

ORDINANCE GOVERNING REGULATIONS & CURRICULUM FOR BACHELOR OF SCIENCE
DEGREE COURSES IN MEDICAL LABORATORY TECHNOLOGY

B.Sc Medical Laboratory Technology:-

1. Eligibility for admission:

A candidate seeking admission to the Bachelor of Science Degree Courses in Medical Laboratory Technology course shall have passed:

1. Senior Secondary School Examination from recognised board with Physics, Chemistry, Biology as principal subjects of study.

OR

2. Two year Pre-University examination or equivalent as recognized by Rajasthan University of Health Sciences with, Physics, Chemistry and Biology as principle subjects of study.

OR

3. Pre-Degree/ Degree course from a recognized University considered as equivalent by RUHS, (Two years after ten years of schooling) with Physics, Chemistry and Biology as principal subjects of study.

OR

4. Any equivalent examination recognized by the Rajasthan University of Health Sciences, Jaipur for the above purpose with Physics, Chemistry and Biology as principal subjects of study.

OR

5. Candidates with two years diploma from a recognized Government Board in Medical Lab Technology shall have passed plus 12 [10+2] with Physics, Chemistry and Biology, as principal subjects or candidates with 3 years diploma from a recognized Government Board in Medical lab technology as a subject.

6. Lateral entry to second year for Medical Lab Technology courses for candidates who have passed diploma program from the Government Boards and recognized by RUHS, fulfilling the conditions specified above under SL. No. 5

Note:

a. The candidate shall have passed individually in each of the principal subjects.

b. Candidates who have completed diploma Medical Lab Technology through Correspondence shall not be eligible for B.Sc Medical Lab Technology.

2. Duration of the course:

Duration shall be for a period of three and half years including six months of Internship.

3. Medium of instruction:

The medium of instruction and examination shall be in English only.

4. Scheme of examination:

There shall be three examinations one each at the end of 1st, 2nd and 3rd year.

5. Attendance

Every candidate should have attended at least 80% of the total number of classes conducted in an academic year from the date of commencement of the term to the last working day as notified by university in each of the subjects prescribed for that year separately in theory and practical. Only such candidates are eligible to appear for the university examinations in their first attempt. Special classes conducted for any purpose shall not be considered for the calculation of percentage of attendance for eligibility. A candidate lacking in prescribed percentage of attendance in any subjects either in theory or practical in the first appearance will not be eligible to appear for the University Examination in that subject.

6. Internal Assessment (IA) :

Theory - 20 marks.

Practical - 10 marks*. [Lab work- 06 marks and Record-04 marks]

There shall be a minimum of two periodical tests preferably one in each term in theory and practical of each subject in an academic year. The average marks of the two tests will be calculated and reduced to 20. The marks of IA shall be communicated to the University at least 15 days before the commencement of the University examination. The University shall have access to the records of such periodical tests. The marks of the internal assessment must be displayed on the notice board of the respective colleges with in a fortnight from the date test is held. If a candidate is absent for any one of the tests due to genuine and satisfactory reasons, such a candidate may be given a re-test within a fortnight.

* There shall be no University Practical Examination in First year.

7. Subject and hours of teaching for Theory and Practical.

The number of hours of teaching theory and practical, subject wise in first year, second year and third year are shown in Table-I, Table-II and Table-III

Table - I Distribution of Teaching Hours in First Year Subjects

S.No.	Subject	Theory(hours)	Practical(hours)	Total(hours)
1	Human Anatomy	70	20	90
2	Physiology	70	20	90
3	Biochemistry 1	70	20	90
4	Pathology 1	70	20	90
5	Microbiology 1	70	20	90
	Total	350	100	450

The classes in main and subsidiary subjects are to be held from Monday to Thursday. On Fridays and Saturdays students shall work in hospitals in the respective specialty or department.

Subsidiary Subjects

English 25 Hours

Hospital posting -470 hours- Fri day 9am – 1pm and 2pm - 4-30 pm. Saturday 9am - 1pm

Table - II Distribution of Teaching Hours in Second Year Subjects

S.no	Subject	Theory(hours)	Practical(hours)	Clinical Postings(hours)	Total(hours)
1	Biochemistry 2	100	80	170	350
2	Microbiology 2	100	80	170	350
3	Pathology 2	100	80	170	350
	Total	300	240	510	1050

Subsidiary Subjects

Environmental Science & Health 10 Hours

Table - III Distribution of Teaching Hours in Third Year Subjects

S.no	Subject	Theory(hours)	Practical(hours)	Clinical Postings(hours)	Total(hours)
1	Biochemistry 3	100	80	170	350
2	Microbiology 3	100	80	170	350
3	Pathology 3	100	80	170	350
	Total	300	240	510	1050

Subsidiary Subjects

Computer application 10 Hours

8. Schedule of Examination:

The university shall conduct two examinations annually at an interval of not less than 4 to 6 months as notified by the university from time to time. A candidate who satisfies the requirement of attendance, progress and conduct as stipulated by the university shall be eligible to appear for the university examination. Certificate to that effect shall be produced from the Head of the institution along with the application for examination and the prescribed fee.

9. Scheme of Examination

There shall be three examinations, one each at the end of I, II and III year. Distribution of Subjects and marks for First Year, Second year & Third year University theory and practical Examinations are shown in the Table - IV, V & VI.

First year examination:

The University examination for 1st year shall consist of only theory examination and there shall be no University Practical Examination. Written examination consists of 03 papers in 1st year.

Second & Third year examination:

The University examination for 2nd and 3rd year shall consist of Written Examination & Practical.

Written Examinations consists of
03 papers in the 2nd Year
03 papers in the 3rd Year.

Practical examination:

Three practical examinations, at the end 2nd Year and three practical examinations at the end of the 3rd year.

TABLE-IV

Distribution of Subjects and marks for First Year University theory Examination

A	Main Subject*	Written Paper		I. A. Theory	Total
		Duration	Marks	Marks	Marks
1	Basic Anatomy (Including Histology)	3 Hours	80	20	100
2	Physiology	3 Hours	80	20	100
3	Biochemistry 1	3 Hours	80	20	100
4	Pathology 1	3 Hours	80	20	100
5	Microbiology 1	3 Hours	80	20	100
B	Subsidiary Subject**				Total
1	English	3 Hours	80	20	100
2	Biostatistics	3 Hours	80	20	100

Note * I A = Internal Assessment

Main Subjects shall have University Examination.
There Shall be no University Practical Examination.

** Subsidiary subjects : Examination for subsidiary subjects shall be conducted by respective colleges.

TABLE – V

Distribution of Subjects and marks for Second Year Examination.

A	Main Subject	Theory				Practicals			Grand Total
		Theory	Viva	IA	Subtotal	Practicals	IA	Subtotal	
1	Biochemistry 2	100	30	20	150	40	10	50	200
2	Microbiology 2	100	30	20	150	40	10	50	200
3	Pathology 2	100	30	20	150	40	10	50	200

Distribution of Subsidiary Subjects and marks for Second Year Examination

B	Subsidiary Subject*	Duration	Marks	I.A. Theory Marks	Total Marks
1	Environmental Science & Health	3 Hours	80	20	100
2	Health care	3 Hours	80	20	100

* Subsidiary subjects: Examination for subsidiary subjects shall be conducted by respective colleges

TABLE – VI
Distribution of Subjects and marks for Third Year Examination.

A	Main Subject	Theory				Practicals			Grand Total
		Theory	Viva	IA	Subtotal	Practicals	IA	Subtotal	
1	Biochemistry 3	100	30	20	150	40	10	50	200
2	Microbiology 3	100	30	20	150	40	10	50	200
3	Pathology 3	100	30	20	150	40	10	50	200

Distribution of Subsidiary Subjects and marks for Third Year Examination

B	Subsidiary Subject*	Duration	Marks	I.A. Theory Marks	Total Marks
1	Computer Application	3 Hours	80	20	100

* Subsidiary subjects: Examination for subsidiary subjects shall be conducted by respective colleges

10. Pass criteria

10.1. First year examination.

a. Main Subjects: A candidate is declared to have passed in a subject, if he/she secures, 50% of marks in University Theory exam and internal assessment added together.

b. Subsidiary Subjects: The minimum prescribed marks for a pass in subsidiary subject shall be 35% of the maximum marks prescribed for a subject. The marks obtained in the subsidiary subjects shall be communicated to the University before the Commencement of the University examination.

