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*Annexure to Notification No.F(Prescription-Syllabi/Paramedical Courses/Acad/KU/2021
Syllabi and Courses of Study for B.Sc Medical Lab Technology-2nd year
Effective from academic session 2020 and onwards*

<i>BMLT201</i>	<i>Biochemistry-II</i>
<i>BMLT202</i>	<i>Microbiology-II</i>
<i>BMLT203</i>	<i>Pathology-II</i>
<i>BMLT204</i>	<i>Basics in Computer Applications (Subsidiary subject)</i>

Course Title: Biochemistry-II

Course Code: BMLT201

THEORY SYLLABUS

I. Basic Laboratory Practices

Preparation of solutions and reagents

- Basic requirements – types / grades of chemicals, solvents, types of water and other requirements
- Various types of solutions and reagents – Normal, Molar, percent, buffer solutions and substrates, indicators, standards

Measurements in Clinical Laboratory

- Quantitative estimations- Selecting a method, linearity of a method, endpoint and rate reaction methods. Checking accuracy and precision
- Calibration: Preparation of calibration curve, importance of a calibration curve, straight line calibration and non-linear calibration graph; Technique of preparing a calibration curve using stock standard solutions. Graphic representation of calibration.

II. Chemistry of Carbohydrates

- Structural properties- Stereoisomerism, optical activity, cyclic structures, mutarotation, epimers.
- Monosaccharides of biological importance. Important chemical reactions –formation of furfural derivatives, enediols, osazones, sugar acids, sugar alcohols. Deoxy sugars Biomedical importance of amino sugars, glycosides.
- Disaccharides: Properties of maltose, lactose, sucrose. Invert sugars. Biomedical importance of Lactose and sucrose.
- Polysaccharides: Properties of starch and glycogen. Biomedical importance of inulin. Mucopolysaccharides- Composition, tissue distribution and functions.

III. Chemistry of amino acids and proteins

- Properties of amino acids- Isomerism, amphoteric nature and isoelectric pH. Peptide bond formation. Colour reactions of amino acids. Use of amino acids analysis in diagnosis of diseases. Peptides and functions.
- Proteins- Functions. Classification - Based on composition and solubility, functional and nutritional. Protein Structure-primary(insulin), secondary, tertiary and quaternary
- Precipitation reactions of proteins- salting out, iso-electric precipitation, precipitation by organic solvents, heavy metal ions, alkaloidal reagents. Denaturation of proteins. Heat coagulation. Preparation of protein free filtrates for quantitative estimations

IV. Enzymes

- Classification, properties, specificity, mechanism of enzyme action, factors affecting enzyme activity, enzyme inhibition. Coenzymes. Analytical and therapeutic role of enzymes. Immobilized enzymes

V. Chemistry of Nucleic acids

- Structure of RNA. Types of RNA. Structure of tRNA
- Functions of DNA and RNA

VI. Water soluble vitamins:

- Thiamine, riboflavin, niacin, pyridoxine, vitamin B12, folic acid and Vitamin C
- Chemistry, Sources, RDA, functions, deficiency and or toxicity. Antivitamins

VII. Metabolism of Carbohydrates

- Digestion and absorption of carbohydrates. Disorders
- Metabolic pathways, energetics, inhibitors and regulation, disorders - Glycolysis, TCA cycle, Glycogen metabolism.
- Diabetes mellitus-Diagnosis and management.
- Principles and procedures for the determination of plasma glucose levels-reductometric and enzymatic methods.
- Urinary glucose.

VIII. Metabolism of amino acids and nucleic acids

a. Non protein nitrogenous compounds:

- Formation of ammonia - transamination and deamination, Urea cycle and disorders, Blood urea/ Blood urea nitrogen- clinical importance.
- Biosynthesis of creatine. formation of creatinine, clinical importance of creatinine
- Degradation of purine nucleotides, formation of uric acid, Disorders- Gout, Lesch Nyhan syndrome.

Principles and procedures for the determination of Blood urea nitrogen, creatinine & uric acid - colorimetric and enzymatic methods.

b. Catabolism of Branched chain, Phenylalanine/Tyrosine catabolism :

- Pathway Disorders- Phenylketonuria, Alkaptonuria, Maple Syrup Urine Disease

IX. Overview of Body fluids

- Ascitic fluid, CSF, peritoneal, pleural, pericardial and synovial fluids. Quantitative analysis of constituents in different types of fluids.

X. Specimen collection: Technique, use of anticoagulants and preservatives where appropriate. Storage, time of collection, instructions to patients for timed sample collection.

