

AC 27-2-13  
Item no. 4.13

# **UNIVERSITY OF MUMBAI**



**Syllabus for Sem. V & VI**  
**Program: B.Sc.**

**Course: Medical Laboratory Technology**  
**(USACMT)**  
**APPLIED COMPONENT**

(Credit Based Semester and Grading System with  
effect from the academic year 2013–2014)

**Programme: B.Sc**  
**Course :Applied Component(USAC)**  
**(Semester –V & VI)**  
**PREAMBLE**

Applied Component was introduced for T.Y.B.Sc. class in the academic year 1979-80 with a view to enhance essence for employability. There are several combinations of Applied component courses with Microbiology as a Major Course. The three applied component courses under the umbrella of BOS in Microbiology are-

- i. Biotechnology (USACBT)**
- ii. Food Production and Processing (USACFP)**
- iii. Medical Laboratory Technology (USACMT)**

In the syllabi of these applied components, applied topics having commercial propositions have been incorporated that further adds to the enhancement of entrepreneurial potential and skills amongst the learners.

From the academic year 2011-12, the University has introduced Credit Based Semester and Grading System (CBSGS) with continuous evaluation involving Internal Assessment and External Assessment. Accordingly the existing syllabi of these applied components have been restructured to fit into the CBSGS pattern. Sub-committees were formed with Dr. D.B.Thakare as the convener, BOS members as co-conveners and Head/ Senior teachers from affiliated colleges as members of these sub-committees.

As mentioned in the outline of the syllabus, each semester (Semester –V & VI) consists of one theory and one practical course of 100 marks each.

**T.Y.B.Sc.**  
**Medical laboratory technology (Applied component)**

**Course code - USACMT**

**SEMESTER V**

Course Code	Unit	Topics	Credits	Lec / Week
<b>USACM T501</b>		<b>Techniques and Automation In MLT</b>	<b>2</b>	
	I	Introduction to diagnostic microbiology		1
	II	Automation and newer approaches in MLT		1
	III	Haematology		1
	IV	Clinical Biochemistry		1
<b>USAC MT5P1</b>		<b>Practicals based on above course in theory</b>	<b>2</b>	<b>4</b>

**SEMESTER VI**

Course Code	Unit	Topics	Credits	Lec / Week
<b>USACM T601</b>		<b>Microbiology ,Clinical Pathology and Histopathology</b>	<b>2</b>	
	I	Bacteriology		1
	II	Mycology, Parasitology, and Virology		1
	III	Organ Function Tests		1
	IV	Clinical Pathology and Histopathology		1
<b>USAC MT6P1</b>		<b>Practicals based on above course in theory</b>	<b>2</b>	<b>4</b>

**T.Y.B.Sc.**

**Medical laboratory technology (Applied component) syllabus  
Restructured for Credit Based and Grading System  
To be implemented from the academic year 2013-2014.**

**SEMESTER V**

Course Code	Unit	Topics	Credits	Lec/Sem
<b>USACMT 501</b>		<b>Techniques and Automation In MLT</b>	<b>2</b>	<b>60 Lec.</b>
	<b>I</b>	<p><b>Introduction to diagnostic microbiology</b></p> <p><b>1.1</b> Safety and special precautions in clinical microbiology lab, Legislative and regulatory control, Infectious waste management, Methods of sterilization, Classification of biohazardous agents. <b>(05L)</b></p> <p><b>1.2</b> Antimicrobial susceptibility testing: Selection of antimicrobial agents, Disc diffusion test, Dilution antimicrobial susceptibility test, E test, commercial systems. <b>(04L)</b></p> <p><b>1.3</b> Serodiagnostic tests: <b>(06L)</b></p> <p>a) Types of antigen antibody reactions used in diagnostic serology – precipitin reactions, CFT, Haemagglutination inhibition, agglutination reactions, flocculation.</p> <p>b) Solid phase immunoassay methods – Enzyme immunoassay for antibody and antigen detection.</p> <p>c) Immunofluorescent techniques for antibody and antigen detection.</p>		<b>15L</b>
	<b>II</b>	<p><b>Automation and newer approaches in MLT</b></p> <p><b>2.1</b> Automation: Semiautomated and automated identification systems for Enterobacteriaceae, Non fermentors, Mycobacteria, Staphylococci, Anaerobes <b>(07L)</b></p>		<b>15L</b>

