

**Program Name : Diploma in Medical Laboratory Technology**

**Program Code : ML**

**Semester : Second**

**Course Title : Medical Lab Instruments**

**Course Code : 24222**

### 1. RATIONALE

Medical Laboratory instruments plays diagnostic role in modern pathology laboratory. This subject will provide basic and advanced instrumentation part including components, principle of working and procedure of routine analytical work by various instruments.

### 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Use of modern Equipment techniques in Medical Laboratory.

### 3. COURSE OUTCOMES (COs)

The theory, practical experiences, and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry/medical laboratory oriented COs associated with the above-mentioned competency:

- Understand lab safety and maintain quality control.
- Operate basic laboratory instruments.
- Analyze samples using colorimeter & spectrophotometer.
- Work in Hi-tech laboratories with full automation.
- Estimate protein and DNA from different specimens.

### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	--	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

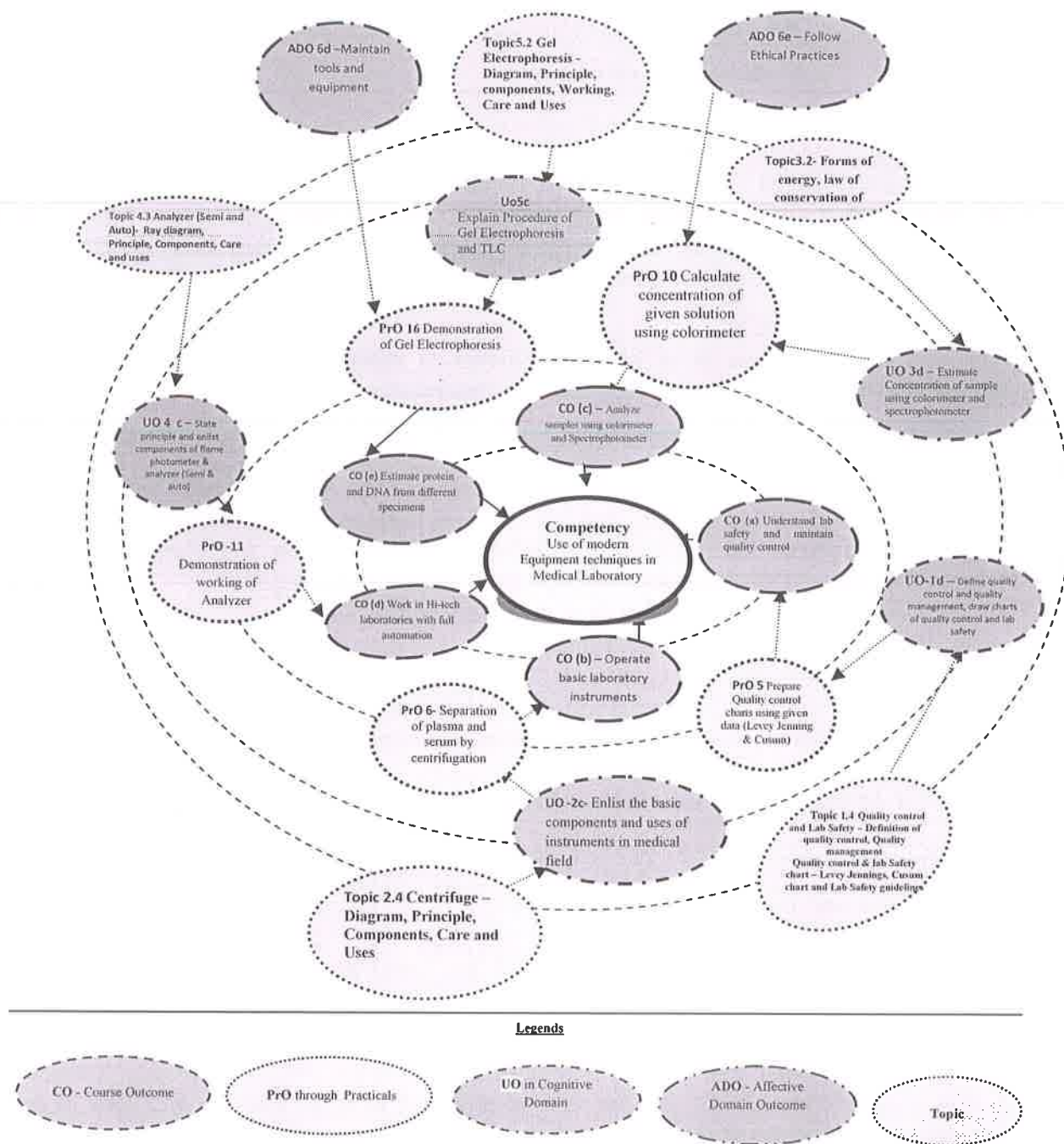
(\*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

### 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map





**Figure 1 - Course Map**

**6. SUGGESTED PRACTICALS / EXERCISES**

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Prepare chart of different containers	I	02*
2	Collection of blood by vein puncture and Capillary puncture		02*



