

BSc. Perfusion Technology

CURRICULUM FOR BSc. Perfusion Technology

1. Eligibility for admission:

A candidate seeking admission to the Bachelor of Science Degree Course in **Perfusion Technology** should have passed:

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

OR

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

OR

3. Any equivalent examination recognized by the KUHS, Kerala for the above purpose with Physics, Chemistry and Biology as principal subjects of study.

OR

4. The vocational higher secondary education course conducted by Vocational Higher Secondary Education, Government of Kerala with five subjects including Physics, Chemistry, Biology and English in addition to vocational subjects conducted is considered equivalent to plus TWO examinations of Government of Kerala Pre University Course.

Age limit

3. Duration of the course:

Duration shall be for a period of four years including one year clinical training..

4. Medium of instruction:

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

5. Scheme of examination:

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

6. 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 .

7. Internal Assessment (IA) :

Theory - 20 marks.

Practical - 20 marks. [Lab work- 12 marks and Record-8 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.**

8. 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, II and III

Table - I Distribution of Teaching Hours in First Year Subjects

Main Subjects

SL NO	Subject	Theory No Of Hrs	Practical No Of Hrs	Total No. of Hours
1	Human Anatomy	70	20	90
2	Physiology	70	20	90
3	Biochemistry	70	20	90
4	Pathology-[Clinical pathology,Haematology & Blood –Banking	70	20	90
5	Microbiology	70	20	90
	Total	350	100	450

The classes in main subjects are to be held from Monday to Thursday. On Fridays and Saturdays students shall work in hospitals

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

Table - II Distribution of Teaching Hours in Second Year Subjects

Main Subjects

SL NO	Subject	Theory No Of Hrs	Practical No Of Hrs	Clinical Posting	Total No. of Hours
1	Medicine relevant to perfusion technology	50	--	--	50
2	Section A Applied Pathology	30	30	--	60
3	Section B Applied Microbiology	30	30		60
4	Applied Pharmacology	50	--		50
5	Introduction to Perfusion technology	80	100	650	830
	Total	240	160	650	1050

Table - III Distribution of Teaching Hours in Third Year Subjects

Main Subjects

S L No	Subject	Theory No. of Hours	Practical No. of Hours	Clinical posting	Total No. of Hours
1	Perfusion Technology – Clinical	50	50	250	350
2	Perfusion Technology – Applied	50	50	250	350
3	Perfusion Technology – Advanced	50	50	250	350
		150	150	750	1050

9. 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.

10. 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.

Second & Third year examination:

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

Written Examinations consists of 02 papers in the 2nd Year 02 papers in the 3rd Year.

Practical examination:

Two practical examinations, at the end 2nd Year and one practical examination at the end of the 3rd year.

TABLE-IV**Distribution of Subjects and marks for First Year University theory Examination**

SI No	Main Subjects*	Written Paper		I .A Theory	Total
		Duration	Marks	Marks	Marks
1	Basic Anatomy [Including Histology]	3 hours	80	20	100
2	P h y s i o l o g y	3 hours	80	20	100
3	Biochemistry	3 hours	80	20	100

4	Pathology	3 hours	80	20	100
5	Microbiology	3 hours	80	20	100
					100

Note * I A = Internal Assessment

Main Subjects shall have University Examination.

There Shall be no University Practical Examination

TABLE – V

Distribution of Subjects and marks for Second Year Examination.

		Theory				Practicals			
Paper	Subjects	Theory	Vivavoca	IA	Sub Total	Practicals	IA	Sub Total	Grand Total
I	Section A – Applied Pathology Section B - Applied Microbiology	50 50	30	20	150	40	10	50	200
II	Introduction to Perfusion Technology	100	30	20	150	40	10	50	200
III	Pharmacology	80	--	20	100	No Practicals			100
IV	Medicine relevant to Perfusion Technology	80	--	20	100	No Practicals			100

TABLE – VI

Distribution of Subjects and marks for Third Year Examination.

		Theory				Practicals			Grand Total
Paper	subjects	Theory	Vivavoca	I A	Sub Total	Practicals	I A	Sub Total	
I	Perfusion Technology –	100	30	20	150	120	30	150	600

	Clinical					(40=40=40)	(10=10=10)		
II	Perfusion Technology – Applied	100	30	20	150				
III	Perfusion Technology – Advanced	100	30	20	150				

11. Pass criteria

11.1. 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.

11.2. 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.

In the third year a candidate is declared to have passed only if he/she passes all the three theory papers and one practical examination in a single attempt failing which were in the candidate fails in one or more theory papers and or practical examination he/she will have to re appear for all the 3 theory papers and the practical examination in the subsequent attempt. .

12. Carry over benefit

12.1 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/se must pass the carry over subjects before appearing for second year examination; otherwise he/she shall not permitted to proceed to third year.