		<p><b>2.2</b> Newer approaches: use of molecular techniques in diagnosis <b>(08L)</b></p> <p>a) Signal amplification methods – Nucleic acid probes, in situ hybridization</p> <p>b) PCR and modifications of PCR</p> <p>c) Post amplification analysis – DNA sequencing, microarray analysis</p> <p>d) Strain typing – Pulse field gel electrophoresis, PCR-RFLP</p>		
	<b>III</b>	<p><b>Hematology</b></p> <p><b>3.1</b> Introduction to hematology – composition of blood, serum and plasma, structure, function and life span of blood cells, Hematopoiesis and factors required for the same, hemoglobin: structure, types-normal &amp; abnormal, glycosylated Hb, HbCo, Hi, SHb, Hbs, HbC, HbD, IIBe, HbH. <b>(04L)</b></p> <p><b>3.2</b> Collection of blood- Capillary blood by skin puncture, Venous blood by venipuncture <b>(01L)</b></p> <p><b>3.3</b> Anticoagulants: types and mechanism of action. <b>(01L)</b></p> <p><b>3.4</b> Anemia: Types – Sickle cell anemia, thalassemia, iron deficiency, aplastic, hemolytic, megaloblastic (only a brief outline). <b>(01L)</b></p> <p><b>3.5</b> Abnormal forms of RBC: microcytes, macrocytes – hypochromic, spherocytes, target cell, stomatocytes, anisocytes, poikilocytes, sickle cells. Abnormalities of WBC's: toxic granulation, vacuoles, hypersegmentation, hypo segmentation. <b>(01L)</b></p> <p><b>3.6</b> Haemostasis &amp; coagulation: vascular response, platelet plug formation, coagulation. <b>(02L)</b></p>		<b>15L</b>

		<p><b>3.7</b> Automation in hematology: Introduction- the automated full blood count impedance cell counters, optical cell counters, automated blood cell morphology. <b>(01L)</b></p> <p><b>3.8</b> Blood bank: blood ABO (H), Rh, secretor and Lewis systems, Isoagglutinins &amp; their titre, concept of universal donor &amp; universal recipient blood transfusion: cross matching, transfusion reactions blood collection: screening of donor criteria for rejecting donor, registration of donor, blood collection procedure, transportation of blood, storage of blood. Preparation &amp; use of blood components: whole blood, packed red cells, FFP, platelet concentrate. <b>(04L)</b></p>		
	<b>IV</b>	<p><b>CLINICAL BIOCHEMISTRY</b></p> <p><b>4.1</b> Blood sugar level - Glucose tolerance curve and its interpretation. Evaluation methods of blood glucose - o-toluidine, Glucose oxidase - peroxidase. Diabetes and its types. <b>(04L)</b></p> <p><b>4.2</b> Enzymes in diagnostics – determination of enzymes, AST, ALT, ALP, ACP, LDH, GGT, serum lipase. <b>(03L)</b></p> <p><b>4.3</b> Thyroid tests – Introduction – function of thyroid hormones, determination of T-3, T-4, TSH <b>(01L)</b></p> <p><b>4.4</b> Automation in clinical biochemistry - Introduction, classification of automated systems, steps of automation in biochemical analysis, computers in clinical lab with its drawbacks. Commonly used automated analyzers of biochemical laboratories – autoanalysers, clinicon, R X L system. <b>(04L)</b></p>		<b>15L</b>

