Content Outline for Medical Technologist and Medical Laboratory Technician Certification Examinations

GENERAL LABORATORY: (MT=12% / MLT=13%)

A. Laboratory quality

1. Perform quality control necessary in the clinical laboratory and for point-of-care testing, and know related terminology:

linearity	coefficient of variation	
accuracy	skewness	confidence limit
precision	mean value	normal distribution
reliability	standard deviation	standard deviation index (SDI)
delta o.d.	shift, trend	Levey-Jennings charts

2. Perform laboratory and point-of-care proficiency testing
3. Review and evaluate results of proficiency testing with all laboratory personnel and implement appropriate corrective action
4. Understand the differences between accuracy and precision
5. Review all kit/procedure package inserts to assure that accurate and up-to-date testing procedures are being executed
6. Employ quality improvement (TQM, CQI, PIC)

B. Laboratory laws and regulations

1. Observe OSHA regulations
2. Observe CLIA regulations
3. Observe HIPAA regulations

C. Laboratory safety

1. Employ universal (standard) precautions
2. Employ equipment safety to include sharps for needle disposal
3. Employ materials safety (and MSDS sheets)
4. Employ hazardous chemical safety
5. Employ proper infection control through the use of hand washing, gloves, and alcohol gel

D. Laboratory instrumentation, maintenance, and principles of operation

1. Use manual instrumentation
    a. Use glassware and pipettes
    b. Clean and maintain instruments
    c. Calibrate instruments knowing the difference between testing
    d. technologies requiring calibration and those requiring only
    e. quality control checks (non-calibratable, rate reaction tests)
2. Balance centrifuge and know centrifugation durations
3. Assure proper centrifuge setup and operation and RPM/RCF
4. Use automated instrumentation and analyzers

E. Laboratory mathematics

1. Know normal solutions, molar solutions, percentage solutions (w/w, w/v, and v/v), calculate equivalent weight and dilutions used most frequently in the clinical laboratory
2. Know designations and abbreviations used for weights and measures

F. General microscopy

1. Know types of microscopes
2. Know parts of binocular microscope

3. Use binocular microscope
4. Calibrate ocular micrometer
5. Clean microscope

G. Phlebotomy and Specimen Collection
1. Collect and handle blood specimens for analysis
2. Know the differences between serum, plasma, and whole blood
3. Employ safety precautions when collecting blood samples
4. Employ procedures to prevent hemolysis
5. Collect blood in collecting tubes for analysis (clotted blood and anticoagulated blood)
6. Employ proper order of draw when collecting blood in multiple types of vacuum tubes
7. Employ proper anticoagulants for each analysis
8. Know effects of improper anticoagulant use
9. Handle and preserve body fluids for chemical analysis Preserve urine specimens
10. Preserve urine specimens
11. Know procedure for blood culture collection
12. Know the proper labeling of blood tubes including sentinel event with blood bank arm bands
13. Process irretrievable specimens (CSF, tissue, etc.)
14. Perform infant blood collection through heel puncture
15. Perform glucose tolerance test
16. Know length of time for samples to clot

H. Patient Identification
1. Match name, MR, DOB, registration number, and other identifiers with tests and orders to confirm positive patient identification
2. Confirm patient identification through all processes (to include STAT, call reports as inpatient and outpatient)

I. Waived testing
1. Address waived testing in the clinical laboratory

II. CHEMISTRY (MT=20% / MLT=18%)

A. General knowledge
1. Define the following terms and describe how they are used in the clinical chemistry laboratory:

spectrophotometry	densitometry
refractometry	electrophoresis
turbidimetry	nephelometry
osmometry	mass spectrometry
chromatography	enzyme linked immunoassay (ELISA)
chemiluminescence	fluorescence polarization immunoassay (FPIA)

2. Define terms related to *principles of instrumentation* and describe how they are used in the clinical chemistry laboratory:

radiant energy	visual spectrum/wavelength
end point reactions	diffraction grating
kinetic/rate reactions	random access
Beer-Lambert Law	