10.2. Second and Third year Examination

a. Main Subjects: A candidate is declared to have passed the Examination in a subject if he/she secures 50% of the marks in theory and 50% in practical separately. For a pass in theory, a candidate has to secure a minimum of 40% marks in the University conducted written examination, and 50% in aggregate in the University conducted written examination, internal assessment and Viva-Voce added together and for pass in Practical, a candidate has to secure a minimum of 40% marks in the university conducted Practical/Clinical examination and 50% in aggregate i.e. University conducted Practical/Clinical and Internal Assessment.

b. Subsidiary Subjects: The minimum prescribed marks for a pass in subsidiary subject shall be 35% of the maximum marks prescribed for a subject. The marks obtained in the subsidiary subjects shall be communicated to the University before the commencement of the University examination.

11. Carry over benefit

11.1 First year examination: A candidate who fails in any two of the five main subjects of first year shall be permitted to carry over those subjects to second year. However, he/she must pass the carry over subjects before appearing for second year examination; otherwise he/she shall not be permitted to proceed to third year.

11.2. Second year examination: A candidate is permitted to carry over any one main subject to the third year but shall pass this subject before appearing for the third year examination

12. Eligibility for the award of Degree: A candidate shall have passed in all the subjects of first, second and third year to be eligible for award of degree.

13. Distribution of Type of Questions and Marks for Various Subjects

THEORY

SUBJECTS HAVING MAXIMUM MARKS = 100		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	2	10
SHORT ESSAY TYPE	12(10X5)	5
SHORT ANSWER TYPE	12(10X3)	3

SUBJECTS HAVING MAXIMUM MARKS = 80		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	2	10
SHORT ESSAY TYPE	8(6X5)	5
SHORT ANSWER TYPE	12(10X3)	3

SUBJECTS HAVING MAXIMUM MARKS = 60		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	2	10
SHORT ESSAY TYPE	7(5X5)	5
SHORT ANSWER TYPE	7(5X3)	3

SUBJECTS HAVING MAXIMUM MARKS = 50		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	2	10
SHORT ESSAY TYPE	5(3X5)	5
SHORT ANSWER TYPE	7(5X3)	3

RAJASTHAN UNIVERSITY OF HEALTH SCIENCES, JAIPUR, RAJASTHAN.

B. Sc Medical Laboratory Technology

ANATOMY

No. of theory classes: 70 hours

No. of practical classes : 20 hours

1. Introduction: human body as a whole

Theory: Definition of anatomy and its divisions, terms of location, positions and planes.
Cell and its organelles epithelium-definition, classification, describe with examples, function.
Glands- classification, describe serous & mucous glands with examples
Basic tissues – classification with examples

Practical: Histology of types of epithelium, histology of serous, mucous & mixed salivary gland

2. Locomotion and support

Theory:

Cartilage – types with example & histology

Bone – Classification, names of bone cells, parts of long bone, microscopy of compact bone, names of all bones, vertebral column, intervertebral disc, fontanelles of fetal skull

Joints – Classification of joints with examples, synovial joint (in detail for radiology)

Muscular system: Classification of muscular tissue & histology, names of muscles of the body

Practical: Histology of the 3 types of cartilage

Demo of all bones showing parts, radiographs of normal bones & joints

Histology of compact bone (TS & LS)

Demonstration of all muscles of the body

Histology of skeletal (TS & LS), smooth & cardiac muscle

3. Cardiovascular system

Theory:

Heart-size, location, chambers, exterior & interior

Blood supply of heart

Systemic & pulmonary circulation

Branches of aorta, common carotid artery, subclavian artery, axillary artery, brachial artery, superficial palmar arch, femoral artery, internal iliac artery

Peripheral pulse

Inferior venacava, portal vein, portosystemic anastomosis

Great saphenous vein

Dural venous sinuses

Lymphatic system- cisterna chyli & thoracic duct

Histology of lymphatic tissues

Names of regional lymphatics, axillary and inguinal lymph nodes in brief

Practical:

Demonstration of heart and vessels in the body

Histology of large artery, medium sized artery & vein, large vein

Microscopic appearance of large artery, medium sized artery & vein, large vein pericardium

Histology of lymph node, spleen, tonsil & thymus

Normal chest radiograph showing heart shadows

Normal angiograms

4. Gastro-intestinal system

Theory:

Parts of GIT, Oral cavity (lip, tongue (with histology), tonsil, dentition, pharynx, salivary glands, Waldeyer's ring)
Oesophagus, stomach, small and large intestine, liver, gall bladder, pancreas
Radiographs of abdomen

5. Respiratory system**Theory**

Parts of RS, nose, nasal cavity, larynx, trachea, lungs, bronchopulmonary segments
Histology of trachea, lung and pleura
Names of paranasal air sinuses

Practical: Demonstration of parts of respiratory system.
Normal radiographs of chest
Histology of lung and trachea

6. Peritoneum

Theory: Description in brief

Practical: Demonstration of reflections

7. Urinary system**Theory**

Kidney, ureter, urinary bladder, male and female urethra
Histology of kidney, ureter and urinary bladder

Practical: demonstration of parts of urinary system
Histology of kidney, ureter, urinary bladder
Radiographs of abdomen-IVP, retrograde cystogram

8. Reproductive system**Theory:**

Parts of male reproductive system, testis, vas deferens, epididymis, prostate (gross & histology)
Parts of female reproductive system, uterus, fallopian tubes, ovary (gross & histology)
Mammary gland – gross

Practical: demonstration of section of male and female pelvis with organs in situ
Histology of testis, vas deferens, epididymis, prostate, uterus, fallopian tubes, ovary
Radiographs of pelvis – hysterosalpingogram

9. Endocrine glands**Theory:**

Names of all endocrine glands in detail on pituitary gland, thyroid gland, parathyroid gland, suprarenal gland – (gross & histology)

Practical: Demonstration of the glands
Histology of pituitary, thyroid, parathyroid, suprarenal glands

10. Nervous system

Theory:

Neuron Classification of NS, Cerebrum, cerebellum, midbrain, pons, medulla oblongata, spinal cord with spinal nerve(gross & histology)
Meninges, Ventricles & cerebrospinal fluid
Names of basal nuclei
Blood supply of brain
Cranial nerves
Sympathetic trunk & names of parasympathetic ganglia

Practical: Histology of peripheral nerve & optic nerve
Demonstration of all plexuses and nerves in the body
Demonstration of all part of brain
Histology of cerebrum, cerebellum, spinal cord

11. Sensory organs:

Theory:

Skin: Skin-histology
Appendages of skin
Eye: Parts of eye & lacrimal apparatus
Extra-ocular muscles & nerve supply
Ear: parts of ear- external, middle and inner ear and contents

Practical:

Histology of thin and thick skin
Demonstration and histology of eyeball
Histology of cornea & retina

12. Embryology:

Theory:

Spermatogenesis & oogenesis
Ovulation, fertilization
Fetal circulation
Placenta

Internal Assessment

Theory - Average of two exams conducted. 20

Practicals: Record & Lab work* 10

* There shall be no University Practical Examination and internal assessment marks secured in Practical need not be sent to the University.

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 Anatomy shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	8(To attempt 6)	6X5	30
Short Answer (SA)	12 (To Attempt 10)	10X3	30
Total			80

NO PRACTICAL EXAMINATION

REFERENCE BOOKS

Anatomy

- 1 William Davis (P) understanding Human Anatomy and Physiology MC Graw Hill
2. Chaurasia –A Text book of Anatomy
T.S. Ranganathan – A text book of Human Anatomy
3. Fattana, Human anatomy
(Description and applied)
Saunders & C P Prism Publishers, Bangalore – 1991
4. ESTER . M. Grishcimer,
Physiology & Anatomy with Practical
Considerations, J.P. Lippin Cott. Philadelphia

SYLLABUS FOR FIRST YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS **B.Sc Medical Laboratory Technology**

PHYSIOLOGY

Theory 70 hours
Practical 20hours

1. Introduction – composition and function of blood

Red blood cells – Erythropoiesis , stages of differentiation function , count physiological variation.
Haemoglobin – Structure, functions, concentration physiological variation
Methods of Estimation of Hb
White blood cells – Production, function, life span, count, differential count
Platelets – Origin, normal count, morphology functions.
Plasma Proteins – Production, concentration, types, albumin, globulin, Fibrinogen, prothrombin
functions, Haemostasis & Blood coagulation
Haemostasis – Definition, normal haemostasis, clotting factors, mechanism of clotting, disorders
of clotting factors.

