

1	Name of Course	CC in Medical Instrumentation (308105)																																								
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 Instrumentation. Awareness of Medical Instrumentation Awareness of Repair & Maintenance of Medical Instrument.																																								
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which Develop, maintain and repair Medical Instrument 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. With 3 year Teaching experience in Medical Instrumentation.																																								
12	Training System	Training System Per Week <table><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><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>30810511</td><td>Medical Instrumentation</td><td>TH-I</td><td>3 hrs</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30810521</td><td>Basic Electronic & Electronics Instrumentation.</td><td>PR-I</td><td>3 hrs</td><td>100</td><td>50</td></tr><tr><td>3</td><td>30810522</td><td>Medical 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	30810511	Medical Instrumentation	TH-I	3 hrs	100	35	2	30810521	Basic Electronic & Electronics Instrumentation.	PR-I	3 hrs	100	50	3	30810522	Medical Instrumentation	PR-II	6 hrs	200	100			TOTAL			400	185
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SYLLABUS

Medical Instrumentation

Practical – II	Theory - I
<ul style="list-style-type: none"> - Layout and repairing of electrical installation, Construction of earth pit and testing, testing of leakage currents. - Demonstration of various filters, - Construction of rectifiers, Filter circuits - Construction of CE amplifiers and testing - Construction of Oscillators and testing - Construction of power supplies and testing - SCR, TRIC circuits and testing, Speed control of motors etc., - Study of different amplifiers using Op-Amp, instrumentation amplifier and testing. - Testing of different Logic gates, flip-flops, counters, study of digital ICs. etc. <p>Verification of_ combinational circuits, Logic gates.</p>	<p>AC/ DC: supply sources, Cells & Batteries, Button cells etc., AC Single phase/3-phase concepts, Star- delta concept, Electrical safety.</p> <p>Magnetism: Permanent Magnet/ Electromagnet, Electromagnetic Relay.</p> <p>Types of meters, Analog/ Digital Multimeter etc., C.R.O., Function generator.</p> <p>Passive components: Resistor -classification & rating, Capacitor -classification & ratings, Inductor -Classification, Transformer - types. RC, RL, LC, RLC series/ parallel circuits, Resonance etc., & other filter circuits. Introduction to crystal. DC motor, principle of operation, types, constructional details, etc.,</p> <p>Review of electronic devices & circuits:>>> Diodes, Rectifiers, Filters etc. Bipolar Junction Transistor, Junction Field Effect Transistor, MOSFET, Regulated power supplies, Amplifiers, Oscillators, Multivibrators, UJT, SCR, TRIAC, DIAC, LED, LDR, Photo diode, opto-coupler, SMPS. UPS Op-Amp: Basic details of the Op-Amp, Instrumentation amplifiers, Bio-medical applications, 555 IC timer circuit.</p> <p>Digital Electronics: Basic concepts, Number system, Gates, Boolean algebra, Introduction to flip-flops, counters, ADC & DAC, LSI, MSI, VLSI, CMOS etc.,</p> <p>Microprocessors: Introduction to MP & MC, Ports etc.,_____</p> <ul style="list-style-type: none"> - Demonstration of various multi meters used in electronic industry - Measurement of AC/ DC voltages, currents - Checking of passive components, fault discussion, - Checking of transformers, - Testing of cells, batteries, Maint. schedule etc., - Wave form observation in C.R.O. by using function generator. - Demonstration of different motors,