B. Instrumentation: Parts, principles of operation, and maintenance
1. Perform spectrophotometric procedure
   a. Describe monochromater/diffraction grating
   b. Differentiate between colorimeter/spectrophotometer

c. Describe measurement of wavelengths
d. Calibrate spectrophotometer

2. Demonstrate the ability to operate and describe the principles of operation of the following:
    a. refractometer
    b. osmometer
    c. nephelometer
    d. immunoassay analyzers
    e. random access analyzers
    f. blood gas analyzers
    g. sandwich technique of EIA
    h. discrete analysis
3. Demonstrate an understanding of the use of Beer-Lambert Law
4. Describe chemistry analyzer maintenance

C. Renal Function Tests

1. Perform renal function tests
2. Demonstrate understanding of the following:
    a. anatomy and physiology of kidneys
    b. common tests for renal function (non-protein nitrogens)
    c. clearance tests
    d. reference ranges
    e. estimated glomerular filtration rate

D. Hepatic Function Tests

1. Perform hepatic function tests
2. Demonstrate understanding of the following:
    a. anatomy and physiology of the liver
    b. formation of bilirubin and urobilinogen
    c. types of bilirubin
    d. types of jaundice
    e. common tests for liver function
    f. describe and differentiate tests that are elevated in liver disease, obstructive jaundice, and hemolytic jaundice

E. Carbohydrate Metabolism Tests

1. Define terminology related to carbohydrates and carbohydrate metabolism

carbohydrate	ketones	lipogenesis
monosaccharide	insulin	renal threshold
disaccharide	glycolysis	diabetes mellitus
polysaccharide	glycogenesis	A1C hemoglobin
glycogen	glycogenolysis	

2. Demonstrate understanding of the following:
    a. classification of carbohydrates
    b. digestion of carbohydrates
    c. insulin and carbohydrate metabolism
    d. types of diabetes
    e. tests for glucose in blood, urine, and cerebrospinal fluid
    f. glucose tolerance tests
    g. A1C hemoglobin
3. Perform and interpret tests for glucose analysis
    a. Perform tests for all carbohydrates and reducing substances
    b. Perform testing for glucose on blood, urine, and spinal fluid
4. Perform glucose tolerance test
    a. Perform oral glucose tolerance test

b. Recognize and differentiate normal glucose tolerance, diabetic glucose tolerance, and hypoglycemic (flat) curves

5. Describe the principles of, and perform glycohemoglobin A_1C procedure

F. Protein Analysis

1. Perform protein analysis
2. Demonstrate understanding of the following:
    a. protein classification
    b. synthesis, distribution, catabolism, and excretion of proteins
    c. function of plasma proteins
    d. tests measuring total protein, albumin, globulin, and immunoglobulins
    e. reference limits
    f. principles of protein electrophoresis
    g. normal and disease patterns in protein electrophoresis
    h. interpretation of SPE patterns
    i. clinical correlations with disease

G. Enzymology

1. Demonstrate understanding of the following:
    a. clinically-significant enzymes

CP	ALT	GGT
ALP	AST	LD
amylase	CK	lipase

    b. isoenzymes (CK, ALP, LD)
    c. measurement of enzyme activity
    d. cardiac enzymes and related markers (troponin, myoglobin)
    e. pancreatic enzymes
    f. enzymes associated with the liver
2. Differentiate enzymes of the pancreas and tests used to determine the activity of these enzymes
3. Describe cardiac enzymes and interpret test results (describe order in which cardiac enzymes rise and return to normal)
4. Describe cardiac markers and their uses
5. Describe enzymes elevated and differentiate liver diseases based on the results
6. Demonstrate knowledge of acid phosphatase and alkaline phosphatase and correlate with disease states
7. Perform cardiac marker tests
    a. troponin T and I
    b. cardiac myoglobin
    c. B natriuretic peptide (BNP)
    d. C-reactive protein (CRP)

H. Endocrinology

1. Demonstrate understanding of the following:
    a. endocrine system (glands and hormones)
    b. function of hormones
    c. feedback mechanisms
    d. common tests and reference ranges
    e. conditions resulting from hypo- and hypersecretion of hormones
2. Perform thyroid function testing (TSH, free T_3)
3. Perform 24-hour urine endocrinology tests (T_3, 5HIAA)
4. Perform tests for reproductive hormones (FSH, LH, estriol, estradiol, estrogen, testerosterone, 17-ketosteroids)
5. Perform tests for pregnancy hormones (HPL, HCG, prolactin)