Blood Bank

Blood groups – ABO system, Rh system, Blood grouping & typing, Cross matching,
Rh system – Rh factor, Rh in compatibility.
Blood transfusion – Indication, universal donor and recipient concept, selection criteria of a blood
donor, transfusion reactions
Anticoagulants – Classification, examples and uses

2. Anaemias :

Classification – morphological and etiological. effects of anemia on body
Blood indices – Colour index , MCH, MCV, MCHC,
Erythrocyte sedimentation Rate (ESR) and Packed cell volume
Normal values, Definition . determination,
Blood Volume -Normal value ,determination of blood volume and regulation of blood volume
Body fluid – pH, normal value, regulation and variation
Lymph – lymphoid tissue formation, circulation, composition and function of lymph

3. Cardiovascular system

Heart – Physiological Anatomy, Nerve supply, properties of Cardiac muscle,
Cardiac cycle - systole, diastole, Intraventricular pressure curves.
Cardiac Output – only definition, Heart sounds Normal heart sounds Areas of auscultation.
Blood Pressure – Definition, normal value, clinical measurement of blood pressure.
Physiological variations, regulation of heart rate, cardiac shock, hypotension, hypertension.
Pulse – Jugular, radial pulse, Triple response
Heart sounds – Normal heart sounds, cause characteristics and signification. Heart rate
Electrocardiogram (ECG) – Significance.

4. Digestive System - Physiological anatomy of Gastro intestinal tract, Functions of digestive system, Salivary glands, Structure and functions.

Deglutination – Stages and regulation
Stomach – structure and functions
Gastric secretion – Composition function regulation of gastric juice secretion
Pancreas – structure, function, composition, regulation of pancreatic juice
Liver – functions of liver, bile secretion, composition, function regulation of bile secretion .Bilirubin metabolism, types of bilirubin, Vanderberg reaction, Jaundice- types and significance.
Gall bladder – functions
Intestine – small intestine and large intestine
Small intestine –Functions- Digestive, absorption ,movements.
Large intestine – Functions, Digestion and absorption of Carbohydrates, Proteins, Fats, Lipids, Defecation

5. Respiratory System

Functions of Respiratory system, Physiological Anatomy of Respiratory system, respiratory tract, respiratory muscles, Respiratory organ-lungs, Alveoli, Respiratory membrane, stages of respiration. Mechanism of normal and rigorous respiration. Forces opposing and favouring expansion of the lungs. Intra pulmonary pleural pressure, surface tension, recoil tendency of the wall.

Transportation of Respiratory gases:

Transportation of Oxygen: Direction, pressure gradient, Forms of transportation, oxygenation of Hb. Quantity of Oxygen transported. Lung volumes and capacities, Regulation of respiration what? Why? How? Mechanisms of Regulation, nervous and chemical regulation. Respiratory centre, Hering Breuer Reflexes.
Applied Physiology and Respiration: Hypoxia, Cyanosis, Asphyxia, Dyspnea, Dysbarism, Artificial Respiration, Apnoea.

6. Endocrine System - Definition Classification of Endocrine glands & their Hormones Properties of Hormones.

Thyroid gland hormone – Physiological, Anatomy, Hormone secreted, Physiological function, regulation of secretion. Disorders – hypo and hyper secretion of hormone,
Adrenal gland: Adrenal cortex physiologic anatomy of adrenal gland, Adrenal cortex, cortical hormones – functions and regulation.
Adrenal medulla – Hormones, regulation and secretion. Functions of Adrenaline & noradrenaline
Pituitary hormones – Anterior and posterior pituitary hormones, secretion, function.
Pancreas – Hormones of pancreas
Insulin – secretion, regulation, function and action
Diabetes mellitus – Regulation of blood glucose level
Parathyroid gland – function, action ,regulation of secretion of parathyroid hormone.
Calcitonin – function and action

7. Special senses

Vision – structure of eye. Function of different parts.
Structure of retina
Hearing structure and function of ear mechanism of hearing
Taste – Taste buds functions. Smell physiology, Receptors.

8. Nervous System

Functions of Nervous system, Neurone structure, classification and properties.

Neuroglia, nerve fiber, classification, conduction of impulses continuous and salutatory. Velocity of impulse transmission and factors affecting. Synapse – structure, types, properties.

Receptors – Definition, classification, properties.

Reflex action – unconditioned properties of reflex action. Babinski's sign. Spinal cord nerve tracts, Ascending tracts, Descending tracts – Pyramidal tracts – Extrapyramidal tracts. Functions of Medulla, pons, Hypothalamic, disorders. Cerebral cortex lobes and functions, Sensory cortex, Motor cortex, Cerebellum functions of Cerebellum. Basal ganglion functions. EEG.

Cerebro Spinal Fluid (CSF) : formation, circulation, properties, composition and functions, lumbar puncture.

Autonomic Nervous System: Sympathetic and parasympathetic distribution and functions and comparison of functions.

9. Excretory System

Excretory organs

Kidneys: Functions of kidneys structural and functional unit nephron, vasarecta, cortical and juxtamedullary nephrons – Comparison, Juxta Glomerular Apparatus – Structure and function.

Renal circulation peculiarities.

Mechanism of Urine formation: Ultrafiltration criteria for filtration GFR, Plasma fraction, EFP, factors effecting EFR. Determination of GFR selective reabsorption – sites of reabsorption, substance reabsorbed, mechanisms of reabsorption Glucose, urea. H + Cl aminoacids etc. TMG, Tubular lead, Renal threshold % of reabsorption of different substances, selective e secretion. Properties and composition of normal urine, urine output. Abnormal constituents in urine, Mechanism of urine concentration.

Counter – Current Mechanisms : Micturition, Innervation of Bladder, Cystourethrogram.

Diuretics : Water, Diuretics, osmotic diuretics, Artificial kidney Renal function tests – plasma clearance Actions of ADH, Aldosterone and PTH on kidneys. Renal function tests

10. Reproductive system

Function of Reproductive system, Puberty, male reproductive system. Functions of testes, spermatogenesis site, stages, factors influencing semen. Endocrine functions of testes

Androgens – Testosterone structure and functions. Female reproductive system, Ovulation, menstrual cycle. Physiological changes during pregnancy, pregnancy test.

Lactation : Composition of milk factors controlling lactation.

11. Muscle nerve physiology

Classification of muscle, structure of skeletal muscle, Sarcomere contractile proteins, Neuromuscular junction. Transmission across, Neuromuscular junction. Excitation contraction, coupling. Mechanism of muscle contraction muscle tone, fatigue Rigour mortis

12. Skin -structure and function

Body temperature measurement, Physiological variation, Regulation of body Temperature by physical chemical and nervous mechanisms :Role of Hypothalamus, Hypothermia and fever.

Practicals

Haemoglobinometry

White Blood Cell count

Red Blood Cell count

Determination of Blood Groups

Leishman's staining and Differential WBC count

Determination of packed cell Volume

Erythrocyte sedimentation rate [ESR]

Calculation of Blood indices

Determination of Clotting Time, Bleeding Time
Blood pressure Recording
Auscultation for Heart Sounds
Artificial Respiration
Determination of vital capacity

Internal Assessment

Theory - Average of two exams conducted. 20

Practicals: Record & Lab work* 10

* There shall be no University Practical Examination and internal assessment marks secured in Practical need not be sent to the University.

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 Physiology shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	8(To attempt 6)	6X5	30
Short Answer (SA)	12 (To Attempt 10)	10X3	30
Total			80

NO PRACTICAL EXAMINATION

REFERENCE BOOKS

Physiology

1. Guyton (Arthur) Text Book of Physiology.
Latest Ed. Prism publishers

2. Chatterjee(CC) Human Physiology Latest Ed.
Vol-1, Medical Allied Agency

3. Choudhari (Sujith K) Concise Medical Physiology Latest Ed. New
Central Book,

4. Ganong (William F) Review of Medical
Physiology. Latest Ed . Appleton

SYLLABUS FOR FIRST YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

BIOCHEMISTRY

No. Theory classes: 70hours

No. of practical classes: 20 hours

Theory:

1. **Specimen collection:** Pre-analytical variables, Collection of blood, Collection of CSF & other fluids, Urine collection

Use of preservatives

Anticoagulants

1. Introduction to Laboratory apparatus

Pipettes- different types (Graduated, volumetric, Pasteur, Automatic etc) Calibration of glass
pipettes Burettes, Beakers, Petri dishes, depression plates.