Disposal

- Blood- venous and capillary puncture.
- Urine-random, timed & 24 hrs

XI. Normal constituents of urine: Physical characteristics. Chemical examination of urinary constituents.

XII. Renal function tests

- Glomerular and tubular function. Handling of different solutes by tubules. Reabsorption of water
- Abnormal constituents of urine - Physical characteristics. Chemical examination of urinary constituents.
- Clearance tests: Definition. Procedure for creatinine clearance test, reference values and significance
- Tests of tubular function: Concentration and dilution tests. Measurement of specific gravity and osmolality
- Urinary acidification: Ammonium chloride loading test

XIII. Techniques

- Spectrophotometry: Principle, components, operation, care and maintenance, relation between concentration and optical density, standardization of spectrophotometer.
- Chromatography: Principle. Partition chromatography-instrumentation and application in identification of amino acids
- Others- Principle and application
Osmometry, Reflectance photometry, Turbidimetry, Nephelometry
- Glucometers: Principle, instrumentation and application

ASSIGNMENT TOPICS:

- Oral Glucose tolerance test
- Glycated HbA1c
- Microalbuminuria

PRACTICAL SYLLABUS

I. PRACTICAL APPROACH TO BASIC LABORATORY PRACTICES

a. Pipetting techniques

- Use of glass pipettes-graduated and volumetric pipets; Specimen and Reagent using fixed and variable pipettes

b. Operation of instruments

- Analytical Balance: Weighing chemicals, deliquescent, hygroscopic compounds and acids.
- pH meter: Checking pH of urine and buffers by electrometry.
- Centrifuges: concept of balancing, time and speed specifications
- Urinometer, Esbach's albuminometer

c. Techniques of preparation of solutions and reagents

- Normal, molar, percent (Na_2CO_3 , NaCl , NaOH , KCl , HCl , H_2SO_4 , H_3PO_4 , CH_3COOH , Sodium tungstate) Buffers (Phosphate buffer, citrate buffer), Indicators.
- Standard solutions – Creatinine, Total Protein etc.,

d. Dilution techniques

- Dilution of stock standards and reagents to working
- Dilution of acids
- Part dilution of body fluids

e. Determination of pH: using indicators, pH paper, universal indicator solutions

II. QUALITATIVE

a. Color reactions - known test solutions

- Carbohydrates: Glucose, Fructose, Xylose, Sucrose, Starch
- Amino acids in protein solution
- NPN- Urea, Creatinine and Uric acid
- Titrable acidity and ammonia in urine

b. Precipitation reactions

- Albumin
- Preparation of protein free filtrates for quantitative estimations - glucose, urea, creatinine uric acid estimation

c. Spot tests for

- Phenylketonuria, alkaptonuria, MSUD

d. Urine analysis

- Normal and Abnormal urine

III. QUANTITATIVE

a. Operation of Colorimeter / Spectrophotometer.

- Colorimetric experiment to select a complementary filter.
- Concepts of use of blank, reagent blank
- Standardization of a colorimeter/ spectrophotometer using coloured solutions
- Graphing of Beer's law- drawing calibration curves.
- Determination of unknown concentration of colored solution from calibration curve. Concept of one point calculation or calibration (T/S X concentration of standard)

b. Quantitative estimation by manual methods- Preparation of calibration curve & estimation of unknown analyte concentration

- Blood Glucose by reductometric method (Not to use O-toluidine method as it is a potent carcinogen)
- Blood urea by Diacetyl Monoxime method.
- Serum and urine creatinine by Jaffe's reaction. Determination of Creatinine clearance rate.
- Serum uric acid by Caraway's method
- CSF and urine protein by sulphosalicylic acid method

PRACTICAL DEMONSTRATION

- Paper chromatography of amino acids
- Dipsticks for urine analysis

INTERNAL ASSESSMENT

Theory-average of 2 exams conducted 20
Practicals: record and lab work 20

SCHEME OF EXAMINATION -THEORY

There shall be one theory paper of three hours duration carrying 80 marks. Distribution of type of questions and marks for Biochemistry II shall be as given under.

TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS	SUB-TOTAL
Long essay	3 (attempt 2)	2 x 10	20
Short essay	8 (attempt 6)	6 x 5	30
Short answer	12 (attempt 10)	10 x 3	30
GRAND TOTAL			80

SCHEME OF EXAMINATION – PRACTICALS

The scheme of examination for Biochemistry II Practical shall be as follows: Distribution of marks

Type of Question	Marks allotted
Quantitative estimation	30
Qualitative estimation	30
Urine examination	20
Total	80

Distribution of Marks for University Theory and Practical Exam

Theory				Practicals			Grand total
Theory	Viva Voce	IA	Sub Total	Practicals	IA	Sub Total	
80	-	20	100	80	20	100	200

Course Title: Microbiology-II

Course Code: BMLT202

MICORBIOLOGY II

(Systematic Bacteriology + Parasitology)