I. Lipids

1. Demonstrate understanding of the following
    a. cholesterol and triglyceride metabolism
    b. lipoproteins
    c. desirable limits (Lipid Research Clinic, etc.)
    d. methodology for measurement of lipids
    e. diseases associated with hyperlipidemia

J. Water and Electrolytes

1. Demonstrate understanding of the following:
    a. characteristics of electrolytes
    b. fluid movements and compartments
    c. electrolytes in body fluids (cations and anions)
    d. electrolyte balance
    e. expressing concentration of electrolytes (meq/L)
    f. reference limits of electrolytes
    g. methodology for measuring electrolytes
    h. electrolyte imbalances

K. Acid-Base Balance

1. Demonstrate understanding of the following:
    a. hydrogen ion concentration (pH)
    b. relationship of pH, bicarbonate, and carbonic acid (Henderson-
    c. Hasslebach equation)
    d. regulation of acid-base balance by kidneys and lungs
    e. acid-base imbalances
    f. tests for acid-base balance

L. Other Chemistry Procedures

1. Demonstrate understanding of the following:
    a. C-reactive protein
    b. BNP
    c. cerebrospinal fluid concentrations
    d. tumor markers
2. Perform electrophoresis
    a. Define the general principles of electrophoresis
    b. Define the principles of protein electrophoresis
    c. Define the principles of immunoelectrophoresis
    d. Define the principles of isoenzyme electrophoresis (LDH,CK,
    e. alkaline phosphatase)
    f. Define the principles of hemoglobin electrophoresis
3. Perform C-reactive protein tests
4. Perform and interpret test for specific disease states such as the presence of gout
    a. Perform test for uric acid
    b. Describe the metabolism of purines in food and the formation of uric acid
5. Demonstrate knowledge of minerals of the body and mineral metabolism
6. Perform therapeutic drug monitoring and define the following terms:

    a. a. peak and trough
    b. b. mechanism of action
    c. c. steady state kinetics
    d. d. pharmacodynamics
    e. e. pharmacokinetics
    f. beta blockers and calcium channel blockers
    g. antiepilectic drugs and metabolites
    h. cardioactive drugs and metabolites
    i. antidepressive drugs
    j. immunosuppressive drugs
    k. antibiotics

7. Perform tests for drugs of abuse

8. Perform toxicological tests and differentiate screening tests from confirmatory tests
9. Perform cerebral spinal fluid analysis
10. Analyze other body fluids for glucose, total protein, and LDH
11. Define the principles of the prostatic specific antigen (PSA) procedure
12. Perform tests for fetal distress
    a. fetal fibronectin
    b. AFP
    c. L/S ratio
    d. 450

M. Specimen Integrity and Handling

III. HEMATOLOGY (MT=13% / MLT=13%)

A. General Knowledge

1. Apply knowledge of terminology related to hematology

leukocytes	RBC indices (MCV, MCH, MCHC)
erythrocytes	red cell distribution width (RDW)
thrombocytes	erythrocyte sedimentation rate(ESR)
reticulocytes	hematopoiesis
nucleated red blood cell (NRBC)	erythropoietin (EPO)
complete blood count (CBC)	anemia
hemoglobin (HGB)	leukemia
hematocrit (HCT)	sodium citrate
red blood cell (RBC)	serum
white blood cell (WBC)	plasma
platelet (PLT)	buffy coat
differential (DIFF)	RBC, WBC inclusions
RBC, WBC, PLT morphology	
ethylenediaminetetraacetic acid (EDTA)	

2. RBC, WBC, PLT cell structure and function
3. Erythrocyte production and destruction
4. Manual cell counts
5. Peripheral blood smear preparation and staining
6. Examination of the peripheral blood smear and correlation with the CBC
7. Bone marrow aspiration procedure
8. Touch preps from bone biopsies and bone marrow aspirate

B. Erythrocyte Procedures

1. Red blood cell (RBC) count
2. Hemoglobin
3. Microhematocrit (spun hematocrit)
4. Reticulocyte count & calculations (relative count, ARC, CRC RPI)
5. Red blood cell indices:
    a. Mean cell volume (MCV)
    b. Mean cell hemoglobin (MCH)
    c. Mean cell hemoglobin concentration (MCHC)
6. Erythrocyte sedimentation rate (ESR); Westergren method
7. Malaria slide preparation and evaluation