Flasks - different types (Volumetric, round bottomed, Erlenmeyer conical etc.,)

Funnels – different types (Conical, Buchner etc.,)

Bottles – Reagent bottles – graduated and common, Wash bottles – different type

Specimen bottles etc.,

Measuring cylinders, Porcelain dish

Tubes – Test tubes, centrifuge tubes, test tube draining rack, Tripod stand, Wire gauze, Bunsen burner. Cuvettes, significance of cuvettes in colorimeter, cuvettes for visible and UV range, cuvette holders Racks – Bottle, Test tube, Pipette

Dispensers – reagent and sample

Any other apparatus which is important and may have been missed should also be covered

Maintenance of lab glass ware and apparatus:

Glass and plastic ware in Laboratory

*use of glass: significance of boro silicate glass ; care and cleaning of glass ware, different cleaning solutions of glass

* care and cleaning of plastic ware, different cleaning solutions

2. Instruments (Theory and demonstration) Diagrams to be drawn

Water bath: Use, care and maintenance, Oven & Incubators : Use, care and maintenance.

Water Distillation plant and water deionisers. Use, care and maintenance

Refrigerators, cold box, deep freezers – Use, care and maintenance

Reflux condenser : Use, care and maintenance

Centrifuges (Theory and demonstration) Diagrams to be drawn

Definition, Principle, svedberg unit, centrifugal force, centrifugal field rpm, ref. Conversion of G to rpm and vice versa.

Different types of centrifuges

Use care and maintenance of a centrifuge

Laboratory balances (Theory & Practicals) Diagrams to be drawn

Manual balances: Single pan, double pan, trip balance

Direct read out electrical balances.

Use care and maintenance. Guideline to be followed and precautions to be taken while weighing.

Weighing different types of chemicals, liquids. Hygroscopic compounds etc.

Colorimeter and spectrophotometer (Theory and Practicals) Diagrams to be drawn

Principle, Parts Diagram.

Use, care and maintenance.

pH meter (Theory & practicals) Diagrams to be drawn

principle, parts, Types of electrodes, salt bridge solution.

Use, care and maintenance of Ph meter and electrodes

Guidelines to be followed and precautions to be taken while using pH meter

3. Safety of measurements

4. Conventional and SI units

5. Atomic structure

Dalton's theory, Properties of electrons, protons, neutrons, and nucleus, Rutherford's model of atomic structure, Bohr's model of atomic structure, orbit and orbital, Quantum numbers, Heisenberg's uncertainty principle.

Electronic configuration – Aufbau principle, Pauli's exclusion principle, etc.

Valency and bonds – different types of strong and weak bonds in detail with examples

Theory & Practicals for all the following under this section

Molecular weight, equivalent weight of elements and compounds, normality molarity

Preparation of molar solutions (mole/litre solution) eg: 1 M NaCl, 0.15 M NaCl

1 M NaOH, 0.1 M HCl, 0.1 M H_2SO_4 etc.,

Preparation of normal solutions. eg., 1N Na_2CO_3 , 0.1N Oxalic acid, 0.1 N HCl, 0.1N

H_2SO_4 , 0.66 N H_2SO_4 etc.,

Percent solutions: Preparation of different solutions – v/v w/v (solids, liquids and acids)

Conversion of a percent solution into a molar solution

Dilutions

Diluting solutions: eg. Preparation of 0.1 N NaCl from 1 N NaCl from 2 N HCl etc.,
Preparing working standard from stock standard, Body fluid dilutions, Reagent dilution techniques, calculating the dilution of a solution, body fluid reagent etc.,

Saturated and supersaturated solutions.

Standard solutions. Technique for preparation of standard solutions eg: Glucose, urea, etc., Significance of volumetric flask in preparing standard solutions. Volumetric flasks of different sizes, Preparation of standard solutions of deliquescent compounds (CaCl_2 , potassium carbonate, sodium hydroxide etc.,)

Preparation of standards using conventional and SI units

Acids, bases, salts and indicators.

Acids and Bases: Definition, physical and chemical properties with examples. Arrhenius concept of acids and bases, Lowry – Bronsted theory of acids and bases classification of acids and bases. Difference between bases and alkali, acidity and basicity, monoprotic and polyprotic acids and bases

Concepts of acid base reaction, hydrogen ion concentration, ionisation of water, buffer, Ph value of a solution, preparation of buffer solutions using Ph meter.

Salts: Definition, classification, water of crystallization – definition and different types, deliquescent and hygroscopic salts

Acid- base indicators: (Theory and Practicals)

Theory – Definition, concept, mechanism of dissociation of an indicator, colour change of an indicator in acidic and basic conditions, use of standard buffer solution and indicators for Ph determinations, preparation and its application, list of commonly used indicators and their Ph range, suitable pH indicators used in different titrations, universal indicators

Practical – Titration of a simple acid and a base (Preparation of standard solution of oxalic acid and using this solution finding out the normality of a sodium hydroxide solution. Acid to be titrated using this base) Calculation of normality of an acid or a base after titration, measurement of hydrogen ion concentration

Quality control : Accuracy

Precision

Specificity

Sensitivity

Limits of error allowable in laboratory

Percentage error

Normal values and Interpretations

Special Investigations: Serum Electrophoresis

Immunoglobulins

Drugs: Digitoxin, Theophyllines

Regulation of Acid Base status:

Henderson Hasselback Equations

Buffers of the fluid

pH Regulation

Disturbance in acid Base Balance

Anion Gap

Metabolic acidosis

Metabolic acidosis

Metabolic alkalosis

Respiratory acidosis

Respiratory alkalosis

Basic Principles and estimation of Blood Gases and pH
 Basic principles and estimation of Electrolytes
 Water Balance
 Sodium regulation
 Bicarbonate buffers
 Nutrition, Nutritional support with special emphasis on parental nutrition.
 Calorific Value
 Nitrogen Balance
 Respiratory Quotient
 Basal metabolic rate
 Dietary Fibers
 Nutritional importance of lipids, carbohydrates and proteins
 Vitamins

PRACTICALS

1. Analysis of Normal Urine
 - Composition of urine
 - Procedure for routine screening
 - Urinary screening for inborn errors of metabolism
 - Common renal disease
 - Urinary calculus
 - Urine examination for detection of abnormal constituents
2. Interpretation and Diagnosis through charts
 - Liver Function tests
 - Lipid Profile
 - Renal Function test
3. Cardiac markers
 - Blood gas and Electrolytes
4. Estimation of Blood sugar, Blood Urea and electrolytes
5. Demonstration of Strips
 - Demonstration of Glucometer

Internal Assessment

Theory - Average of two exams conducted, 20

Practicals: Record & Lab work* 10

* There shall be no University Practical Examination and internal assessment marks secured in Practicals need not be sent to the University.

Scheme of Examination

Theory

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

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	8(To attempt 6)	6X5	30
Short Answer (SA)	12 (To Attempt 10)	10X3	30
Total			80

NO PRACTICAL EXAMINATION

REFERENCE BOOKS

Biochemistry

1. Varley – Clinical chemistry
2. TEITZ – Clinical chemistry
3. Kaplan – Clinical chemistry
4. Ramakrishna(S) Prasanna(KG), Rajna ® Text book of Medical Biochemistry Latest Ed Orient longman Bombay –1980
5. Vasudevan (DM) Sreekumari(S) Text book of Biochemistry for Medical students, Latest Ed
6. DAS(Debajyothi) Biochemistry Latest ED Academic, Publishers, Calcutta – 1992

SYLLABUS FOR FIRST YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B. Sc Medical Laboratory Technology

PATHOLOGY – 1st Year

Histopathology, Clinical Pathology, Haematology and Blood Banking
Theory – 70 hours
Practical – 20 hours

1. Histopathology – Theory

- Introduction to Histopathology
- Receiving of Specimen in the laboratory
- Grossing Techniques
- Mounting Techniques – various Mountants
- Maintenance of records and filing of the slides.
- Use & care of Microscope
- Various Fixatives, Mode of action, Preparation and Indication.
- Bio-Medical waste management
- Section Cutting
- Tissue processing for routine paraffin sections
- Decalcification of Tissues.
- Staining of tissues - H& E Staining
- Bio-Medical waste management

2. Clinical Pathology –

Theory

- Introduction to Clinical Pathology
- Collection, Transport, Preservation, and Processing of various clinical specimens
- Urine Examination – Collection and Preservation of urine. Physical, chemical, Microscopic Examination
- Examination of body fluids.
- Examination of cerebro spinal fluid (CSF)
- Examination of semen

3. Haematology –

Theory

- Introduction to Haematology
- Normal constituents of Blood, their structure and function.
- Collection of Blood samples
- Various Anticoagulants used in Haematology
- Various instruments and glassware used in Haematology, Preparation and use of glassware
- Laboratory safety guidelines
- SI units and conventional units in Hospital Laboratory
- Hb, PCV

- ESR
- Normal Haemostasis Bleeding Time, Clotting Time, Prothrombin Time, Activated Partial Thromboplastin Time.