		<p><b>4.5</b> Cancer marker - Introduction, clinical application, enzymes as tumor markers ALP, CK, LDH, PAP, prostate specific antigens, hormones, oncofetal antigens, carbohydrates, bladder specific, breast tumor markers. <b>(02L)</b></p> <p><b>4.6</b> Pregnancy test – Role of hCG and testing. <b>(01L)</b></p>		
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<b>USACMT5 P1</b>		<p><b>Practicals based on above course in theory</b></p> <ol style="list-style-type: none"> <li>1. Parts and functions of microscope</li> <li>2. Study of hot air oven</li> <li>3. Study of autoclave</li> <li>4. Study of incubator</li> <li>5. Widal test</li> <li>6. VDRL test</li> <li>7. ASO test</li> <li>8. Disc diffusion method</li> <li>9. Blood collection :capillary &amp; venous</li> <li>10. Hemoglobin estimation: acid hematin and drabkin's method</li> <li>11. Total RBC &amp;WBC count, Differential WBC count</li> <li>12. ESR</li> <li>13. PCV</li> <li>14. Red cell indices</li> <li>15. Bleeding time &amp; clotting time</li> <li>16. Blood grouping ABO and Rh typing</li> <li>17. Cross matching</li> <li>18. Estimation of blood glucose</li> </ol>	<b>2</b>	<b>60 Lecs.</b>
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**SEMESTER VI**

Course Code	Unit	Topics	Credits	Lec / Sem
<b>USACMT 601</b>		<b>Microbiology ,Clinical Pathology and Histopathology</b>	<b>2</b>	<b>60L</b>
	<b>I</b>	<p><b>Bacteriology</b></p> <p>Guidelines for collection, transport, processing, analysis and reporting of cultures from specific specimen sources for the following infections-</p> <p>    <b>1.1</b> Infections of the respiratory tract.                   <b>(02L)</b>            <b>1.2</b> Infections of the gastrointestinal tract.           <b>(02L)</b>            <b>1.3</b> Urinary tract infections.                               <b>(02L)</b>            <b>1.4</b> Infections of the genital tract.                       <b>(01L)</b>            <b>1.5</b> Infections of the bones and joints.                   <b>(01L)</b>            <b>1.6</b> Infections of the CNS.                                   <b>(01L)</b>            <b>1.7</b> Wounds, abscesses and cellulites.                   <b>(02L)</b>            <b>1.8</b> Eye infections.   <b>(01L)</b>            <b>1.9</b> Infections of the blood.                                   <b>(03L)</b></p>		<b>15L</b>
	<b>II</b>	<p><b>Mycology, Parasitology, and Virology</b></p> <p><b>2.1</b> Mycology:   <b>(05L)</b>  a) Laboratory approach for diagnosis of fungal infections- Specimen collection and transport, processing, direct examination, preparation of mounts for study, selection and inoculation of culture media, incubation of fungal cultures.  b) Identification of dermatophytes and Candida.</p> <p><b>2.2</b> Parasitology: Collection, transport and processing of specimens  a) Fecal specimens- Preservation of clinical specimens, visual examination, processing fresh stool specimens for ova and parasitic examination.  b) Examination of intestinal specimens other than stool.  c) Examination of extra intestinal specimens- sputum, blood  d) Overview of life cycles of parasites of human</p>		<b>15L</b>