C. Leukocyte Procedures

1. Maturation series of the granulocytes (neutrophils, eosinophils, and basophils) and nongranulocytes (lymphocytes, monocytes)

2. White blood cell (WBC) count
3. WBC differential (peripheral blood and bone marrow)
4. Leukocyte count correction for nucleated red blood cells
5. Leukocyte disorders and correlation with WBC differential
6. Absolute white blood cell counts
7. Cytochemical staining
8. WBC differentials (Wright/Giemsa stain, Romanowsky stain)
9. Cytogenetic abnormalities associated with hematologic neoplasms
10. Molecular diagnostic tests relevant to the diagnosis of hematologic neoplasms

D. Thrombocyte Procedures
1. Maturation series of the thrombocyte (platelet)
2. Perform platelet count
3. Platelet count sources of error

E. Special Procedures
1. Eosinophil count
2. Sickle cell screen
3. Hemoglobin electrophoresis
4. Body fluid analysis:
   a. synovial fluid
   b. cerebrospinal fluid
   c. serous fluid
5. Body fluid cell counts and morphology
6. Seminal fluid analysis

F. Automated instrumentation
1. Principles of automated hematology cell counters (impedance, flow cytometry)
2. Data/histogram/cytogram evaluation
3. Calibration and linearity
4. Quality control (QC) procedures
5. Troubleshooting

IV. COAGULATION AND HEMOSTASIS (MT=7% / MLT=5%)

A. Apply knowledge of the following:

1. Terminology

hemostasis	prothrombin time (PT)
coagulation	activated partial thromboplastin time (APTT)
factors	International Normalized Ratio (INR)
thrombin	fibrin degradation products (FDP)
fibrinogen	platelet function test
heparin	Coumadin® (warfarin)
sodium citrate	

2. Collection and processing of coagulation specimens
3. Principles of hemostasis (primary, secondary, and fibrinolysis)
4. Coagulation factor nomenclature
5. Intrinsic, extrinsic, common pathways, and associated factors
6. Coagulation, thrombocyte, and vasculature disorders
7. Evaluation of hemostasis and coagulation tests
8. Molecular assays for coagulation/hemostasis

B. Coagulation procedures
1. Prothrombin time (PT) / International Normalized Ratio (INR)
2. Activated partial thromboplastin time (APTT or PTT)
3. Fibrinogen test
4. D-dimer test
5. Fibrin degradation / split products (FDP or FSP)
6. Heparin assays
7. Factor testing
8. Mixing studies
9. Platelet function testing

V. IMMUNOLOGY AND SEROLOGY (MT=9% / MLT=4%)

A. General Knowledge
1. Know terminology related to immunology and serology

reagin	thermostable	anticomplementary
antigen	thermolabile	serum vs. plasma
antibody	physiologic	amboceptor or hemolysin
hemolysis	hypertonic	*Treponema pallidum*
VDRL	hypotonic	inactivation
PCT	cardiolipin	monoclonal
RPR	complement	polyclonal

2. Know the principles of immunologic examination
    a. know antigen-antibody reaction
    b. know the relationship of T and B cells to antibody production
3. Know the definition of syphilis and the stages of infection
4. Know factors affecting antigen/antibody reactions
    a. temperature
    b. pH
    c. incubation time
    d. ionic strength
    e. antibody or antigen excess
    f. enhancement media and technology used in blood banking
    g. (LISS, PEG, enzymes, albumin, microplates, gel)

B. Serological Tests for Syphilis
1. Know the types of serological tests for syphilis
2. Perform qualitative VDRL and RPR
3. Perform quantitative VDRL and RPR
4. Test VDRL and RPR delivery needles for accuracy
5. Perform and know the principle of the MHA-TP test (microhemagglutination test for *Treponema pallidum*)

C. Analytic Procedures
1. Perform febrile agglutination tests
2. Perform and know the theory of immunologic and serologic tests
    a. perform C-reactive protein (CRP) test
    b. perform anti-Streptolysin screen and titer (ASO)
    c. perform rheumatoid arthritis tests (latex agglutination)
    d. perform systemic lupus erythematosus (SLE or LE agglutination) tests
    e. perform anti-nuclear antibody tests
    f. perform antigen detection of organisms in spinal fluid (Directogen® and Bactogen® tests)

g. perform fluorescent antibody procedures
h. perform pregnancy tests
i. perform cold agglutination test