4. Blood Bank

Introduction

Blood grouping and Rh Types

Cross matching

PRACTICALS

- Urine Examination.
- Physical
- Chemical
- Microscopic
- Blood Grouping Rh typing.
- Hb Estimation, Packed Cell Volume[PCV], Erythrocyte Sedimentation rate[ESR]
- Bleeding Time, Clotting Time.
- Histopathology – Section cutting and H & E Staining.[For BSc MLT only]

Internal Assessment

Theory - Average of two exams conducted. 20

Practical: Record & Lab work* 10

* There shall be no University Practical Examination and internal assessment marks secured in Practical need not be sent to the University.

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 shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	8(To attempt 6)	6X5	30
Short Answer (SA)	12 (To Attempt 10)	10X3	30
Total			80

NO PRACTICAL EXAMINATION

REFERENCE BOOKS

Pathology –

1. Culling Histopathology techniques
2. Bancroft Histopathology techniques
3. Koss – cytology
4. Winifred greg – Diagnostic cytopathology
5. Orell – Cyto Pathology
6. Todd & Sanford Clinical Diagnosis by laboratory method
7. Dacie & Lewis – Practical Haematology
8. Ramanic Sood, Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi –1996)
9. Satish Gupta Short text book of Medical Laboratory for technician J.P. Bros, New Delhi – 1998
10. Sachdev K.N. Clinical Pathology and Bacteriology 8th Ed, J.P. Bros, New Delhi-1991.
11. Krishna - Text book of Pathology, Orient Longman PVT Ltd.

SYLLABUS FOR FIRST YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B. Sc Medical Laboratory Technology

Microbiology – 1st Year

Objective: - This course introduces the principles of Microbiology with emphasis on applied aspects of Microbiology of infectious diseases particularly in the following areas Principles & practice of sterilization methods.

Collection and despatch of specimens for routine microbiological investigations. Interpretation of commonly done bacteriological and serological investigations.

Control of Hospital infections

Biomedical waste management

Immunization schedule

Theory - 70 hours

1. Morphology of bacteria (4 hours)

Classification of microorganisms, size, shape and structure of bacteria. Use of microscope in the study of bacteria.

2. Growth and nutrition of bacteria (4 hours) Nutrition, growth and multiplications of bacteria, use of culture media in diagnostic bacteriology.

3. Sterilisation and Disinfection (4 hours) Principles and use of equipments of sterilization namely Hot Air oven, Autoclave and serum inspissator. Pasteurization, Anti septic and disinfectants. Antimicrobial sensitivity test

4. Immunology (6 hours) Immunity Vaccines, Types of Vaccine and immunization schedule Principles and interpretation of commonly done serological tests namely Widal, VDRL, ASLO, CRP, RF & ELISA. Rapid tests for HIV and HbsAg(Technical details to be avoided)

5. Systematic Bacteriology (20 hours) Morphology, cultivation, diseases caused, laboratory diagnosis including specimen collection of the following bacteria(the classification, antigenic structure and pathogenicity are not to be taught) Staphylococci, Streptococci, Pneumococci, Gonococci, Meningococci, diphtheriae, Mycobacteria, Clostridia, Bacillus, Shigella, Salmonella, Esch coli, Klebsiella, Proteus, vibrio cholerae, Pseudomonas & Spirochetes

6. Parasitology (10 hours) Morphology, life cycle, laboratory diagnosis of following parasites E. histolytica, Plasmodium, Tape worms, Intestinal nematodes

7. Mycology (4 hours) Morphology, diseases caused and lab diagnosis of following fungi. Candida, Cryptococcus, Dermatophytes, opportunistic fungi.

8. Virology (10 hours) General properties of viruses, diseases caused, lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Rabies and Poliomyelitis.

9. Hospital infection (4 hours) Causative agents, transmission methods, investigation, prevention and control Hospital infection.

10. Principles and practice Biomedical waste management (4 hours) Practical (20 hours) Compound Microscope. Demonstration and sterilization of equipments – Hot Air oven, Autoclave, Bacterial filters. Demonstration of commonly used culture media, Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, Mac conkey medium, LJ media, Robertson Cooked meat media, Potassium tellurite media with growth, Mac with LF & NLF, NA with staph Antibiotic susceptibility test. Demonstration of common serological tests – Widal, VRDL, ELISA. Grams stain, Acid Fast staining, Stool exam for Helminthic ova Visit to hospital for demonstration of Biomedical waste management. Anaerobic culture methods.

Internal Assessment

Theory - Average of two exams conducted. 20

Practicals: Record & Lab work* 10

* There shall be no University Practical Examination and internal assessment marks secured in Practicals need not be sent to the University.

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 shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	8 (To attempt 6)	6X5	30
Short Answer (SA)	12 (To Attempt 10)	10X3	30
Total			80

NO PRACTICAL EXAMINATION**REFERENCE BOOKS**

Microbiology

1. Anathanarayana & Panikar Medical Microbiology
2. Roberty Cruickshank – Medical Microbiology – The Practice of Medical Microbiology
3. Chatterjee – Parasitology – Interpretation to Clinical medicine.
4. Rippon – Medical Mycology
5. Emmons – Medical mycology
6. Basic laboratory methods in Parasitology, 1st Ed, J P Bros, New Delhi – 199
7. Basic laboratory procedures in clinical bacteriology, 1st Ed, J P Brothers, New Delhi
8. Medical Parasitology – Ajit Damle

SYLLABUS FOR FIRST YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS**B.Sc Medical Laboratory Technology****SUBSIDIARY SUBJECTS****ENGLISH****COURSE OUTLINE**

COURSE DESCRIPTION: This course is designed to help the student acquire a good command and comprehension of the English language through individual papers and conferences.

BEHAVIOURAL OBJECTIVES :

The student at the end of training is able to

1. Read and comprehend english language
2. Speak and write grammatically correct english
3. Appreciates the value of English literature in personal and professional life.

UNIT - I :**INTRODUCTION :**

Study Techniques

Organisation of effective note taking and logical processes of analysis and synthesis Use of the dictionary, Enlargement of vocabulary, Effective diction

UNIT - II :**APPLIED GRAMMAR :**

Correct usage
The structure of sentences
The structure of paragraphs
Enlargements of Vocabulary

UNIT - III :**WRITTEN COMPOSITION :**

Precise writing and summarising
Writing of bibliography
Enlargement of Vocabulary

UNIT - IV:**READING AND COMPREHENSION :**

Review of selected materials and express oneself in one's words.
Enlargement of Vocabulary.

UNIT - V:**THE STUDY OF THE VARIOUS FORMS OF COMPOSITION :**

Paragraph, Essay, Letter, Summary, Practice in writing

UNIT - VI:**VERBAL COMMUNICATION :**

Discussions and summarization, Debates, Oral reports, use in teaching

Scheme of Examination

Written (Theory): Maximum Marks: -80 marks.

No Practical or Viva voce examination

This is a subsidiary subject, examination to be conducted by respective colleges. Marks required for a pass is 35%

REFERENCE

1. English Grammar Collins, Birmingham University, International Language Data Base, Rupa & Co. 1993
2. Wren and Martin - Grammar and Composition, 1989, Chanda & Co, Delhi
3. Letters for all Occasions. A S Myers. Pub - Harper Perennial
4. Spoken English V. Shasikumar and P V Dhanija. Pub. By: Tata Mcgraw Hill, New Delhi
5. Journalism Made Simple D Wainwright
6. Writers Basic Bookself Series, Writers Digest series
7. Interviewing by Joan Clayton Platkon
8. Penguin Book of Interviews.

BIO STATISTICS

Time Allotted: 20 Hours

Course Description:

Introduction to basic statistical concepts: methods of statistical analysis; and interpretation of data

Behavioural Objectives: Understands statistical terms. Possesses knowledge and skill in the use of basic statistical and research methodology.

