

West Bengal State Council of Technical &  
Vocational Education and Skill  
Development  
(Technical Education Division)



Syllabus  
of

Diploma in Medical Laboratory Technology  
[MLT]

Part-III (6<sup>th</sup> Semester)

2023



**West Bengal State Council of Technical, Vocational Education and Skill Development**  
(Technical Education Division)

**Curriculum Structure of MLT 6<sup>th</sup> Semester**

<b>MLT / SEMESTER – 6<sup>th</sup></b>													
S N o	Course Code	Course Name	Credit	Contact Hr./Week			Evaluation / Assessment Scheme						Full Ma rks
				L	T	P	Internal				External		
							CA	TA	MST	P	P	ESE	
<b>Theoretical</b>													
1	MLTPC616	Installation & Maintenance of Medical Equipment	3	2	1	-	10	10	20	-	-	60	100
2	MLTPE64#	Elective-IV:	3	3	-	-	10	10	20	-	-	60	100
3	*OE611	Open Elective-I:	3	3	-	-	10	10	20	-	-	60	100
4	*OE62#	Open Elective-II :	3	3	-	-	10	10	20	-	-	60	100
5	*HS604	Entrepreneurship and Start-ups	3	2	1	-	10	10	20	-	-	60	100
<b>Sessional</b>													
6	MLTPC616P	Installation & Maintenance of Medical Equipment Lab.	1	-	-	2	-	-	-	60	40	-	100
7	*PR603	Major Project	4	-	-	6	-	-	-	60	40	-	100
8	*SE601	Seminar	1	-	-	2	-	-	-	60	40	-	100
		<b>TOTAL:</b>	21										



**Syllabus of Installation Maintenance of Medical Equipment**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Installation Maintenance of Medical Equipment	Course Code:	MLT PC 616
Course Category:	Theory; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-2, T-1

Course Objective:

Sr. No	Course Objective
1	To acquire the basic knowledge of Installation of medical Instruments
2	To be familiar with the Layout of installation site.
3	To acquire the basic knowledge Maintenance and Care of medical instruments
4	To acquire the basic knowledge requirements for the installation.

Course Content:

Unit	Topic	Hrs.
1	<b>Electrical Power Supply:</b> Concept of single phase & three phase power supply system, Voltage, wattage, Earthing method, Open ground problem, Shielding, Electrical rules & regulation, switch, fuse, UPS	4
2	<b>Electrical Shock Hazard &amp; safety :</b> Electrical Shock, Type of shock, Gross shock, Micro Shock, Let-go-current, Physiological effect of electrical shock, electrical safety, Prevention of shock, Isolation circuit, leakage current, code & regulation for the medical Instrument, Patient safety,	6
3	<b>Installation:</b> Checklist, Requirement for the installation of medical Instruments - Power , Room size, construction & others, drawing of Layout and Requirement for the installation of X-ray, USG, CT, MRI, Laboratory Instruments – colorimeter, Spectrophotometer, Semi analyzer, Auto-analyzer, Electrophoresis machine, ECG, EEG, EMG , Computed Spirometer etc.	15
4	<b>Maintenance:</b> Function of the instruments, Use of manual , maintenance, Troubleshooting – fault, possible cause, solution, Approach of fault analysis, Preventive maintenance& annual maintenance of different medical instruments such - X-ray, USG, CT, MRI, Laboratory Instruments – colorimeter, Spectrophotometer, Semi analyzer, Auto-analyzer, Electrophoresis machine, ECG, EEG, EMG , Computed Spiro meter, BP Instrument, Stethoscope etc.	15
5	<b>Condemnation &amp; Disposal:</b> Introduction, Reason for condemnation of equipment, Constitution of “Condemnation & Disposal Board”, Concept of unserviceable equipment, General principle & procedure to declare an item as unserviceable, Determination of floor/Reserve price, Disposal procedure, legislation relevant to disposal, scrap item, sale Procedure.	5
Total Teaching Hrs. : (3 hrs. x 15 Weeks)		45
Assessment : ( 3hrs. x 2 Weeks)		06
<b>Total:</b> (3hrs. x 17 Weeks)		<b>51</b>



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Course Outcomes (COs):

COs	<i>At end of the course, students would be able to</i>
CO1	State the electric power supply, electric shock hazards & safety.
CO2	Demonstrate the installation of biomedical equipment.
CO3	Demonstrate the maintenance of medical equipment.
CO4	Explain the condemnation & disposal of item.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
1.	<b>Objective Type:</b> MCQ/ Fill-in-the blanks	A	All	25	20	1 x 20	20	
2.	<b>Short Answer Type:</b>	B	All	12	10	1 x 10	10	
3.	<b>Subjective Type:</b>	C - I	1,2	3	Any <b>Five</b> taking at least <b>One</b> from each group	6 x 5	30	
		C - II	3	3				
		C - III	4, 5	3				
	<b>Total (A+B+C) :</b>						<b>60</b>	