I. Systematic Bacteriology

Biochemical reactions for identification of bacteria

Antimicrobial Susceptibility Testing

Normal flora of the human body

Gram Positive Bacteria: Systematic study of the following bacteria with special reference to morphology, cultural characteristics, pathogenicity, lab diagnosis and prophylaxis -

- Staphylococcus,
- Streptococcus,
- Pneumococcus
- Corynebacterium , Bacillus
- Mycobacterium
- Clostridium
- Actinomycetes

Gram Negative Bacteria:

- Neisseria
- Haemophilus, Bordetella, Brucella
- Enterobacteriaceae, Salmonella & Shigella
- Vibrio, Campylobacter & Helicobacter

- Pseudomonas, Burkholderia & non fermenters
- Yersinia

Spirochaetes & Others:

- Treponemes, Leptospira & Borrelia
- Mycoplasma, Chlamydia & Rickettsia
- Non sporing anaerobes
- Gardnerella, Legionella & Listeria
- Miscellaneous Bacteria

Applied bacteriology

- UTI, Diarrhoeal diseases and food poisoning, Meningitis, Sexually transmitted diseases, pyogenic infections, Hospital infections and PUO
- Specimen collection for the above said infections.

Bacteriology of Water, Milk and Air

II. Parasitology

1. Protozoology

- Entamoeba, Balantidium coli,
- Trichomonas, Giardia, Leishmania, Trypanosoma
- Malaria, Toxoplasma
- Cryptosporidium, Microsporidium, Isospora, Cyclospora

2. Helminthology

- Cestodes – Taenia, Echinococcus, D. latum, H. nana,
- Trematodes – Schistosoma, Fasciola,
- Nematodes – Ascaris, Ancylostoma, Enterobius, Strongyloides, Trichuris, Trichinella, Dracunculus, Wuchereria and other Filarial worms.

Lab Diagnosis of Parasitic Infections

Arthropods of Medical Importance

Practicals:

Staining:

1. Gram Stain, Z N Stain, Albert stain
2. Hanging drop Preparation
3. Culture methods
4. Introduction to Biochemical reactions
5. Identifications of pure bacterial culture based on morphology, colony characteristics, motility, biochemical reaction and anti biogram
6. Antibiotic sensitivity testing -Kirby Bauer method
7. Stool examination
8. Saline mount
9. Iodine mount
10. Peripheral smear examination for malaria and filariasis

INTERNAL ASSESSMENT

Theory-average of 2 exams conducted	20
Practicals: record and lab work*	20

SCHEME OF EXAMINATION -THEORY

There shall be one theory paper of three hours duration carrying 80 marks. Distribution of type of questions and marks for Microbiology II shall be as given under.

TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS	SUB-TOTAL
Long essay	3 (attempt 2)	2 x 10	20
Short essay	8 (attempt 6)	6 x 5	30
Short answer	12 (attempt 10)	10 x 3	30
GRAND TOTAL			80

SCHEME OF EXAMINATION – PRACTICALS

The scheme of examination for Microbiology II Practical shall be as follows: Distribution of marks

Type of Question	Marks allotted
Spotters	20
ZN staining	10
Pure culture of the organism	25
Stool examination.	15
Record	10
Total	80

Distribution of Marks for University Theory and Practical Exam

Theory				Practicals			Grand total
Theory	Viva Voce	IA	Sub Total	Practicals	IA	Sub Total	
80	-	20	100	80	20	100	200



Course Title: Pathology-II

Course Code: BMLT203

BSC MLT -2nd year Theory

1. Hematology ----- 40 hrs

i. Anemias

- a. Introduction to anemias
- b. Definition, etiology and Lab. diagnosis of Iron deficiency anemia and Megaloblastic anemia
- c. Definition , etiology and lab. diagnosis of haemolytic anemia
- d. Hemoiglobinopathies and Thalassemia-pathogenesis and Lab. diagnosis.
- e. LE cell- definition, morphology and methods of demonstration.
- f. Blood parasites-malaria, LD bodies and methods of demonstration .

ii. Hemostasis

- a. Introduction to hemostasis and factors governing hemostasis.
- b. Mechanism of blood coagulation.
- c. Fibrinolytic system
- d. Bleeding disorders and Lab. investigations in bleeding disorders.
- e. Thrombocytopenia-pathogenesis and lab. approach.
- f. Platelet function disorders.
- g. Disorders of coagulation- inherited and acquired.
- h. DIC-pathogenesis and lab. investigations.

iii. Automation in hematology laboratory.

