



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170317

Semester – VII

Subject Name: Testing and Troubleshooting in Medical Devices

Type of course: Professional Elective Course

Prerequisite: Basic Physics, Mathematics, Human Anatomy and Physiology, Basic Electronics, Advance Electronics

Rationale: All medical devices comprises electronics components and it required testing and troubleshooting. Basics of electronics troubleshooting must be a skill of Professional Biomedical Engineer. This subject aims to includes basic troubleshooting fundamentals and Electronics testing and fault finding techniques. Human errors of Medical Devices are also included.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Principles of Troubleshooting: Problem-Solving Analysis, Circuit Faults, Troubleshooting Methods, Safety Considerations, Testing Basic Components, Semiconductors, Integrated Circuits, Electron Tubes, Ultra capacitors, Inductors	5
2	Fault Diagnosis in Analog & Digital Integrated Circuits: Fault diagnosis in op-amp circuits, Digital troubleshooting methods, Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator.	5
3	Board Level trouble shooting: Historical device repair perspective, The concept of board level troubleshooting, Isolating device repair problems, The decision making process-when to repair the board	5
4	Troubleshooting Biomedical Equipment: Troubleshooting- anesthesia machine, autoclaves & sterilizers, Troubleshooting- endoscope, incubators, nebulizer, Troubleshooting- oxygen concentrators, sphygmomanometers, suction machine,	5
5	Troubleshooting Biomedical Equipment: Electrical Safety and Safety Equipment, Defibrillators, ECG Systems, ECG Lead Systems, ECG Machine Troubleshooting, ECG Machine Maintenance, EEG Systems EEG Amplitudes and Frequency Bands, EEG Machines, Troubleshooting and Preventive Maintenance, Hemodialysis Machines and Troubleshooting, MRI Machines and Troubleshooting	10

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	Ultrasound Machines, Troubleshooting of Ultrasound Machines, X-Ray Machines and Troubleshooting	
		30

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25	25	20	15	15	00

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair & Maintenance", Tata McGrawHill, 2nd edition, 2009
2. Basem S EL-Haik& Khalid S Mekki, "Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness", John Wiley & Sons, 1st edition, 2008
3. Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting for Biomedical Technicians", TSTC Publishing, 2nd edition, 2010.
4. Electronic Troubleshooting, Fourth Edition, by Daniel R. Tomal, Aram Agajanian, McGraw-Hill Education; 4th edition (22 April 2014), ISBN-978-0071819909.
5. World Health Organisation, "Maintenance & Repair of Laboratory, Diagnostic imaging & Hospital Equipment", Geneva,1994
6. Ian R McClelland, "X-ray Equipment maintenance & repairs workbook for Radiographers & Radiological Technologists", World Health Organisation, Geneva, 2004.
7. Ministry of Health & Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, 2010.

Course Outcomes: After learning the course, the students should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply the common troubleshooting procedures in electronic equipment.	16%



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CO-2	Analyze the fault diagnosis in analog circuits and digital circuits.	16%
CO-3	Understand principals of board level troubleshooting in electronic devices.	16%
CO-4	Identify the problems in low risk biomedical equipment in hospitals when it is not working and provide a suitable solution.	19%
CO-5	Identify the problems in high risk biomedical equipment in hospitals when it is not working and provide a suitable solution.	33%

List of Experiments:

1. Study of basic troubleshooting techniques.
2. Study of fault diagnosis in analog circuits.
3. Study of fault diagnosis in digital circuits.
4. Study of electrical safety and safety equipment.
5. Study of board level troubleshooting.
6. Troubleshooting and preventive maintenance of X-Ray machines.
7. Troubleshooting and preventive maintenance of MRI machines.
8. Troubleshooting and preventive maintenance of ECG machines.
9. Troubleshooting and preventive maintenance of endoscopes, nebulizers and incubators.
10. Troubleshooting and preventive maintenance of defibrillators.