Reference Book:

Sr No	Book	Author	Publisher
1	Medical Equipment Maintenance Management & Oversight	Binseng Wang	
2	Servicing Biomedical Equipment	Elliott S. Kanter	
3	Biomedical Equipment Technology	Joseph J. Carr & John M. Brown	
4	Biomedical Instrumentation	R. S. Khandpur	Tata Mc
5	The hand book of Biomedical Engineering	Josep D. Bronzino	CRC Press
6	Medical Equipment Maintenance (Guidelines by Ministry of Health)		

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**Syllabus of Installation Maintenance of Medical Equipment Lab**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Installation Maintenance of Medical Equipments Lab	Course Code:	MLTPC 616P
Course Category:	Sessional; Program Core	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	T-0: P-2

Course Objective:



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Sr. No	Course Objective
1	To acquire the basic knowledge of Installation of Medical equipment
2	To be familiar with the Layout
3	To be familiar with the requirements for the installation
4	To acquire the basic knowledge of the preventive and annual maintenance

Course Details:

Expt. No	Experiment	Hrs.
1	Introduction to tools for installation & maintenance of biomedical equipment.	
2	Draw the layout for installation of ECG machine.	
3	Demonstration of ECG machine maintenance.	
4	Draw the layout for installation of EEG machine.	
5	Demonstration of EEG machine maintenance.	
6	Draw the layout for installation of X-ray machine.	
7	Demonstration of X-ray machine maintenance.	
8	Draw the layout for installation of CT machine.	
9	Demonstration of CT machine maintenance.	
10	Draw the layout for installation of USG machine.	
11	Demonstration of USG machine maintenance.	
12	Draw the layout for installation of bio-chemistry analyzer.	
13	Demonstration of bio-chemistry analyzer maintenance.	
14	Demonstration of BP instrument maintenance.	
Total Teaching Hrs. : (2 hrs. x 15 Weeks)		30
Assessment : (2hrs. x 2 Weeks)		04
<b>Total: (2hrs. x 17 Weeks)</b>		<b>34</b>

Course Outcomes (Cos):

COs	<i>At end of the course, students would be able to</i>
CO1	Identify the tools for installation & maintenance.
CO2	Draw the layout for biomedical equipment.
CO3	Demonstrate installation of biomedical equipment.
CO4	Demonstrate the maintenance of biomedical equipment.

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**Elective-IV (Any one course to be selected)**

Sl	Course Code	Program Elective-IV:	Credit	Semester	Full Marks
4.1	MLTPE 641	Power & Control System	3	6 <sup>th</sup>	100
4.2	MLTPE 642	Micro Electro Mechanical System	3	6 <sup>th</sup>	100

**Code System:**

Program (i.e. MLT) \_Course Category (i.e. PE) \_Semester (i.e. 6) \_ Elective Course No ( i..e 4)\_Course No (i.e. 1, 2,)



**Syllabus of Power & Control System**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Power & Control System	Course Code:	MLT PE 641
Course Category:	Theory; Program Elective-IV	Full Marks & Duration:	100; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-3; T-0

Course Objective:

Sr. No	Course Objective
1	To introduce application of power electronic.
2	To acquire the knowledge of control system.
3	To develop the concept of time & frequency domain analysis.

Course Details:

Unit	Topic	Hrs.
1	<b>Thyristor:</b> Introduction to Thyristor Family, Principle of operation of SCR, Two transistor analogy and turn on & off mechanism of SCR, Firing of thyristor, Gate trigger circuits, Brief of modern power semiconductor devices- DIAC, TRIAC, GTO, RCT, SIT, LASCR, IGBT, MOSFET, UJT	7
2	<b>Phase Control Rectifiers and Inverters:</b> Introduction, Phase angle control, 1-phase half and full wave control rectifier, 3-phase half and full controlled bridge converter, Thyristor Inverter classification- Series Inverter, Parallel Inverter, 1-phase and 3-phase bridge inverter	7
3	<b>Choppers and AC regulators:</b> Principle of operations, Step up/down chopper, Chopper Configuration, AC Chopper, 1-phase and 3-phase AC Regulator	5
4	<b>Control System Components:</b> Basic concept on Laplace and Fourier, Error sensing devices, potentiometer, tachometer, servomotor, stepper motor, pneumatic system, P, PI and PID controller	13
5	<b>Time and Frequency Domain:</b> Introduction, Time response of 1 <sup>st</sup> and 2 <sup>nd</sup> order systems, Effect of adding pole zeros to TFMR-H criteria, Root locus method, Frequency response plot: Polar Plots, Bode Plot, Nyquist Criteria	13
Total Teaching Hrs. : (3 hrs. x 15 Weeks)		45
Assessment : (3 hrs. x 2 Weeks)		06
<b>Total:</b> (3 hrs. x 17 Weeks)		<b>51</b>