2. Immunohematology and blood transfusion.-----40 hrs

- a. HLA and their significance.
- b. Introduction to blood transfusion.
- c. Criteria for selection of donors.
- d. Donor recruitment and registration.
- e. Various types of anticoagulants used in blood banking.
- f. Collection of blood for transfusion and post- phlebotomy donor care.
- g. Component therapy and processing of blood for different component preparation.
- h. Autologous transfusion.
- i. Apheresis (general concept).
- j. Blood borne infections.
- k. Screening of blood for various infectious diseases.
- l. Compatibility testing and coomb's test-Principle and different methods.
- m. Transfusion reactions and work up.
- n. Blood bank organization, standards and quality control.
- o. Automation in blood banking.

3. Histopathology -----20 hrs

- a. Introduction to Histopathology .
- b. Receipt of surgical specimens.
- c. Fixatives –various types of fixatives, their mode of action, preparation and storage.
- d. Tissue processing for routine paraffin sections.
- e. Decalcification-different decalcifying agents and end point of decalcification.
- f. Routine paraffin sectioning.
- g. Frozen sectioning and its application.
- h. General outline of the theory and practice of staining.
- i. Hematoxylin and eosin staining.
- j. Mountants-different types of mountants .

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Practical(Bsc Mlt 2nd year)

- 1) Estimation of serum iron and TIBC.
- 2) Peripheral blood findings in Iron deficiency anemia.
- 3) Bone marrow iron assessment by Perl's staining.
- 4) Vitamin B12 and folate assay.
- 5) PBF findings in Megaloblastic anemias.
- 6) PBF in haemolytic anemia.
- 7) Coombs test.
- 8) Methhemoglobin reduction test for G6PD deficiency.
- 9) Osmotic fragility test.
- 10) Sickling test.
- 11) Determination of HbF by Alkali denaturation method.
- 12) Acidified serum lysis test (Ham's test).
- 13) Detection of Hemosiderin in urine
- 14) Preparation of thick and thin blood films for demonstration of malarial parasite.
- 15) Demonstration of malarial parasite and LD bodies in peripheral smear.
- 16) LE cell preparation.
- 17) Pre-analytical variables in coagulation laboratory including sample collection.
- 18) Investigation of hemostatic mechanism- Bleeding time, Clotting Time, Clot retraction time, Prothrombin time (PT) Activated partial thrombin time(aPTT) and thrombin time(TT) .
- 19) Correction studies for deficiencies of various coagulation factors.
- 20) Factor assay VII, VIII.IX, X and XIII.
- 21) Crossing matching .
- 22) Coombs test (Direct and Indirect).

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Scheme of examination: Theory

There shall be one theory paper of three hours duration carrying 80 marks. Distribution of type of questions and marks for Pathology II shall be as given under.

TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS	SUB- TOTAL
LONG ESSAY (LE)	3 (to attempt 2)	2 x 10	20
SHORT ESSAY (SE)	8 (to attempt 6)	6 x 5	30
SHORT ANSWER (SA)	12 (to attempt 10)	10 x 3	30
GRAND TOTAL			80

Scheme of Examination: Practical

Distribution of marks

Type of Question	Marks allotted
Haematoxylin and eosin or a special stain	10
Haemoglobin or PCV	10
Total count	10
Differential count	10
ESR	10
PS preparation and staining	10
Record	10
Spotters	10
Total	80

Distribution of Marks for University Theory and Practical Exam

Theory				Practicals			Grand total
Theory	Viva Voce	IA	Sub Total	Practicals	IA	Sub Total	
80	-	20	100	80	20	100	200

SCHEME SUBJECTS
Theory
Practicals
Grand Total

Course Title: Basics in Computer Applications

Course Code: BMLT204

BASICS IN COMPUTER APPLICATIONS

The course enables the students to understand the fundamentals of computer and its applications.

Introduction to Data processing :

Features of computers, Advantages of using computers. Getting data into /out of computers. Role of computers. What is Data processing? Application areas of computers involved in Data processing. Common activities-in processing. Types of Data processing, Characteristics of information. What are Hardware and Software?

Hardware Concepts :

Architecture of computers, Classification of computers, Concept of damage. Types of storage devices. Characteristics of disks, tapes, Terminals, Printers, Network. Applications of networking concept of PC System care, Floppy care, Data care.

Concept of Software.

Classification of software : System software. Application of software. Operating system. Computer system. Computer virus. Precautions against viruses. Dealing with viruses. Computers in medical electronics Basic Anatomy of Computers Principles of programming Computer application - principles in scientific research ; work processing, medicine, libraries, museum , education, information system.
Data processing
Computers in physical therapy - principles in EMG, Exercise testing equipment, Laser.

Scheme of Examination for MEDICAL ELECTRONICS including COMPUTER APPLICATIONS
One Written (Theory) paper: Maximum Marks: -80 marks.
No Practical or Viva voce examination