12.2. 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

13. Declaration Of Class

a. A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secures 75% of marks or more of grand total marks prescribed will be declared to have passed the examination with Distinction.

b. A candidate having appeared in all subjects in the same examination and passed that examination in the first attempt and secures 60% of marks or more but less than 75% of grand total marks prescribed will be declared to have passed the examination in First Class.

c. A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secures 50% of marks or more but less than 60% of grand total marks prescribed will be declared to have passed the examination in Second Class.

d. A candidate passing the university examination in more than one attempt shall be placed in Pass class irrespective of the percentage of marks secured by him/her in the examination.

e. The marks obtained by a candidate in the subsidiary subjects shall not be considered for award of Class or Rank. [Please note fraction of marks should not be rounded off clauses (a), (b) and (c)]

14. 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.

15. 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	3 (2x10)	10
SHORT ESSAY TYPE	12 (10 × 5)	5
SHORT ANSWER TYPE	12 (10 × 3)	3

SUBJECTS HAVING MAXIMUM MARKS = 80		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	3 (2x10)	10
SHORT ESSAY TYPE	8(6X5)	5
SHORT ANSWER TYPE	12 (10 × 3)	3

SUBJECTS HAVING MAXIMUM MARKS = 60		
TYPE OF QUESTION	NUMBER OF QUESTIONS	MARKS FOR EACH QUESTION
ESSAY TYPE	3 (2x10)	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	3 (2x10)	10
SHORT ESSAY TYPE	5(3X5)	5
SHORT ANSWER TYPE	7(5X3)	3

Syllabus for First year BSc. Perfusion Technology

A ANATOMY

No. of theory classes: 70 hours

No. of practical classes : 20 hours

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

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 vena cava, 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

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

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

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

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 Questions	No. 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
Total Marks			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) Saunder's & C P Prism Publishers, Bangalore – 1991
4. ESTER . M. Grishcimer, Physiology & Anatomy with Practical Considerations, J.P. Lippin Cott. Philadelphia
5. Essential of Human embryology, Bhatnagar revised edition, Orient Longman PVT Ltd.

Syllabus for First year BSc. Perfusion Technology

B PHYSIOLOGY

Theory 70 hours

Practical 20hours

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.Crossmatching.Rh system – Rh factor, Rh incompatibility.

Blood transfusion – Indication, universal donor and recipient concept.Selection criteria of a blood donor. transfusion reactions Anticoagulants – Classification,Examples and uses

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

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.

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. Pancrease – structure, function, composition, regulation of pancreatic juice
 Liver – functions of liver. Bile secretion, composition, function regulation of bile secretion .Bilirubin metabolism types of bilirubin, Vandernberg reaction, Jaundice- types, 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

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 favoring 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. Hearing Brier, Reflexes.
 Applied Physiology and Respiration : Hypoxia, Cyanosis, Asphyxia, Dyspnea, Dysbarism, Artificial Respiration, Apnoea.

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 and nor adrenaline. 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

Special senses

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

Nervous system

Functions of Nervous system, Neurone structure, classification and properties. Neuroglia, nerve fiber, classification ,conduction of impulses continuous and saltatory. 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.

Excretory System

Excretory organs
 Kidneys: Functions of kidneys structural and functional unit nepron, vasarecta, cortical and juxtamedullary nephrons – Comparision, 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 load, 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

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.

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 Rigor mortis

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 Practicals need not be sent to the University.

Scheme of Examination Theory

Type of Questions	No. 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
Total Marks			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 BSc. Perfusion Technology

C BIOCHEMISTRY

No. Theory classes : 70hours

No. of practical classes : 20 hours

Theory:

Specimen collection : Pre-analytical variables

Collection of blood, Collection of CSF & other fluids, Urine collection, Use of preservatives, Anticoagulants

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, Dessicator, Stop watch, rimers, scissors, 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 borosilicate glass ; care and cleaning of glass ware, different cleaning solutions of glass, care and cleaning of plastic ware, different cleaning solutions .

3. 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

4. Safety of measurements

5. Conventional and SI units

6. 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 H₂SO₄ etc.,

preparation of normal solutions. eg., 1N Na₂CO₃, 0.1N Oxalic acid, 0.1 N HCl, 0.1N H₂SO₄, 0.66 N H₂SO₄ 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 (CaCl₂, 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

Practicals – 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 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

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, Interpretation and Diagnosis through charts, Liver Function tests, Lipid Profile

Renal Function test, 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

Type of Questions	No. 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
Total Marks			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, Culcutta – 1992
7. Text Book of Medical Biochemistry – 3rd Edition, Orient Longman PVT Ltd
8. Practical Biochemistry for Medical Students – Rajagopal, Orient Longman PVT Ltd

Syllabus for First year B.Sc. Perfusion Technology

D PATHOLOGY

Histo Pathology ,Clinical Pathology, Haematology and Blood Banking

Theory – 70 hours

Practical – 20 hours

HistoPathology - Theory

- Introduction to Histo Pathology, 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

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). Sputum Examination.
- Examination of feces

Haematology – Theory

- Introduction to Haematology, Normal constituents of Blood, their structure and function. Collection of Blood sample. 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.