D. Special Procedures
1. Perform analyses related to cytomegalovirus, retrovirus, Epstein-Barr virus, HIV, rubella, hepatitis markers, ANA, alpha-fetoprotein (AFP), tumor markers, and other viral markers

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VI. IMMUNOHEMATOLOGY (MT= 10% / MLT=10%)

A. General Knowledge
1. Know terminology related to immunohematology

antigen	anti-human globulin (direct & indirect)
antibody (natural & immune)	compatibility testing (methods)
immunoglobulin	auto control (autoimmunity)
genotype	Rh immune globulin
phenotype	agglutination
hemolysis	elution
sensitization	hemolytic disease of the newborn (HDN)

2. Know the principle of antigen-antibody reactions
3. Know the histories of the ABO and Rh systems
4. Know the chemical structures of the H, A, and B antigens
5. Know the antigens of the ABO system
6. Know the antibodies of the ABO system
7. Know the phenotypes and genotypes of the ABO system
8. Know the phenotypes and genotypes of the Rho(D) system
9. Know the genetics of blood group antigen
10. Know comparisons of the Rh nomenclature of Fisher-Race, Wiener, and Rosenfeld
11. Understand frequencies of antigen phenotypes in the population for purposes of screening for antigen-negative units
12. Alloimmunization and immune-mediated red cell destruction (transfusion reactions)

B. Soluble components of immune response: Immunoglobulins, complement, and cytokines
1. Demonstrate understanding of the following related to antibodies:
   a. five major classes of immunoglobulins
   b. ABO antibodies
   c. Rh antibodies
   d. other blood group antibodies (irregular or atypical)
   e. cold-reacting antibodies
   f. warm-reacting antibodies
   g. naturally-occurring antibodies
   h. principles of the anti-human globulin (AHG) test
   i. antiglobulin (Coombs) phase in detecting IgG or 7S antibodies
   j. mechanisms that cause a positive direct antiglobulin test (DAT) in auto and allo-antibody sensitization
   k. quality control of red blood cell (RBC)testing: single-dose/double-dose of antigen as the positive control

C. Compatibility Testing Principles and Procedures
1. Perform crossmatch procedures
   a. saline tube
   b. Gel
   c. enzyme
   d. pre-warmed

2. Interpret crossmatch results
    a. use of auto control
    b. grading of reactions
    c. interferences
        1. cold agglutinins
3. Perform and know principles of anti globulin testing
    a. direct
    b. indirect
4. Interpret AHG test results
    a. employing polyspecific AHG
    b. monospecific AHG
    c. grading of positive results
        1. mixed-field
    d. negative results
    e. false results
    f. interferences
        1. drugs
        2. improper technique
    g. recognition of possible errors
5. Know principles of Rh immune globulin
    a. indications
    b. patient criteria
    c. dosage

D. Blood Typing
1. Perform direct or forward blood grouping
2. Perform reverse typing
3. Perform Rho(D) typing
4. Perform typing for subgroups of A
5. Perform genotyping

E. Special Tests
1. Know the principle and procedure for Du testing
    a. Rh typing
    b. in choosing donors
    c. for blood recipients
2. Detection of secretors
3. Detection of cold agglutinins
4. Elution of antibodies

VII. BLOOD BANKING (MT=6% / MLT=6%)

A. General Knowledge
1. Know blood banking terminology

directed donations	autologous transfusions
anticoagulants	deglycerized units
cryoprecipitate	whole blood units
frozen blood cells	packed red cell units
fresh frozen plasma	platelet transfusion
platelet pheresis	leukocyte-reduced units
leukopheresis	radiated units
plasma pheresis	HLA antigen
washed red cells	therapeutic phlebotomies
product pooling	

2. Know blood donor requirements
3. Know all requirements for blood bank operation
    a. know how to visibly inspect units of blood daily
    b. know regulations for the disposition of blood bags and patient samples
    c. know policies for proper storage of blood and blood products for transfusion
    d. know procedures for transfusion reaction investigation
    e. know the blood components, their uses, storage requirements, and preparation
    f. know regulations for checking blood bank and freezer temperatures and alarms, and checking incubator temperatures
    g. know labeling requirements, and codebar and ISBT numbering systems
    h. know issuance of blood products, 30-minute rule, return, and quarantine procedures
    i. know transfusion-transmitted infections and look-back /recall procedures

