & MOSFET.• Construct and measure the output of MOSFET based inverter, SMPS.& UPS
<p>Testing of SCR by multi meter plot the forward characteristics of a SCR</p> <ul style="list-style-type: none">• Find the latching current and holding current of SCR,• AC switching circuit by UJT, plot the Characteristics of UJT, Construct and observe outputs of UJT firing circuit, light dimmer circuit,• Characteristics of DIAC, DIAC as a DC pulse generator, characteristics of TRIAC fan regulated• DC motor speed control method and armature current control method, SCR trainer kit.

<p>Integrated Circuits: - Formation of diode, transistor, Resistor and constructional details- Different types of ICs.</p> <p>Assemble and verify truth table of OR, AND, NOT gate using discrete components.</p> <p>Verify truth table of NAND, NOR, XOR and XNOR gates.</p> <p>Study the inter conversion of gates by combination of another logic ckts</p> <p>Making of Min and Max Combination ckt using logic gate</p> <p>Study of Digital Logic Lab and perform various experiments of Flip Flops, Registers, and Counters.</p>
<p>Familiarization with common anode, cathode and seven segments, LED display, LCD display and display drivers,</p> <ul style="list-style-type: none"> • Construct and observe output of resistive network and binary ladder. • D/A converter, observe the output of comparator with different inputs, • Familiarize with A/D converter • Familiarize with memory ICs, parallel expansion of memory ICs, EPROM ICs, EPROM programmer
Measurement of LC & R, using LCR Bridge, Digital LC & R meter
<p>Measurement of AC, DC voltage, current using all types of Analog and digital meters, ramp type, Integrating type, Continuous Balance type.</p> <p>Study complete method of use of digital millimeter for its complete measurement provision like V,I,R, db, Temperature, capacitance, feature of testing of semiconductors, Frequency, feature of hold and memory provision</p>
<p>Use of Analog and Digital Frequency meter/Counter , Various Type of Timer, Timers and controllers</p> <p>Familiarization with operation, use & application of CRO in detail .Measurement of Freq., Voltage, Phase & Phase Difference using Single, Dual Trace, Storage Type Oscilloscope.</p> <p>Seeing and comparative analysis of wave shape using Oscilloscope.</p> <p>Plotting of Lissagous Pattern</p> <p>Familiarization with operation and use of various kind of signal generator, function generator, pulse generator</p>