<ul style="list-style-type: none"> - Familiarization with microprocessors and microcontroller based equipment kit, Study of microprocessor applications using trainers etc 	<p>Introduction to anatomy: Surface and regional anatomy, cells, tissues and organs, Terminology, blood and their components</p> <p>Human physiology: Blood. Lymphatic system. Skeleton. Muscle. The heart. The lungs. Alimentary canal and associated structures. Abdomen, Organ position in the abdomen, Kidney Organs of the head and neck. The brain</p>
<ul style="list-style-type: none"> - Demonstration of Human body and its parts by using Charts, various clay & other models, - Hospital visit. 	<p>Electro physiology: Nerves, nerve structure, resting potential, action potentials (regeneration), action potential (propagation), volume conductor effects, recorded nerve signals.</p> <p>Introduction to medical electronics: Overview of various departments in hospital, equipment found in various department and specialties..</p> <p>Static & dynamic characteristics of electronic equipment, standards. Generic block diagram of biomedical equipment.</p> <p>Introduction to electrode: Electrode, bio-potentials, types of electrodes, shapes & their applications, electro conductive jelly.</p> <p>Introduction to Transducer: Define Transducer, classification, configuration of a Wheatstone Bridge, Types of transducers used in biomedical instrumentation. Temperature measurement using thermistors, thermocouples, liquid-in-glass thermometer, solid-state sensor.</p>
<ul style="list-style-type: none"> - Construct & test a wheat stone bridge. - Construct & test a Thermo couple. - Construct & test a strain gauge using LVDT. - Construct & test a Strain gauge based on resistance, capacitance / inductance. - Use of various electrodes, making measurements with them, - Use of various transducers and correct usage in the respective area. - Care and maint. of electrodes/ transducers, Sensors. 	<p>Displacement/force/acceleration measurement using potentiometers, variable inductance differential transformer (LVDT), strain gauges -measurement types</p>
<ul style="list-style-type: none"> - To sketch the different bioelectric signals (state typical magnitude and frequency) - Construct & test >> Differential amplifier using op-amp, instrumentation amplifier using op-amp, isolation amplifier. - Instrumentation amplifier >> type number, package, pin diagram. 	<p>Bio-medical signals: Types, definition, characteristics</p> <p>Bioelectric amplifiers >> definition, different configurations, Define terms used in bioelectric amps (e.g.: inverter, offset null, zero suppression, summing junction, common mode rejection and virtual ground), need of bioelectric amplifier.</p> <p>Differential amplifier, instrumentation amplifier, isolation amplifier & their types</p>

<ul style="list-style-type: none"> - Properly prepare cable ends -Install fittings on cable ends and splices, - Wiring a small room as per standards - Preparation of wiring diagram - Earth preparation as per standards 	<p>Medical probe cable, co axial cable, connectors - for various applications, specification etc. Explain methods of pre-wiring and ways to wire existing buildings including entry, attic and crawl space precautions and methods of fishing walls and routing wiring through false ceilings, List the standards used in the electrical wiring of buildings, good earthing procedure</p>
<ul style="list-style-type: none"> - Identify the class of the medical equipment by power cord and symbol represented on the equipment -Open a circuit breaker and identify the components -Demonstration on equipotential grounding - Familiarization with electrical safety tester - Construct a circuit to perform receptacle test -Perform ground pin to chassis resistance test using multimeter - Perform chassis leakage current test using multimeter -Perform lead-to-ground leakage current test using multimeter 	<p>receptacle test, Ground-to-chassis resistance test, chassis leakage current test, lead-to-ground leakage current test, lead-to-lead leakage current test, lead isolation test. Typical values of resistance and leakage current as per IEC 601 test standards</p>
<ul style="list-style-type: none"> - Perform lead isolation test using multimeter - Perform safety test using electrical safety tester -Develop an electrical safety program for a typical hospital 	<p>Preventive maintenance for reducing electrical hazards, reducing ground faults hazards, Describe fire safety rules commonly required for medical equipment maintenance personnel, Precautions required for H.I.V. or TB prevention for hospital workers, List extra precautions biomedical personnel must take to maintain cleanliness standards in medical facilities</p> <p>General safety standards for electro medical equipments</p>
<ul style="list-style-type: none"> - Set the temp. and measure as per the test requirement for heating the sample using Hot air Oven, Incubator, Water bath. - Trace the circuit diagrams. - Identify various controls available on the control panel of colorimeter, Spectrophotometer- meter, Flame photometer and Measure the concentration of the material present in the given sample - Identify various controls and practice their use, Measure acid/ base condition of the given sample using pH meter - Identify various controls and practice their use, measure the concentration of the given sample using Conductivity meter - Identify various controls and practice their 	<p>Introduction: Different type of analytical equipments, Hot air Oven, Incubator, Water bath etc., Purpose, Use, Circuit constructional details, Temperature measurement and Control Introduction to chromatography, Colorimeter, Spectrophotometer, Flame photometer, Working principle, Block diagrams, pH meter, Conductivity meter, Electrophoresis, Auto analyser, Blood gas analyser, Analytical balance, Centrifuge, Microscope, blood cell counter, sterilizers, auto clave</p>