B. Blood Banking Practices
1. Draw blood from donors
2. Perform therapeutic phlebotomies
3. Perform quality control on all reagents
4. Maintain proper records of all quality control and procedures including blood bank procedures

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MICROBIOLOGY

VIII. BACTERIOLOGY (MT=12% / MLT=11%)

A. General Knowledge
1. Know terminology related to bacteriology

bacteria	osmosis	capsule
autotrophic	semipermeable	ambient
heterotopic	cytoplasm	nucleus
pathogenic	cell wall/membrane	spore
flagella	microaerophilic	aerobic
phagocytosis	facultative aerobic	anaerobic
bacteriophage	facultative anaerobic	Pili
mesophilic	thermophilic	

2. Describe and identify shapes and arrangements of bacteria
3. Know growth curve of bacteria
4. Prepare and use stains and know the theory of staining procedure
    a. acid-fast stains
    b. Gram's stain
    c. India ink stain
    d. fluorescent stains
    e. Giemsa and Wright's stains
5. Describe the appearance of gram-positive and gram-negative cell after performing Gram stain
6. Know and perform quality control on bacteriological procedures

B. Media Quality Control, Techniques, and Cultures
1. Know additives used in media preparation
    a. inhibitors
    b. indicators
    c. enrichments
    d. salts and buffers
    e. pH
2. Prepare bacterial smears and stains (including Gram's, acid-fast stains, and other stains)

3. Justify uses of bacterial culture methods: selective and differential media, enrichment procedures, anaerobic media and techniques, living host cells, candle jars
4. Culture specimens

    a. blood
    b. urine
    c. stool (feces)
    d. sputum
    e. throat
    f. spinal fluid
    g. upper respiratory
    h. wound
    I. abscess
    j. other body fluids/tissue specimens
    k. urethral/cervical/gynecological
    l. catheter tip (intravenous)
    m. intrauterine devices (IUD)

5. Perform routine work by demonstrating knowledge of proper processing and planting of specimens
6. Prepare and interpret gram stain
7. Recognize normal flora from cultures
8. 8Recognize pathogens from cultures
9. Identify criteria for proper collection and rejection of specimens for the clinical microbiological laboratory
10. Concentrate and culture sputum for acid-fast bacilli
11. Test for multi-drug resistant tuberculosis (MDR-TB)
12. Perform quality control on media based on standards of the Clinical and Laboratory Standards Institute (CLSI)

C. Bacterial Identification

1. Examine stained smears
2. Examine smears for acid-fast bacilli
3. Know various systems of bacterial identification (API, automated systems, biochemical and carbohydrate systems)
4. Perform bacterial identification using biochemical and carbohydrate systems
5. Perform differentiating tests

    a. oxidase
    b. catalase
    c. coagulase
    d. bile solubility
    e. beta lactam disk (cefinase disk)
    f. optochin disk (P disk)
    g. bile esculin (enterococcal slant)
    h. bacitracin disk (A disk)
    i. Mannitol salt test for differentiating Staphylococcus species
    j. indole
    k. Camp test
    l. TSB with NACL

6. Isolate, identify, and differentiate gram-positive cocci
7. Isolate, identify, and differentiate gram-positive bacilli
8. Isolate, identify, and differentiate gram-negative cocci and coccobacilli
9. Isolate and identify gram-negative Enterobacteriaceae and differentiate genera and species
10. Isolate, identify, and differentiate gram-negative bacilli
    a. Brucella
    b. Bordetella
    c. HACEK family (upper respiratory): Haemophilus, Actinomycetemcomitans, *Cardiobacterium hominis*, *Eikenella corrodans*, *Kingella kingae*
    d. Pseudomonas
    e. Campylobacter
    f. Anaerobic bacteria
        1. fusobacterium
        2. bacteroides group
        3. actinomyces

4. *Clostridium difficile*

11. Know MRSA and its importance in nosocomial infections
12. Differentiate nosocomial from community-acquired MRSA
13. Understand the impact of multi-drug resistant organisms (MRDO) and their significance
14. Know vancomycin-resistant Enterococcus