S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
3	Transportation of Specimen- Blood and Urine	I	02*
4	Dispose infectious specimen by various physical and chemical method	I	02*
5	Prepare Quality control charts using given data (Levey Jenning and Cusum)	I	02*
6	Separation of plasma and serum by centrifugation	II	02*
7	Check the pH of urine sample	II	02*
8	Sterilize Petri dish, test tube using autoclave	II	02*
9	Estimate blood sugar by glucometer	II	02*
10	Calculate concentration of given solution using colorimeter	III	02*
11	Demonstration of working of analyzer	IV	02*
12	Separation of Urine components by TLC	V	02*
13	Perform sterilization using Hot air oven	II	02
14	Standardize colorimeter	III	02
15	Demonstration of working of flame photometer	IV	02
16	Demonstration of Gel electrophoresis	V	02
	<b>Total</b>		<b>32</b>

**Note**

i. A suggestive list of **PrOs** is given in the above table. More such **PrOs** can be added to attain the **COs** and competency. A judicious mix of minimum 12 or more practical **LOs**/tutorials need to be performed, out of which, the practicals marked as '\*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.

ii. Hence, the 'Process' and 'Product' related skills associated with each **PrO** of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	20
e.	Answer to sample questions	15
f.	Submission of report in time	15
	<b>Total</b>	<b>100</b>

The above **PrOs** also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safety practices.
- b. Practice good housekeeping.
- c. Demonstrate working as a leader/a team member.
- d. Maintain tools and equipment.
- e. Follow ethical Practices.



The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year
- 'Organizing Level' in 2<sup>nd</sup> year
- 'Characterizing Level' in 3<sup>rd</sup> year

## 6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. S. No.
1	Containers for Blood, Urine, Sputum and Stool	1,2,3,4,6,7
2	Digital pH meter	7
3	Hot Air Oven	4,13
4	Autoclave	4,8
5	Colorimeter	10,14
6	Glucometer	9
7	Chromatography Apparatus	12
8	Centrifuge	6

## 8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit – I</b> <b>Basic</b> <b>Laboratory</b> <b>Techniques</b>	1a.Name and identify various types of containers 1b.Write Collection procedure for various specimen 1c.Explain transportation and disposal of specimen 1d.Define quality control and quality management, Draw charts of quality control & lab safety	1.1 Diagram and Types of containers for collection of Blood, Sputum, Urine and Stool 1.2 Collection technique of - Blood, Sputum, Urine, Stool 1.3 Transportation & Disposal of - Blood, Sputum, Urine, Stool 1.4 Quality control and Lab Safety: a.Definition of quality control, quality management b.Quality control and lab safety chart Levey Jennings, Cusum chart and lab safety guidelines
<b>Unit – II</b> <b>Basic</b> <b>Laboratory</b>	2a. Draw diagrams of instruments in Medical field 2b.State principles of various instruments	2.1 Digital pH meter , Glucometer - Diagram, Principle, component, care and uses 2.2 Autoclave , Hot air oven - Diagram,



<b>Instruments</b>	2c. Enlist the basic components and uses of instruments in medical field 2d. Explain care and maintenance of instruments in medical field	Principle, component, care and uses 2.3 Incubator - Diagram, Principle, component, care and uses 2.4 Centrifuge - Diagram, Principle, component, care and uses
<b>Unit– III Colorimeter &amp; Spectrophotometer</b>	3a. Define Spectroscopy. 3b. Write statement of Beer and Lamberts Law 3c. Estimate concentration of samples using Colorimeter & Spectrophotometer 3d. Write care and maintenance of Colorimeter and Spectrophotometer	3.1 Definition of spectroscopy 3.2 UV and visible range (wave length) 3.3 Beer's and Lamberts Law (only statement) 3.4 Colorimeter, Spectrophotometer - Principle, Components, Working, care and uses
<b>Unit– IV Flame Photometer &amp; Analyzer</b>	4a. Define Photometer 4b. Draw ray diagram of working 4c. State principle and Enlist Components of flame photometer & Analyzer (Semi & auto) 4d. Write Care and Uses of flame photometer & analyzer (Semi & Auto)	4.1 Definition of Photometer 4.2 Flame Photometer - Ray diagram, Principle, Components, Care and uses 4.3 Analyzer (Semi and Auto)- Ray diagram, Principle, Components, Care and uses
<b>Unit – V Electrophoresis &amp; Chromatography</b>	5a. Define Electrophoresis, Chromatography 5b. State principle of electrophoresis & Chromatography 5c. Explain procedure of Gel Electrophoresis & TLC 5d. Enlist applications of electrophoresis & Chromatography	5.1 Definition of Electrophoresis, Chromatography. 5.2 Gel Electrophoresis - Diagram, Principle, components, Working, Care and Uses 5.3 Thin Layer Chromatography - Diagram, Principle, components, Working, Care and Uses

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

### 9.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basic Laboratory Technique	08	2	8	-	10
II	Basic Laboratory Instruments	12	2	4	12	18
III	Colorimeter and Spectrophotometer	08	2	8	-	10
IV	Flame Photometer and analyzer	10	2	8	6	16
V	Electrophoresis and Chromatography	10	2	8	6	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>Total</b>		<b>48</b>	<b>10</b>	<b>36</b>	<b>24</b>	<b>70</b>

**Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)

**Note:** This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 2-3 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Arrange exhibition of lab instruments.
- b. Demonstrate working of instruments by charts.
- c. Visit pathology laboratory to identify principles & tech. used.
- d. Search software/freeware for the course content and write the report stating their applications.