Unit – I:

Introduction

Meaning, definition, characteristics of statistics, Importance of the study of statistics.
Branches of statistics, Statistics and health science including nursing, Parameters and estimates.
Descriptive and inferential statistics, Variables and their types, Measurement scales

Unit – II:

Tabulation of Data

Raw data, the array, frequency distribution, Basic principles of graphical representation.
Types of diagrams - histograms, frequency polygons, smooth frequency polygon, commulative frequency curve, ogive, Normal probability curve.

Unit - III:

Measure of Central Tendency

Need for measures of central tendency, Definition and calculation of mean - ungrouped and grouped, Meaning, interpretation and calculation of median ungrouped and grouped, Meaning and calculation of mode, Comparison of the mean, and mode.
Guidelines for the use of various measures of central tendency.

Unit - IV:

Measure of Variability

Need for measure of dispersion, The range, the average deviation, The variance and standard deviation, Calculation of variance and standard deviation ungrouped and grouped, Properties and uses of variance and SD

Unit -V:

Probability and Standard Distributions.

Meaning of probability of standard distribution, the Binominal distribution, the normal distribution, Divergence from normality - skewness, kurtosis.

Unit - VI:

Sampling Techniques

Need for sampling - Criteria for good samples, application of sampling in Community, procedures of sampling and sampling designs errors, sampling variation and tests of significance.

Unit - VII:

Health Indicator

Importance of health Indicator, indicators of population, morbidity, mortality, health services.
Calculation of rates and ratios of health.

Scheme of Examination

Written (Theory): Maximum Marks: –80 marks.

No Practical or Viva voce examination

This is a subsidiary subject, examination to be conducted by respective colleges. Marks required for a pass is 35%

Recommended Books:

B.K. Mahajan & M. Gupta (1995) Text Book of Preventive & Social Medicine, 2002,
17th Edition Jaypee Brothers.

HEALTH CARE

Teaching Hours: 40

Introduction to Health

Definition of Health, Determinants of Health, Health Indicators of India, Health Team Concept. National Health Policy, National Health Programmes (Briefly Objectives and scope) Population of India and Family welfare programme in India

Introduction to Nursing

What is Nursing ? Nursing principles. Inter-Personnel relationships. Bandaging : Basic turns; Bandaging extremities; Triangular Bandages and their application. Nursing Position, Bed making, prone, lateral, dorsal, dorsal re-cumbent, Fowler's positions, comfort measures, Aids and rest and sleep. Lifting And Transporting Patients: Lifting patients up in the bed. Transferring from bed to wheel chair. Transferring from bed to stretcher.

Bed Side Management: Giving and taking Bed pan, Urinal : Observation of stools, urine, observation of sputum, Understand use and care of catheters, enema giving.

Methods Of Giving Nourishment: Feeding, Tube feeding, drips, transfusion, care of rubber goods Recording of body temperature, respiration and pulse, simple aseptic technique, sterilization & disinfection.

Surgical Dressing: Observation of dressing procedures

First Aid: Syllabus as for Certificate Course of Red Cross Society of St. John's Ambulance Brigade.

Scheme of Examination

Written (Theory): Maximum Marks: -80 marks.

No Practical or Viva voce examination

This is a subsidiary subject, examination to be conducted by respective colleges. Marks required for a pass is 35%

ENVIRONMENT SCIENCE AND HEALTH

Introduction to Environment and Health

Sources, health hazards and control of environmental pollution

Water: the concept of safe and wholesome water, the requirements of sanitary sources of water. Understanding the methods of purification of water on small scale and large scale, various biological standards, including WHO guidelines for third world countries, concept and methods for assessing quality of water.

Domestic refuse, sullage, human excreta and sewage their effects on environment and health, methods and issues related to their disposal.

Awareness of standards of housing and the effect of poor housing on health.

Role of arthropods in the causation of diseases, mode of transmission of arthropods borne diseases, methods of control

Scheme of Examination

Written (Theory): Maximum Marks: -80 marks.

No Practical or Viva voce examination

This is a subsidiary subject, examination to be conducted by respective colleges. Marks required for a pass is 35%

Recommended Books.

1. Text Book of Environmental Studies for under graduate courses By Erach Bharucha Reprinted in 2006, Orient Longman Private Limited /Universities Press India Pvt. Ltd.

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

SYLLABUS FOR SECOND YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

BIOCHEMISTRY – 2nd Year

THEORY

1. Blood chemistry (Its constituents)
2. Urine chemistry (Its constituents)
3. Biomolecules:
 - a. Carbohydrate: Metabolism & disorder of carbohydrate
 - b. Lipids: Metabolism & disorders lipids.
4. Vitamins: sources, functions, deficiency, requirements,
5. Enzymes – Introduction, Activation energy, classification, activity, specificity, kinetics v max, Km, Michaelis Menten equation
6. Biophysics-surface tension, osmolarity and viscosity.
7. Photometry, spectrometry, turbidometry, flame photometry and atomic, absorption, spectroscopy.
8. MPNB - Urea, Uric Acid, Creatinine of these importance
9. Nutrition
10. Special investigations, demonstration - Serum electrophoresis, immunoglobulins, drug estimation

PRACTICALS

1. Qualitative analysis of carbohydrates, proteins, amino acids.
2. Estimation blood sugar and Blood Urea
3. Quantitative test for urine glucose and GTT.

4. Qualitative screening test for normal and abnormal urine sample.
5. Estimation of non-protein nitrogenous compounds of blood: Blood urea, Creatinine, Creatinine clearance test (CCT)
6. Protein precipitation, dialysis and separation of proteins, electrophoresis of serum, CSF and urine proteins.

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	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	10 (To attempt 8)	8X5	40
Short Answer (SA)	12 (To Attempt 10)	10X2	20
Total			80

Scheme of Practical Examination shall be decided by the department head

SYLLABUS FOR SECOND YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

MICROBIOLOGY – 2nd Year

Topics: Parasitology, Mycology and Virology

1. Introduction of Mycology. Terms & Classification.

2. Lab Diagnosis of Fungal Infections 2 Hrs.

3. Mycology 14 Hrs.

a. Superficial Mycoses, *Malesezia furfur*, *T. nigra*, *T. pidera*

b. Subcutaneous Mycoses

i. Mycetoma

ii. Rhinosporidium

iii. Sporotrichosis

c. Dermatophytes

d. Systemic Mycoses

i. Histoplasmosis

ii. Blastomycosis

iii. Coccidioidosis

iv. Paracoccidioidosis

e. Opportunistic Fungi

1. Aspergillosis

2. Penicilliosis

3. Zygomycosis

4. Pneumocystis

5. Mycotoxins

4. Parasitology

1. Protozoology- *Entamoeba histolytica*, *Balantidium coli*, *Giardia*, *Toxoplasma*, Malaria, *Leishmania*

2. Helminthology

Cestodes - *Taenia*, *Echinococcus*, *D. latum*, *H. nana*,

Trematodes - *Schistosoma*, *Fasciola*

Nematodes – Ascaris, hookworm, Strongyloides, Trichuris, Trichinella, Dracunculus, Filarial worms

5. Virology- General properties of virus, cultivation of viruses, Pox viruses, Herpes viruses, Adenoviruses, Picornaviruses, Orthomyxovirus, Paramyxoviruses, Arboviruses, Rhabdoviruses, Hepatitis viruses, Oncogenic viruses, HIV, Parvovirus, Viral haemorrhagic fevers, SARS, Rotavirus, Norwalk virus, Astrovirus, Corona virus

PRACTICALS for II year:

Parasitology:

1. Stool examination
 - a. Saline mount
 - b. Iodine mount

Mycology:

1. Slide culture technique
2. KOH mount
3. Identification of fungal cultures
 - a. Colony characteristics and Microscopic examination of Candida, Cryptococcus, Trichophyton, Microsporum, Aspergillus niger, Asp fumigatus, Rhizopus, Fusarium, Penicillium.

Virology

1. Demonstration of embryonated egg inoculation
2. Virology exercise:
 - a. Spots test, ELISA (HBV, HCV, HIV), HI, Paul Bunnell test
 - b. Applied exercise – Rabies, Infantile Diarrhoea, Herpes, HBV, HIV, Influenza.