D. Special Tests

1. Perform special bacteriological tests
    a. Streptococcal grouping tests
        i. rapid enzyme immunoassay test (or other antigen detection kits) from throat swabs
        ii. cultures for beta hemolysis screening, bacterial identification
    b. *Clostridium difficile* toxin test
    c. Campylobacter urease test and antigen/antibody test
    d. *H. Pylori* screening
    e. shiga toxin test
2. Perform antimicrobial susceptibility testing (Kirby-Bauer, MIC, and automated systems)
3. Perform DNA probe testing

IX. PARASITOLOGY (MT=1% / MLT=2%)

A. General Knowledge

1. Know terminology related to parasitology
2. Know parasite classification
3. Know types of parasites and descriptions of each (protozoa, helminths, etc.)

B. Parasite Identification

1. Know and perform examinations for parasites
    a. feces
        i. macroscopic examination
        ii. microscopic direct saline and iodine preparations
        iii. various concentration methods
    b. blood
    c. urine
    d. other body fluids
    e. tissue
2. Examine specimens, direct and concentrated methods for intestinal parasites
    a. Cestodes
    b. Protozoa
    c. Nematodes
    d. Trematodes
3. Prepare and stain permanent smears for ova and parasites using iron hematoxylin and trichrome methods
4. Know, identify, and stain cryptosporidium species
5. Perform trichrome stain
6. Perform stool concentration technique
7. Perform stool flotations technique
8. Prepare and read thick and thin smears of blood for blood parasites
9. Calibrate ocular micrometer
1. Measure standard objects using ocular micrometer

C. Special Tests

1. Perform tests for blood parasites
    a. filaria
    b. malaria

c. trypanosomes
d. babesiosis

2. Stain and examine stool for fats
3. Prepare patient for fecal occult blood test (FOBT)
4. Perform fecal immunochemical test
5. Know concentration methods for identifying intestinal parasites
6. Perform antigen tests for parasites such as Giardia

X. MYCOLOGY (MT= 1% / MLT=2%)

A. General Knowledge
1. Know terminology related to mycology
2. Know types and classification of mycological organisms

B. Mycological Identification
1. Identify mycological organisms

C. Mycological Procedures
1. Perform mycological procedures
a. KOH and calcaflur white stain
b. India ink negative stain
c. Scotch tape preparation from mold cultures
d. tease preparations from mold cultures
e. set up and read mold slide cultures
f. agar cut preparations for mold cultures
g. set up and read hair perforation test
h. set up and read sterile rice grain cultures
i. inoculate and interpret tubed media (T-agars, urea)
j. yeast chromagar
k. cornmeal agar
l. lactophenol cotton blue
m. Kinyoun's modified acid-fast stain for actinomycetes

2. Perform advanced mycological procedures
a. exoantigen testing
b. DNA probe testing

XI. URINALYSIS (MT=9% / MLT=16%)

A. General Knowledge
1. Terminology related to urinalysis

prerenal	Clinitest®	sulfosalicylic acid (SSA)
renal threshold	Ictotest®	amniocentesis
myoglobin	Acetest®	Tamm-Horsfall protein
osmolality	glycoseria	xanthochromic
suprapubic	acites	pass-through

2. Specimen collection
a. random
b. midstream
c. catheterized
d. timed (2, 12, 24-hour)
3. Specimen handling and preservation

B. Renal function
1. Urine formation
2. Renal anatomy
3. Renal physiology
4. Physical properties of urine
5. Chemical properties of urine (principles of reagent test strips)
6. Microscopic structures found in urine

C. Urinalysis Procedures
1. Physical examination
    a. color and clarity
    b. specific gravity (refractometer/urinometer)
2. Chemical examination
    a. pH
    b. glucose
    c. nitrate
    d. urobilinogen
    e. specific gravity
    f. protein
    g. ketones
    h. bilirubin
    i. blood
    j. leukocyte esterase
3. Confirmatory tests
    a. Ictotest®
    b. sulfosalicylic acid (SSA) test
    c. Acetest®
    d. Clinitest®
4. Microscopic examination
    a. cells
    b. casts
    c. crystals
    d. artifacts/contaminants
    e. microorganisms

D. Special tests
1. Bence Jones protein
2. Watson-Schwartz differentiation test
3. Hoesch screening test
4. osmolality
5. myoglobin
6. urine pregnancy test (HCG)
7. occult blood test (stool, gastric)