Course Outcomes (COs):

COs	<i>At end of the course, students would be able to</i>
CO1	Develop the concept of Power electronics
CO2	Demonstrate various applications of Power electronic devices
CO3	Develop the basic concept of Control system
CO4	Develop the concept of Time and frequency domain



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End Semester Exam:

<b>End Semester Exam Scheme (Weightage 60 %, FM – 60):</b>								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	<b>Objective Type:</b> MCQ/ Fill-in-the blanks	A	All	25	20	1 x 20	20	
B	<b>Short Answer Type:</b>	B	All	12	10	1 x 10	10	
C	<b>Subjective Type:</b>	C-I	1	3	Any <b>Five</b> taking at least <b>One</b> from each group	6 x 5	30	
		C-II	2, 3	3				
		C-III	4, 5	3				
<b>Total (A+B+C) :</b>							<b>60</b>	

Reference Book:

Sr No	Book	Author	Publisher
1	Power Electronics	MD Singh, KB Khanchandi	TMG
2	Modern Power Electronics	P.C Sen	S. Chand & Company
3	Power Electronics	B.R Gupta	S.K Kataria & Sons
4	Automatic Control System	Kuo	PHI
5	Control System Engineering	Nagrath & Gopal	New Age
6	Control Systems	A.K Jairath	CBS Publications

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**Syllabus of Micro Electro Mechanical System**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Micro Electro Mechanical System	Course Code:	MLT PE 642
Course Category:	Theory; Program Elective-II	Full Marks & Duration:	100; (15+2) Weeks
Credit:	3	Contact Hr./Week	L-3: T-0

Course Objective:

Sr. No	Course Objective
1	Introduce to Micro-electro mechanical system (MEMS) and its applications.
2	To acquire the basic concept of MEMS Fabrication methods.
3	To be familiar with cell handling & characterization.
4	To be familiar with micro-sensors.



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Course Details:

Unit	Topic	Hrs.
1	<b>Micro-electromechanical Systems (MEMS):</b> Introduction, what is MEMS? Classification, Transducer, sensor, actuator, Applications.	5
2	<b>MEMS Fabrication Methods:</b> Photolithography, Materials for Micromachining: <i>Substrates, Additive Films and Materials</i> , Bulk Micromachining: <i>Wet Etching, Dry Etching</i> , Surface Micromachining: <i>Fusion Bonding</i> , High-Aspect-Ratio Micromachining (HARM): <i>LIGA</i> , Assembly and System Integration, Packaging	10
3	<b>MEMS AND Microfluidic System:</b> Biomaterials and Biocompatibility Issues: Microfluidics, Micro total analysis system ( $\mu$ TAS): Fluid control components, $\mu$ -TAS: Sample handling, $\mu$ -TAS: Separation components, $\mu$ -TAS: Detection.	12
4	<b>Cell Handling and Characterization:</b> Systems for PCR, Polynucleotide arrays and genetic screening.	8
5	<b>MEMS Transducers:</b> MEMS transducer, Micro-sensors and Micro-actuators: Miniature Biosensors, Biosensors arrays and implantable devices, Neural interfaces, microsurgical tools, Micro needles, and drug delivery, and Microsystems for tissue engineering, Tissue scaffolds, Optical biosensors.	10
Total Teaching Hrs. : (3 hrs. x 15 Weeks)		45
Assessment : (3 hrs. x 2 Weeks)		06
<b>Total:</b> (3 hrs. x 17 Weeks)		<b>51</b>

Course Outcomes (COs):

COs	<i>At end of the course, students would be able to</i>
CO1	State the MEMS and its applications.
CO2	Demonstrate the principle of MEMS Fabrication methods.
CO3	Explain microfluidic system, cell handling & characterization.
CO4	State working of MEMS transducer, micro-sensor.

End Semester Exam:

End Semester Exam Scheme (Weightage 60 %, FM – 60):								
Sr No	Question Type	Group	Unit	No of question to be Set	No of question to be Answered	Allotted Marks	Total Marks	Time (Hrs.)
A	<b>Objective Type:</b> MCQ/ Fill-in-the blanks	A	All	25	20	1 x 20	20	
B	<b>Short Answer Type:</b>	B	All	12	10	1 x 10	10	
C	<b>Subjective Type:</b>	C-I	1, 2	3	Any <b>Five</b> taking at least <b>One</b> from each group	6 x 5	30	
		C-II	3, 4	3				
		C-III	5	3				
<b>Total (A+B+C) :</b>							<b>60</b>	





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Reference Book:

Sr No	Book	Author	Publisher
1	Microsystem Technology in Chemistry and Life Sciences	Manz and H. Becker, Eds	Springer-Verlag
2	Fundamental of Bio-MEMS and Medical Microdevice	Steven S. Saliterman	springer
3	Bio-MEMS and Biomedical Nanotechnology	A. P. Lee, Abraham P. Ed Lee	
4	Biomedical Transducers and Instruments	T. Togawa, T. Tamura and P. Ake Oberg	
5	Biomedical Engineering and Design Hand book,	J. M. Pallis	
6	Handbook of Biomedical Engineering.	Kline Jacob	Academic press (N.Y)
7	Introduction to Bio-Medical Engineering	John D. Enderle, Susan M. Blanchard	Elsevier, Academic Press

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**Open Elective-I**

*(Any one course to be selected form the common list of Open Elective)*

Sl	Course Code (OE 61#)	Open Elective-I :	Credit	Semester	Full Marks
1			2	6 <sup>th</sup>	100
2			2	6 <sup>th</sup>	100

**# Please find the course content form the common list of Open Elective-I**

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**Open Elective-II**

*(Any one course to be selected form the common list of Open Elective)*

Sl	Course Code (OE 62#)	Open Elective-II:	Credit	Semester	Full Marks
1			2	6 th	100
2			2	6 th	100
3			2	6 th	100
4			2	6 th	100

**# Please find the course content form the common list of Open Elective-II**

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**Syllabus of Entrepreneurship and Start-ups**

# Please find the course content form the common list.

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**Syllabus of Major Project**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Major Project	Course Code:	* PR 603
Course Category:	Sessional; Project Work	Full Marks & Duration:	100; (15+2) Weeks
Credit:	4	Contact Hr./Week	L-0; T-0; P-6

Course Objective:

Sr. No	Course Objective
1	To build up the creativity & innovation.
2	To enhance the decision making capability
3	To face the problems and solution
4	To allow to do a job as their choice/interest
5	Project report preparation

Course Details:

Unit	Topic	Hrs.
1.	A project work (relevant Entitle) should be completed and submitted with Project Report.	
	Total Teaching Hrs. : (6 hrs. x 15 Weeks)	90
	Assessment : (6 hrs. x 2 Weeks)	12
	<b>Total:</b> (6 hrs. x 17 Weeks)	<b>102</b>

Course Outcomes (Cos):

Cos	<i>At end of the course, students would be able to</i>
CO1	Explain the working principle of the project and requirement for the project.
CO2	Identify the components, tools, problems & solution etc.
CO3	Design the project
CO4	Demonstrate the application, advantage, limitation of the project.
CO5	Develop the project report.

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**Syllabus of Seminar**

Course Introduction:

Program:	Medical Laboratory Technology	Semester:	6 <sup>th</sup>
Course Title:	Seminar	Course Code:	* SE 601
Course Category:	Sessional; Seminar	Full Marks & Duration:	100; (15+2) Weeks
Credit:	1	Contact Hr./Week	L-0; T-0; P-2

Course Objective:

Sr. No	Course Objective
1	To build up the creativity & innovation.
2	To develop the soft skill ability.
3	To develop the skill of presentation.
4	To allow to make a ppt on their choice/interest/ project work
5	Seminar report preparation

Course Details:

Unit	Topic	Hrs.
1.	A seminar topic presentation to be prepared and to be presented & submitted.	
Total Teaching Hrs. : (4 hrs. x 15 Weeks)		60
Assessment : (4 hrs. x 2 Weeks)		8
<b>Total:</b> (4 hrs. x 17 Weeks)		<b>68</b>

Course Outcomes (Cos):

Cos	<i>At end of the course, students would be able to</i>
CO1	Demonstrate the seminar topic.
CO2	Develop the skill of PPT presentation.
CO3	Develop communication skill
CO4	Develop the seminar report



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**Evaluation Scheme of Theory Courses:**

Examination Scheme					
Course	Internal Assessment (40 Marks)			External Assessment (60 Marks)	Full Marks
	Mid Sem. Test	Quiz / Assignment	Attendance	End Semester Exam (Council)	
Theory	20	10	10	60	100
<b>Pass Marks:</b> Students have to obtain at least 40% marks (pass marks) in both Internal assessment and External separately.					

**Evaluation Scheme of Sessional Courses:**

Examination Scheme								
Course	Continuous Internal Assessment (60)					External Assessment (40)		Full Marks (100)
	Performance (30)			Viva-Voce (20)	Attendance (10)	Assignment (On day of External sessional)	Viva-Voce (Before Board of Examiners with Lab Report)	
	Job/Expt.	Assignment	Lab report	VV	ATT			
Sessional	20	5	5	20	10	20	20	100
<b>Pass Criterion:</b> Students have to obtain at least 40% marks (pass marks) in both continuous assessment and end semester Assessment separately.								

**Note:** Course Outcomes may be fixed as per subject teacher of the Institute.