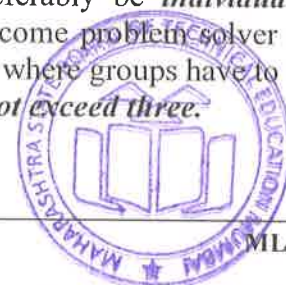
## 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. '*L*' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- e. Guide student(s) in undertaking micro-projects.
- f. Procure various materials required for practical exercises.
- g. Use video/animation films to explain various processes like Manufacturing of construction materials, concrete mixing, and base preparation for painting, mortar laying, carpentry work, false ceiling.
- h. Use different instructional strategies in classroom teaching.

## 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three*.



The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- a. Preparation of chart for different specimen containers.
- b. Preparation of Levey Jenning and Cusum chart.
- c. Survey of random blood sugar in your college.
- d. Survey of urine pH among different age groups.
- e. Quality check of different instruments.
- f. Collection & submission of different video on instruments.
- g. Visit to a clinical laboratory and prepare report.
- h. Participate in blood donation camp and prepare report.
- i. Arrange blood group detection camp.
- j. Preparation of containers for museum specimens.

### 13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Text Book of Medical Laboratory Technology	Praful B Godkar Darshan P Godkar	Bhalani Publication House Third Edition Vol. I and II, 2018 ISBN : 978818557853
2.	Instrumentation methods of Chemical Analysis	Gurdeep R Chatwal Sham K Anand	Himalaya Publication, 5 <sup>th</sup> Edition, 2018, ISBN-9789351420880
3.	The short Text Book of Medical Laboratory for Technician	Satish Gupte	JYPEE Publication, Second Edition, ISBN;9789350908518
4.	Medical Laboratory Science Theory and practice	J.Ochei A. Kolhatkar	Mc Graw Hill Education, ISBN; 978-0074632239
5.	Medical Laboratory Methods & Interpretation Vol 1 & Vol 2	Ramnik Sood	JPB, Sixth Edition ISBN-978-8184484496-Vol-2
6.	Medical Laboratory Technology, Procedure Manual for Routine Diagnostic Tests Vol 1, 2,3	Kanai L. Mukharjee Anuradha Chakravarthy	Mc Graw Hill Education: Third Edition ISBN-9789352606801- Vol-I 9789352606818- Vol-II 9789352606815- Vol-III
7.	Textbook of Microbiology for MLT	C.P.Baveja V. Baveja	Arya Publication, 2 <sup>nd</sup> Edition (2019), ISBN- 978-8178556987
8.	Practical Clinical Biochemistry Methods and Interpretations	Ranjana Chawla	Jaypee Brothers Medical Publishers, fourth Edition ISBN- 978-9350909423
9.	District Laboratory Practices in Tropical	Monica Cheesbrough	Cambridge University Press, 2 <sup>nd</sup> Edition, ISBN- 9780521135177-



S. No.	Title of Book	Author	Publication
	Countries- Part-I		Part- I.9780521135146- Part-II
10.	Clinical Biochemistry	Maheshwari Nanda	Jaypee Brothers Medical Publisher, Second Edition (2017) ISBN- 978-9386150196
11.	Biophysical Chemistry- Principal and technique	Dr. Avinash Upadhyay Dr. Kakoli Upadhyay Dr. Nirmalendu Nath	Himalaya Publ. House Pvt. Ltd. Fourth Edition ISBN-978-9951422273

#### 14. SUGGESTED SOFTWARE/LEARNING WEBSITES

- [www.ehow.com/...895\\_basic laboratory instruments.html](http://www.ehow.com/...895_basic_laboratory_instruments.html)
- <http://www.dhhs.saccountly.net/-atory\Document\specimen>
- [www.weberawier.com\](http://www.weberawier.com/)
- [www.inorganicventures.com](http://www.inorganicventures.com)
- [www.ika.in/overhead\\_stirrers](http://www.ika.in/overhead_stirrers)
- [www.skylabinstruments.com](http://www.skylabinstruments.com)
- [www.shriagencies.co.in/lab\\_instruments](http://www.shriagencies.co.in/lab_instruments)
- [www.britannica.com/...eched/topic558901/spectroscopy](http://www.britannica.com/...eched/topic558901/spectroscopy)
- [www.ehow.com/...6676686med lab instruments.html](http://www.ehow.com/...6676686med_lab_instruments.html)