		importance. <b>(05L)</b>		
		<p><b>2.3 Virology:</b> a) Collection of specimens for diagnosis, b) Transportation and storage of specimens, c) Methods for diagnosis of viral infections (Tabulation), d) Detection of HIV, Hepatitis B viral infections in clinical specimens. <b>(05L)</b></p>		
	<b>III</b>	<p><b>Organ Function Tests</b></p> <p><b>3.1 Cardiac Profile Test</b> – Introduction, Functions of heart, Ischemic heart diseases and their manifestation; Groups in CPT, Lipid profile tests – total lipids, serum cholesterol, triglycerides, phospholipids, lipoproteins. <b>(04L)</b></p> <p><b>3.2 Gastric function Tests</b> – Introduction, gastric analysis, tests involved and gastrointestinal hormones. <b>(02L)</b></p> <p><b>3.3 Liver function tests</b> – Introduction to liver function, types of jaundice; abnormalities of bile pigment and bile acid, change in enzyme and plasma proteins and their determination <b>(04L)</b></p> <p><b>3.4 Kidney function test</b> – Introduction- kidney function; groups in KFT; test to determine renal blood flow; creatinine clearance; urea clearance; diseases of kidney – acute and chronic glomerulonephritis; acute and chronic pyelonephritis, acute renal failure <b>(05L)</b></p>		<b>15L</b>
	<b>IV</b>	<p><b>Clinical Pathology and Histopathology</b></p> <p><b>4.1 Routine urine analysis</b> – Physiology of urine formation, composition of normal urine, collection of urine specimens, routine examination of urine – physical, chemical &amp; microscopic <b>(02L)</b></p> <p><b>4.2 Routine stool analysis</b> – Importance of stool examination, collection of fecal specimen physical examination – color &amp; consistency, odor, presence of blood mucus &amp; pus. Study of some common ova found in stool – Hookworm, <i>Ascaris</i>, <i>Trichuris</i>, <i>Taenia</i>, <i>Schistosoma mansoni</i>, <i>Enterobius</i>, <i>Strongyloides</i>. Study of some protozoa found in stool – <i>E. histolytica</i>, <i>E.coli</i>, <i>Giardia lamblia</i>, <i>Trichomonas hominis</i>. Other findings in stool microscopic examinations – fecal fat, blood cells, Crystals, occult blood test, measuring the pH &amp;</p>		<b>15L</b>

	<p>testing for Lactose <b>(02L)</b></p> <p><b>4.3</b> Examination of C.S.F. – Formation of C.S.F., collection – lumbar puncture (in brief), C.S.F. analysis : color, cells, Pandy’s test, stained films, C.S.F. proteins, C.S.F. sugar, Trypanosomes., abnormalities of the C.S.F. suppurative, viral, Tuberculous meningitis.<b>(02L)</b></p> <p><b>4.4</b> Semen analysis, clinical significance, specimen collection, laboratory investigations: physical examination, microscopic examination, sperm morphology – normal &amp; abnormal, chemical examination <b>(01L)</b></p> <p><b>4.5</b> Laboratory examination of miscellaneous body fluids – A brief account of the following body fluids w.r.t. clinical significance, specimen collection. Lab Investigations – Physical, chemical, microscopic examination, serous, synovial, ascitic fluids, &amp; gastric juice <b>(04L)</b></p> <p><b>4.6</b> Lab examination of sputum – Collection, examination: quantity, consistency, Colour, odor, examination of stained/unstained sputum, chemical examination, parasites <b>(01L)</b></p> <p><b>4.7</b> Basic histopathology techniques – Basic steps for tissue processing: fixing, embedding, microtomy , staining, mounting (to be covered in brief), cytological techniques (brief idea) <b>(03L)</b></p>		
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<b>USACMT 6P1</b>	<p><b>Practicals based on above course in theory</b></p> <ol style="list-style-type: none"> <li>1. Gram’s staining.</li> <li>2. Albert’s staining.</li> <li>3. Acid fast staining.</li> <li>4. Identification of Dermatophytes (Demonstration of permanent slides).</li> </ol>	<b>2</b>	<b>60 Lecs</b>
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	<p>5. Identification of <i>Candida albicans</i>.</p> <p>6. Identification of Malarial parasitic forms in blood smears.</p> <p>7. Study of Nutrient agar, SIBA, MacConkey's agar, XLD, CLED, Salt Mannitol, Tinsdale agar, Cefrimide agar</p> <p>8. Study of transport media.</p> <p>9. Isolation and characterization of bacterial pathogens-</p> <ul style="list-style-type: none"> <li>- <i>S. aureus</i></li> <li>- <i>S. pyogenes</i></li> <li>- <i>E. coli</i></li> <li>- <i>K. pneumoniae</i></li> <li>- <i>Salmonella spp</i></li> <li>- <i>Proteus spp</i></li> <li>- <i>Pseudomonas spp</i></li> </ul> <p>10. Physical, Chemical, Microscopic examination of</p> <ul style="list-style-type: none"> <li>a. Urine</li> <li>b. Sputum</li> </ul> <p>11. Pap's staining for the demo of Barr bodies</p> <p>12. Embedding of tissue in paraffin wax</p> <p>13. Estimation of SGPT/ALT</p> <p>14. Estimation of SGOT/AST</p> <p>15. Estimation of Cholesterol- total, HDL, LDL</p> <p>16. Estimation of total bilirubin</p> <p>17. Estimation of creatinine in serum and urine</p> <p>18. Estimation of blood urea</p> <p>19. Report Writing: For various analyzed pathological samples (CBC, Complete Haemogram, Urine, Stool, C.S.F, Semen and Sputum )</p>		
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## REFERENCES