<p>use, measure protein etc. content in the given sample solution using Electrophoresis equipment</p> <ul style="list-style-type: none"> - Identify various controls and practice their use of other equipment - Replacing of fuse, damaged controls - Routine maintenance of all clinical lab - Do's & don'ts in using clinical equipments 	
<ul style="list-style-type: none"> - Identify various controls available on the control panel and practice its operation of the short-wave diathermy machine - Identify various controls available on the control panel and practice its operation of the Micro-wave diathermy machine - Identify various controls available on the control panel and practice its operation of the Ultrasound diathermy machine - Routine maintenance on short wave diathermy, Microwave diathermy and Ultrasound diathermy machines. - Replacing fused bulb in a IR AND UV source - Replacing heating coil in a wax bath - Study of front panel control and functions of EMG machine - Carry out routine maintenance 	<p>Introduction: list various physiotherapy equipment and their application</p> <p>Short wave diathermy: Basic principle of operation, cable used, radiator used, functional blocks, common problems</p> <p>Ultrasound diathermy: Basic principle of operation, cable used, radiator used, functional blocks, common problems</p> <p>Microwave diathermy: Basic principle of operation, cable used, radiator used, functional blocks, common problems, introduction to Electromagnetic Spectrum</p> <p>Infrared (IR) & UV radiation in physiotherapy, IR lamps, UV sources : construction, types of light source used, application</p> <p>Wax bath: construction</p> <p>EMG machine >> EMG signal -waveform, characteristics, need block diagram, function, specification, Electrode used and positioning, operation</p>
<ul style="list-style-type: none"> - Draw the layout of a X-Ray room - Identify & draw various controls available on the control panel of the X-ray machine - Know the operating procedure of the each control of the X-ray machine. - Draw x-ray machine and its sections. - Dark room layout. - Identify various stages involved in the process of the film development. 	<p>Introduction of imaging systems >> need, types - X-Ray, ultrasound, CT scan, MRI, PET, etc and their application</p> <p>X-Rays >> List the different types of X-Ray systems and their function, X-Ray generation, range of X-rays, Properties, Interaction of X-rays with media, effects of radiation, radiation Hazards & Safety, Introduction to dose meter</p> <p>X-Ray radiography system>> Block diagram, X-Ray tube - construction, types, specification, Scattered radiation control, common problems.</p> <p>Dark room >> basics, procedure for developing X-Ray film</p>
<ul style="list-style-type: none"> - Draw the layout of ultrasound room - Identify, draw and name the parts of ultrasound machine - Identify & draw various controls available on the control panel of the ultrasound machine - Practice tracing of organs in the human body using different controls of the U/S scanner 	<p>block diagram, principle of operation</p> <p>Transducer probe - types and application</p> <p>Scanning modes - A-mode, B-mode, M- mode etc.</p> <p>Image processing controls, image presentation controls, image measurement controls of u/s scanner</p>

- Practice connecting the film unit to the U/ S scanner	
<ul style="list-style-type: none"> - Familiarization of ECG machine front panel / functional controls, electrodes, paper used for recording - Operate ECG machine, loading of paper - Carry out routine maintenance on the machine - Study the front panel control and operation of echo cardiograph - Study the front panel control and operation of pacemaker -BP measurement with manometer and stethoscope 	<p>Introduction >> need, list out the different cardiac equipments and their function, ECG signal -waveform, characteristics ECG machine >>classification, block diagram of single channel recorder, function, galvano mechanism, specification, Electrode used and positioning, operation, Functional blocks of ECG machine, functional problems, List the basic care/maintenance of ECG machine</p> <p>Stress test , Holter test, echo cardiograph</p> <p>Pace maker- types, working principle</p> <p>Introduction to EEG</p>
	<p>diagram, specification, Electrode used and positioning, operation, Functional blocks of ECG machine, List the basic care/maintenance of ECG monitor</p> <p>Defibrillator >> principle of working, application, paddles and cables used, calculate energy discharged, safety</p> <p>Pulse Oximeter >> need, block</p>
<ul style="list-style-type: none"> -- Familiarization of spirometer & nebulizer machine front panel / functional controls, transducer used - Draw a schematic of an operation theatre -Familiarization of the electrosurgical machine front panel - Safety measures to be adopted when using electro surgery machine -Carry out routine maintenance on electrosurgical machine -Replacement of bulbs in OT lights - visit to hospital 	<p>Introduction>> list out the instruments used in the respiratory system and their functions, Describe the various respiratory transducers, Pulmonary parameters, volumes</p> <p>Operating room>> Protocols involved in working in the Operating Room (dress code, cleanliness and attitude), List the special equipment used in the OR and their functions, anesthetics used and types commonly used, List the duties of the personnel employed in the Operating Room (e.g.: the nursing staff, biomedical technician, surgeon, etc.), List the functions of the equipment used in the OR</p> <p>Electro surgery generator >> need,</p>
	<p>principle of operation, List the frequencies commonly used by electrosurgical scalpels, type of waveforms generated (coagulate, cut), List the safety measures to be adopted when using</p> <p>Operation theatre light >> types,</p>