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.

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 Pathology shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3 (To attempt 2)	2 x 10	20
			30

Short Essay (SE)	8 (To attempt 6)	6 x 5	
Short Answer (SA)	12 (To Attempt 10)	10 x 3	30
Total Marks			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. Bacteriology 8th Ed, J.P.

Syllabus for First year BSc. Perfusion Technology

E Microbiology

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 4 hours

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

2. Growth and nutrition 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, C. 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 Causative agents, transmission methods, investigation, prevention and control Hospital infection. 4 hours

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, MacConkey 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. Anaerobic culture methods

Visit to hospital for demonstration of Biomedical waste management.

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 Questions	No. 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
Total Marks			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

9. Introduction to Medical Microbiology –Ananthanarayana, Orient Longman PVT Ltd.

Syllabus for First year BSc. Perfusion Technology

F 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

II Syllabus for Second year BSc. Perfusion Technology

A APPLIED PHARMACOLOGY

☐ General concepts about pharmacodynamic and Pharmacokinetic Principles involved in drug activity.

I. Autonomic nerves system.

☐ Anatomy & functional organisation. List of drugs acting on ANS including dose, route of administration, indications, contra indications and adverse effects.

II. Cardiovascular drugs- Enumerate the mode of action, side effects And therapeutic uses of the following drugs.

a. Antihypertensives

☐ Beta Adrenergic antagonists. Alpha Adrenergic antagonists. Peripheral Vasodilators. Calcium channel blockers

b. Antiarrhythmic drugs

c. Cardiac glycosides

d. Sympathetic and nonsympathetic inotropic agents.

e. Coronary vasodilators.

f. Antianginal and anti failure agents

g. Lipid lowering & anti atherosclerotic drugs.

h. Drugs used in Haemostasis – anticoagulants Thrombolytics and antithrombolytics.

i. Cardioplegic drugs- History, Principles and types of cardioplegia.

j. Primary solutions – History, principles & types.

k. Drugs used in the treatment of shock.

III. Anaesthetic agents.

☐ Definition of general and local anaesthetics. Classification of general anaesthetics.

□ Pharmacokinetics and Pharmacodynamics of inhaled anaesthetic agent. Intravenous general anaesthetic agents. Local anaesthetics – classification mechanism of action, duration of action and methods to prolong the duration of action. Preparation, dose and routes of administration.

IV Analgesics

□ Definition and classification. Routes of administration, dose, frequency of administration, Side effects and management of non opioid and opioid analgesics

V. Antihistamines and antiemetics-

□ Classification, Mechanism of action, adverse effects, Preparations, dose and routes and administration.

VI. CNS stimulants and depressants

□ Alcohol. Sedatives, hypnotics and narcotics. CNS stimulants. Neuromuscular blocking agents and muscle relaxants.

VII. Pharmacological protection of organs during CPB

VIII. Inhalational gases and emergency drugs.

IX. Pharmacotherapy of respiratory disorders

□ Introduction – Modulators of bronchial smooth muscle tone and pulmonary vascular smooth muscle tone

□ Pharmacotherapy of bronchial asthma. Pharmacotherapy of cough. Mucokinetic and mucolytic agents

□ Use of bland aerosols in respiratory care.

X. Corticosteroids – Classification, mechanism of action, adverse effects and complications. Preparation, dose and routes of administration.

XI Diuretics

□ Renal physiology. Side of action of diuretics. Adverse effects. Preparations, dose and routes of administration.

XII. Chemotherapy of infections

□ Definition

□ Classification and mechanism of action of antimicrobial agents

□ Combination of antimicrobial agents

□ Chemoprophylaxis.

□ Classification, spectrum of activity, dose, routes of administration and adverse effects of penicillin, cephalosporins, aminoglycosides, tetracyclines, chloramphenicol, antitubercular drugs.

XIII. Miscellaneous.

□ IV fluids- various preparations and their usage.

□ Electrolyte supplements

□ Immunosuppressive agents

□ New drugs included in perfusion technology.

□ Drugs used in metabolic and electrolyte imbalance.

PRACTICALS:

1. Preparation and prescription of drugs of relevance.

2. Experimental pharmacology directed to show the effects of commonly used drugs of relevance and interpretation of few charts.

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 applied Pharmacology shall be as given under.

Type of Questions	No. 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

Total Marks			80
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NO PRACTICAL EXAMINATION

Recommended Books.