### Course: USACMT-501 and USACMT- 601 :

1. Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 6<sup>th</sup> edition, Washington Winn, jr and others. Lippincott Williams & Wilkins.
2. Practical Medical Microbiology, Mackie and McCartney.
3. Medical Microbiology, B.S. Nagoba and Asha Pichare.
4. Essentials of Diagnostic Microbiology, 1998. Lisa Anne Shimeld, Anne T. Rodgers. Delmar Publishers.
5. Text book of medical laboratory technology, 2<sup>nd</sup> edition, Balani Publishing House. Authors: Praful Godkar and Darshan Godkar.
6. Introduction to MLT 6th ed F.J.Baker & R.E.Silverton Butterworths.
7. Medical laboratory technology, A procedure manual for routine diagnostic tests, Volume I. Kanai Mukherjee. Tata McGraw Hill
8. Medical laboratory technology, A procedure manual for routine diagnostic tests, Volume II. Kanai Mukherjee. Tata McGraw Hill
9. Medical laboratory technology, A procedure manual for routine diagnostic tests, Volume III. Kanai Mukherjee. Tata McGraw Hill
10. Hand book of MLT -Vellore ed-Dr (Mrs) C. Bharucha, Wesley press, Mysore
11. A medical lab for developing countries- Maurice King-ELBS & Oxford uni press
12. Bailey & Scott's - Diagnostic microbiology, 11<sup>th</sup> ed., Betty Forbes, Daniel, Alice Weissfield. Mosby publisher
13. Atlas of Medical Helminthology and Protozoology, 4<sup>th</sup> ed. P. L. Chiodini, A. H. Moody, D. W. Manser. Churchill Livingstone
14. A hand book of medical laboratory technology, V. H. Talib 2<sup>nd</sup> ed.
15. Fundamentals of Biochemistry. New central book agency. Author: A. C. Deb

## Modality of Assessment :

### Theory Examination Pattern:

A) Internal Assessment - 40%

40 marks.

Theory		40 marks
Sr No	Evaluation type	Marks
1	One Assignment/Case study/Project	10
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

B ) External examination - 60 %

### Semester End Theory Assessment - 60%

60 marks

- i. Duration - These examinations shall be of two hours duration.
- ii. Theory question paper pattern :-
  1. There shall be **five** questions each of **12** marks. On each unit there will be one question & fifth one will be based on all the four units .
  2. All questions shall be compulsory with internal choice within the questions. Each question will be of **24** marks with options.
  3. Questions may be sub divided into sub questions a, b, c & d only, each carrying **six** marks **OR** a, b, c, d,e & f only each carrying **four** marks and the allocation of marks depends on the weightage of the topic.

### Practical Examination Pattern:

(A)Internal Examination:-

There will not be any internal examination/ evaluation for practicals.

(B) External (Semester end practical examination) :-

Sr.No.	Particulars	Marks
1.	Laboratory work	80
2.	Journal	10
3.	Viva	10

Semester end practical examination in applied component shall be conducted by the concerned department of the Institute/ College at the end of each semester and the marks of the candidates are to be sent to the University in the prescribed format.

**Semester V:**

Practical examination will be held at the college / institution at the end of the semester.

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department ; failing which the student will not be allowed to appear for the practical examination.**

**Semester VI**

Practical examination will be held at the college / institution at the end of the semester. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department ; failing which the student will not be allowed to appear for the practical examination.**