Practical - I
<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 Lissagus Pattern</p> <p>Familiarization with operation and use of various kind of signal generator, function generator, pulse generator</p>

List of Tools & Equipments :

No.	Name of the Equipment	Quantity
1.	Human Anatomy Models	1 SET
2.	Human Anatomy Charts	1 SET
3.	Human Anatomy Cds	As Required
4.	Ultrasound Diathermy	2 Nos.
5.	Microwave Diathermy	2 Nos.
6.	Short Wave Diathermy	2 Nos.
7.	Tens Unit	2 Nos.
8.	Interferential Therapy Machine	2 Nos.
9.	Electronic Traction Machine	2 Nos.
10.	Emg Machine	2 Nos.
11.	Wax Bath	1 No.
12.	Phototherapy Lamps [Ir/Uv Etc]	4 Nos.
13.	Incubator	2 Nos.
14.	Oven	2 Nos.
15.	Water Bath	2 Nos.
16.	Calorimeter	4 Nos.
17.	Spectrophotometer	2 Nos.
18.	Flame Photometer	2 Nos.
19.	Micro Scope - For Pathlogy	2 Nos.
20.	Ph Meter	2 Nos.

21.	Conductance Meter	2 Nos.
22.	Electrophoresis	1 No.
23.	Semi Auto Analyzer	1 No.
24.	Blood Cell Counter	2 Nos.
25.	Blood Gas Analyzer	2 Nos.
26.	Centrifuge (Electrical)	2 Nos.
27.	Centrifuge (Haematocrit)	2 Nos.
28.	Ultra Sound Machine With Film Unit	2 Nos.
29.	Colour Doppler Ultra Sound Machine	1 No.
30.	Phantom	2 Nos.
31.	Thermal Printer	2 Nos.
32.	Mobile X-Ray Machine- 100ma	2 Nos.
33.	Dental X-Ray Machine	1 No.
34.	Dosi Meter	2 Nos.
35.	Film Dryer	1 No.
36.	300 Ma X-Ray Machine**	--
37.	X-Ray Service Tools & Equipments	2 Sets
38.	Dark Room Accessories	As Required
39.	Emg Machine	1 No.
40.	Eeg Machine**	--
41.	Audiometer	2 Nos.
42.	Dialysis Machine**	--
43.	Eeg Simulator**	--
44.	Single Channel Ecg Recorder	6 Nos.
45.	Multi Channel Ecg Recorder	2 Nos.
46.	Ecg Monitor / Cardiac Monitor	4 Nos.
47.	Defbrillator	2 Nos.
48.	Non-Invasive Blood Pressure Meter	4 Nos.
	[Spygmanometer]	
49.	Stethoscope	4 Nos.
50.	Pace Maker	2 Nos.
51.	Ecg Wave Form Simulator	2 Nos.
52.	Pulse Oximeter	2 Nos.
53.	Ventilltor & Associated Units	1 No.
54.	Nebulizer- Ultrasonic, Diaphragm, Piston	2 Nos.
55.	Apnoea Monitor	2 Nos.
56.	Foetal Monitor	1 No.
57.	Holter Machine	2 Nos.
58.	Electro Surgery Unit [Diathermy]	2 Nos.
59.	Endo Scope [Fibre Optics]	1 No.
60.	Operation Theatre Lamp	1 Nos.
61.	Surgeon's Head Lamp	1 No.
62.	Theatre Lighting [Various]	4 Nos.
63.	Voltage Stabilizer, 5kva Or As Required	1 No.
64.	Any Other Spare Functional Circuit Board/Card	As required
65.	Maintenance Tool Kit	20 Sets

66.	Work Bench / Table / Test Bench	5 Nos.
67.	Revolving Chair / Stool [For Participants]	20 Nos.
68.	Staff Table	2 Nos.
69.	Revolving Chair [For Staff]	2 Nos.
70.	Steel Racks	6 Nos.
71.	Steel Almirah	3 Nos.
72.	Steel Lockers For 20 Participants	As per available design
73.	Gluco Meter	2 Nos.