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	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	10(To attempt 8)	8X5	40
Short Answer (SA)	12 (To Attempt 10)	10X2	20
Total			80

Scheme of Practical Examination shall be decided by the department head

SYLLABUS FOR SECOND YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

PATHOLOGY – 2nd Year

Theory:-

Histopathology and Hematology

Histopathology

Instrumentation : (a) Automated Tissue Processor (b) Microtomes, Knives, Knife sharpeners and Ultramicrotome (c) Freezing microtome and Cryostat (d) Automatic slide stainer

Techniques : (a) Routine paraffin section cutting (b) Frozen section and Cryostat section studies

Staining techniques: Special stains for Carbohydrates, Connective tissue, Nervous tissue, Bone tissue, Collagen fibers, Elastic Fibers, Lipids, Organisms, fungi, parasites, pigments and deposits in tissues

Mounting techniques: Various mounts and mounting techniques

Electron Microscope, Scanning electron microscope, Dark ground and Fluorescent microscope
Museum technology

Microphotography and its applications

Maintenance of records and filing of slides

ICDS Classification and coding

Application of computers in Pathology

Hematology

Hemopoiesis, Stem cells, formed elements and their functions

Anticoagulants used in various hematological studies

Routine hematological tests and normal values: (a) Determination of Hemoglobin and Hematocrit

(b) Enumeration of RBC, WBC & Platelets (c) Absolute Eosinophil count (d) Reticulocyte count

(e) Calculation of Red cell Indices (f) Preparation of staining of blood film for morphology of red cells and differential count

Special Hematological tests:

(a) Sickling tests

(b) Osmotic fragility test

(c) Determination HbF and HbA₂

(d) Hemoglobin Electrophoresis

(e) Investigation of G6PD deficiency

(f) Plasma haptoglobin and demonstration of hemosiderin in urine

(g) Tests for Autoimmune hemolytic anemia

(h) Measurement of abnormal Hb pigments

Hemostasis and Coagulation

(a) Normal hemostasis, mechanism of blood coagulation and normal fibrinolytic system

(b) Collection of blood and anticoagulants used in coagulation studies

(c) Investigation of hemostatic mechanism-BT, CT, whole blood coagulation time test, PT, PTT

(d) Assay of clotting factors

(e) Tests for fibrinolytic activity- Euglobulin, clot lysis test and FDP

(f) Platelet function tests

Investigation of Megaloblastic anemia and Iron deficiency anemia

(a) B₁₂ and Folate assay and Schilling test

(b) Estimation of serum iron and iron binding capacity

Bone marrow biopsy study

(a) Needle aspiration and surgical biopsy technique

(b) Preparation of smears and staining

Demonstration of LE cells

Cytochemistry

Administration in Hematology and Quality control

Practicals:

1. Paraffin section cutting
2. Staining by Hematoxylin & Eosin and other special stains
3. Determination of Hemoglobin and Hematocrit
4. Red blood cell count
5. Total white blood cell count
6. Platelet count
7. Differential count of white blood cells
8. Absolute Eosinophil count
9. Reticulocyte count
10. Calculation of red cell indices
11. Determination of ESR
12. Determination of BT, CT, Whole blood clotting time
13. Determination of PT and PTT
14. Blood smear preparation and staining
15. Osmotic fragility test
16. Sickling test
17. LE cell preparation
18. Test for G-6PD

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	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	10 (To attempt 8)	8X5	40
Short Answer (SA)	12 (To Attempt 10)	10X2	20
Total			80

Scheme of Practical Examination shall be decided by the department head

SYLLABUS FOR THIRD YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

BIOCHEMISTRY 3rd year

THEORY

1. Liver Function tests. Role of the Liver in metabolism, formation of bilirubin and mode of excretion.
2. Gastric Analysis: Composition of gastric juice, concepts of free and bound acids, gastric acid secretions stimulations.
3. Renal function, Renal function test and renal clearance test.
4. Calculi: Theory of formation and analysis, Renal clearance concentration and application of Phenolsulfonaphthalein.

5. Acid – Base balance and its disturbances.
6. Inorganic ions: Calcium metabolism, phosphate metabolism, sodium-potassium balance and trace element (Fe, CU).
7. Metabolism of proteins and amino acids.
8. Over view & replication, translation, transcription and genetic engineering.
9. Metabolic disorders:
 - a. Amino acids
 - b. Proteins
 - c. Inborn errors of metabolic disorders.
11. Clinical enzymology.
12. Radio isotope techniques: Principle, definition of units, measurement of radiation standards, crystal counting. Resources and applications.
13. Immunoassay: Different methods, principle and applications.
14. Biostatistics: Population mean, Correlation Coefficient, Standard deviation, Standard error.

PRACTICALS:

1. Specimen Collections: Urine, Blood, Gastric juice,
 2. Accuracy, precision and quality control – Demonstration and preparation of two methods using histogram, F-test and Barr test.
 3. Enzymes: amylase (salivary and Pancreatic), Alkaline Phosphatase, Acid Phosphatase, SGOT, SGPT, LDH and CPK- demonstration on auto analyzer.
 4. Liver function tests: estimation of Bilirubin – total and conjugates, Urobilinogen,
 5. Gastric analysis: Determination of free and total acid, gastric stimulation.
 6. Lipid determination of serum lipids – cholesterol, triglycerides and lipoprotein fractionation.
 7. Inorganic ions – Determination of calcium in serum and urine, serum phosphates, sodium and potassium chloride.
 8. Analysis of calciculi
 9. Urine – screening for inborn errors of metabolism
 10. RFT
 11. Cardiac markers
- (Relevant charts on the above topics for interpretation and diagnosis)

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 3rd year shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	10(To attempt 8)	8X5	40
Short Answer (SA)	12 (To Attempt 10)	10X2	20
Total			80

Scheme of Practical Examination shall be decided by the department head

SYLLABUS FOR THIRD YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

MICROBIOLOGY 3rd Year

SYSTEMIC BACTERIOLOGY, IMMUNOLOGY, APPLIED BACTERIOLOGY

IMMUNOLOGY

1. Infection 2hrs
2. Immunity 4 Hrs.
 - A. Innate immunity
 - B. Acquired immunity (adaptive immunity)
 - C. Active and passive immunity-1. Natural acquired active immunity 2. Artificial acquired active immunity 3. Natural acquired passive immunity - Breast feeding 4. Artificial acquired passive immunity
3. Cell mediated Immune System
 - A.
 1. Cell development
 2. B lymphocytes(general knowledge of their role)
 - a. Bursa of Fabricius
 - b. Stem cell differentiation
 - c. Gut-associated lymphoid tissue (GALT)
 3. T lymphocytes
 - a. Stem cell differentiation (general knowledge of their role)
 - b. Cytotoxic T (TC) cells
 - c. Delayed-type hypersensitivity T (TD) cells
 - d. Helper T (TH) cells
 - e. Suppressor T (TS) cells
 4. Natural killer cells
 - B. Dual nature of the immune system
 - i. Humoral immunity
 - ii. Cell-mediated immunity
 - C. General properties of immune responses
 1. Recognition of self versus nonself
 - a. Clonal selection theory B-cells
 - b. Tolerance
 - c. Clonal deletion
 2. Specificity
 - a. Definition
 - b. Cross-reactions
 3. Heterogeneity
 4. Memory
 - a. Memory cells
 - b. Anamnestic response
4. Humoral Immunity-General characteristics
 1. Antigen types
 2. Antigen sensitization
 3. Plasma cells
5. Antigen & Antibody(04 Hrs.)
 1. Antigens
 2. Epitopes (antigenic determinants)
 3. Hapten
 4. Antibodies consequences of antibody binding
 5. Titer
6. Immune Response
 - A. Properties of Antibodies (immunoglobulins)
 1. Light chains
 2. Heavy chains
 3. Constant and variable regions

4. Antigen binding sites
5. Fab and Fc regions
- B. Classes of immunoglobulins
 1. IgG
 2. IgM
 3. IgA - a. J chain, b. Secretory piece
 4. IgE
 5. IgD
 6. Antibody titer
- C. Primary and secondary responses
 1. Primary response
 2. Secondary response
- D. Kinds of antigen-antibody responses
- E. How humoral responses eliminate foreign antigens
 1. Basic mechanisms
 - a. Agglutination
 - b. Opsonization
 - c. Activation of complement* Do not worry about the detailed mechanism of complement. Know that it makes a membrane attack complex and what that is.
 - d. Neutralization
 2. Summary of humoral immunity

7. Monoclonal Antibodies

- A. Production
 1. Hybridoma formation
 2. Cloning of cells
- B. Uses
 1. Research tools
 2. Diagnostic uses
 3. Therapy

8. Cell-Mediated Immunity

- A. General characteristics
- B. The cell-mediated immune reactions
 1. Antigen processing
 2. Helper T (TH) cells
 - a. TH1 (inflammatory T) cells
 - b. TH2 cells
 3. Suppressor T (TS) cells
 4. Cytotoxic (killer) T (TC) cells
 5. Natural killer (NK) cells
 6. Memory T cells
 7. Lymphokine release
- C. Superantigens

9. Factors That Modify Immune Responses

- A. Compromised host
- B. Modifying factors
 1. Age
 2. Stress
 3. Diet
 4. Exercise
 5. Injuries
 6. Environmental factors
 10. Hypersensitivity reactions
 11. Autoimmune disorders
 12. Transplantation immunology
 13. Antimicrobial Sensitivity, Disk diffusion and Dilution 3 Hrs.
 14. Bacteriology of Water, Milk and Air 5 Hrs.

15. Systematic Bacteriology(75 Hrs.)

Classification, Morphology, Genotypic & Phenotypic characteristics,
Pathogenesis, Disease caused.

Lab Diagnosis & Prophylaxis

A. Gram Positive Bacteria

- i. Staphylococcus
- ii. Streptococcus
- iii. Pneumococcus
- iv. Corynebacteria
- v. Clostridia
- vi. Bacillus
- vii. Listeria
- viii Actinomyces
- ix. Nocardia

B. Gram Negative Bacteria

- i. Neisseria
- ii. Enterobacteriaceae
- iii. Escherichia
- iv. Klebsiella
- v. Enterobacter
- vi. Proteus
- vii. Salmonella
- viii. Shigella
- ix. Yersinia
- x. Pseudomonas
- xi. Haemophilus
- xii. Brucella
- xiii. Pasturella
- xiv. Legionella
- xv. Bordetella
- xvi. Burkholderia
- xvii. Gardnerella
- xviii. Vibrio
- xix. Campylobacter
- xx. Helicobacter
- xxi. Bacteroides
- xxii. Fusobacterium

C. Spirocheates

- i. Treponema
- ii. Borrelia
- iii. Leptospira

D. Mycobacteria

- i. M.tuberculosis
- ii. M.leprae
- iii. Atypical Mycobacteria

E. Mycoplasma

F. Chlamydiae

G. Rickettsiaceae

H. Applied microbiology- Diseases.

I. Molecular techniques in diagnostic microbiology- PCR, DNA hybridisation

Desirable to know: (There will be no main questions or short notes from this portion. One paper may have only one question under short answers i.e. 3 marks)

a. Erysipelothrix

1. Propionibacteria
2. Rhodococcus
3. Tropheryma
4. Moraxella
5. Serratia
6. Stenotrophomonas
7. Acinetobacter
8. Streptobacillus
9. Parvobacteria

**PRACTICALS FOR 3rd YEAR
BACTERIOLOGY**

1. Staining.
 - a. Grams staining
 - b. ZN staining
 - c. Alberts staining
2. Hanging drop preparation
3. Culture methods
4. Introduction to biochemical reactions
5. Identification of bacterial culture
 - a. Colony characteristics
 - b. Morphological characteristics
 - c. Motility study
 - d. Interpretation of biochemical reactions
6. Antibiotic sensitivity testing- Kirby Bauer method
7. Applied bacteriology- exercise
8. Immunology: Serological tests:
 - a. Specimen collection
 - b. Principle
 - c. Methods.
 - d. Procedure
 - e. Normal values/ Significant titer
 - f. Interpretations
 - g. Limitations : of all the following tests
 - i. Widal
 - ii. ASO
 - iii. CRP
 - iv. RPR/VDRL/TRUST
 - v. RA
 - vi. HBsAg /anti HIV detection
 - vii. ELISA

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 3rd shall be as given under.

Type of Question	No. of Questions	Marks	Sub-total
Long Essay (LE)	2	2X10	20
Short Essay (SE)	10(To attempt 8)	8X5	40
Short Answer (SA)	12 (To Attempt 10)	10X2	20
Total			80

Scheme of Practical Examination shall be decided by the department head

SYLLABUS FOR THIRD YEAR MEDICAL LABORATORY TECHNOLOGY COURSES - RUHS

B.Sc Medical Laboratory Technology

PATHOLOGY 3rd Year

**Cytology, Automation in cytology, Cytogenetics, Cytochemistry
Immunohematology and Blood transfusion**

Cytology

1. Normal cell structure, functions, cytologic criteria of malignancy
2. Types of specimens, methods of collection & preparation of cell block
3. Different fixatives and methods of fixation
4. Staining : (a) Papanicolaou's stain- principle , preparation and staining techniques
(b) May Grunwald Giemsa stain
(c) Shorr's stain
(d) Aceto orcin stain

Female Genital tract

1. Anatomy, Histology, Physiology & normal cytology
2. Techniques of collection of specimen for cervical cytology study
3. Hormonal cytology and cytological indices
4. Cervical cytology screening for malignant and non-malignant conditions , Radiation changes & follow up
5. Cytology of Endometrium – normal , nonmalignant and in malignant conditions
6. Cytology in Ovarian cancers ,Respiratory tract, Gastrointestinal tract and Urinary tract
 1. Anatomy, Histology and Physiology
 2. Collection of sample, preparation of smears and staining
 3. Cytology of normal, nonmalignant & malignant conditions

C S F and Effusions

1. Cytology of CSF in inflammatory, nonmalignant & malignant conditions
2. Cytology of effusions in nonmalignant and malignant conditions

Glands – Breast, Thyroid, Salivary glands and Lymph nodes

1. Anatomy , Histology and Physiology
2. Fine needle aspiration cytology of glands and other soft tissue mass
3. Cytologic features in nonmalignant and malignant conditions of different glands and nipple discharges

Automation in Cytology

1. Flow cytometry
2. Image Analysis
3. Principles, Equipments, procedures & Evaluation

Tissue culture and Immunohistochemistry

1. Equipments for Tissue culture studies
 - (a) Laminar air flow equipment
 - (b) Carbon dioxide incubator
 - (c) Inverted microscope
2. Derivation of culture from tissue
 - (a) Enzymatic digestion of tissue using collagenase, protease
 - (b) Plating in tissue culture media
 - (c) Observation of cells in Invertoscope
 - (d) Subculturing & derivation of cell lines

3. Characterization of cell lines
 - (a) Determination of biochemical markers in cells
 - (b) Chromosomal & DNA content of cells
 - (c) Immunological properties of cells
4. Preservation of Immortalized cell lines
 - (a) Storage in Glycerol in Liquid Nitrogen
 - (b) Storage in Dimethyl sulfoxide in Liquid Nitrogen

Cytogenetics

1. Introduction to cytogenetics, terminology, classification and nomenclature of human chromosomes
2. Methods of karyotypic analysis
 - (a) Culture of bone marrow cells, peripheral blood lymphocytes, solid tumors & skin fibroblasts
 - (b) Direct preparation from tumor materials
3. Characterization of human chromosomes by various banding techniques
4. Sex chromatin identification
5. Chromosomes in neoplasia and oncogenes

Immunocytochemistry

1. Basics concepts, monoclonal antibodies & preparation
2. Fluorescence reactions

Immunohematology and Blood transfusion

1. ABO Blood group and Rh system
2. Subgroups of A and B, Other blood groups and Bombay group
3. HLA antigens and their significance
4. Principles of Blood transfusion:
 - (a) Blood donor selection
 - (b) Methods of bleeding donors
 - (c) Blood containers, anticoagulants and storage of blood
 - (d) Coomb's test and its significance
 - (e) Screening of blood for transfusion transmitted diseases
 - (f) Blood components, preparation & component therapy
 - (g) Autologous transfusion
 - (h) Transfusion reactions and work up
 - (i) Blood bank organization, standards, procedures, techniques, quality control & record keeping

Practicals

1. Preparation of various cytology smears and fixation
2. Papanicolaou's and May Grunwald Geimsa staining
3. Hormonal cytology study
4. Blood grouping and Rh typing
5. Cross matching techniques
6. Screening of Donor's blood for infective agents
7. Transfusion reaction work up
8. Preparation of blood components

Scheme of Examination Theory

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Scheme of Practical Examination shall be decided by the department head