1. R. S. Satoskar, S.D. Bhandarkar, S. S. Ainapure, Pharmacology and Pharmacotherapeutics, 18th Edition, single Volume, M/S Popular Prakashan, 350, Madan Mohan Marg, Tardeo, Bombay – 400 034.
2. K.D. Tripathi, Essentials of Medical Pharmacology, V. Edition, M/s. Jaypee Brothers, Post Box, 7193, G-16, EMCA House, 23/23, Bansari Road, Daryaganj, New Delhi.
3. Laurence and Bennet, Clinical Pharmacology, ELBS Edition, 9th Edition.

II Syllabus for Second year BSc. Perfusion Technology

B APPLIED PATHOLOGY

I. CARDIOVASCULAR SYSTEM

- ☐ Atherosclerosis- Definition, risk factors, briefly Pathogenesis & morphology, clinical significance and prevention.
- ☐ Hypertension- Definition, types and briefly Pathogenesis and effects of Hypertension.
- ☐ Aneurysms – Definition, classification, Pathology and complications.
- ☐ Pathophysiology of Heart failure.
- ☐ Cardiac hypertrophy – causes, Pathophysiology & Progression to Heart Failure.
- ☐ Ischaemic heart diseases- Definition, Types. Briefly Pathophysiology, Pathology & Complications of various types of IHD.
- ☐ Valvular Heart diseases- causes, Pathology & complication. Complications of artificial valves.
- ☐ Cardiomyopathy – Definition, Types, causes and significance.
- ☐ Pericardial effusion- causes, effects and diagnosis.
- ☐ Congenital heart diseases – Basic defect and effects of important types of congenital heart diseases.

II. HAEMATOLOGY

- ☐ Anaemia – Definition, morphological types and diagnosis of anaemia. Brief concept about Haemolytic anaemia and polycythaemia.
- ☐ Leukocyte disorders- Briefly leukaemia, leukocytosis, agranulocytosis etc.,
- ☐ Bleeding disorders- Definition, classification, causes & effects of important types of bleeding disorders. Briefly various laboratory tests used to diagnose bleeding disorders.

III. RESPIRATORY SYSTEM

- ☐ Chronic obstructive airway diseases – Definition and types. Briefly causes, Pathology and complications of each type of COPD.
- ☐ Briefly concept about obstructive versus restrictive pulmonary disease.
- ☐ Pneumoconiosis- Definition, types, Pathology and effects in brief.
- ☐ Pulmonary congestion and edema.
- ☐ Pleural effusion – causes, effects and diagnosis.

IV. RENAL SYSTEM

- ☐ Clinical manifestations of renal diseases. Briefly causes, mechanism, effects and laboratory diagnosis of ARF & CRS. Briefly Glomerulonephritis and Pyelonephritis.
- ☐ End stage renal disease – Definition, causes, effects and role of dialysis and renal transplantation in its management.
- ☐ Brief concept about obstructive uropathy.

PRACTICALS

1. Description & diagnosis of the following gross specimens.
 - a. Atherosclerosis.
 - b. Aortic aneurysm.
 - c. Myocardial infarction.
 - d. Emphysema
 - e. Chronic glomerulonephritis.

- f. Chronic pyelonephritis.
2. Interpretation & diagnosis of the following charts.
 - a. hematology Chart - AML, CML, Hemophilia, neutrophilia, eosinophilia.
 - b. Urine Chart - ARF, CRF, Acute glomerulonephritis.
3. Estimation of Hemoglobin.
4. Estimation Bleeding & Clotting time.

Scheme of Examination Theory

There shall be one theory paper of three hours duration carrying 50 marks. Distribution of type of questions and marks for **Applied Pathology** shall be as given under

Type of Questions	No. 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
Total Marks			80

PRACTICAL EXAMINATION - 40 Marks.

There will be a Combined Practical examination for Applied Pathology & Applied Microbiology.

Sl. No	Tests	Marks
01	Interpretation of Hematology Chart	05
02	Interpretation of Urine Chart	05
03	Estimation of Hemoglobin	05
04	Estimation of Bleeding time & Clotting time	05
	Total	20

II Syllabus for Second year BSc. Perfusion Technology

C APPLIED MICROBIOLOGY

THEORY – 40 HOURS

1. Health care associated infections and Antimicrobial resistance: Infections that patients acquire during the course of receiving treatment for other conditions within a healthcare setting like Methicillin Resistant *Staphylococcus aureus* infections, Infections caused by *Clostridium difficile*, Vancomycin resistant enterococci etc. Catheter related blood stream infections, Ventilator associated pneumonia, Catheter Related urinary tract infections, Surveillance of emerging resistance and changing flora. The impact and cost attributed to Hospital Associated infection. 6 Hours

2. Disease communicable to Healthcare workers in hospital set up and its preventive measure: Occupationally acquired infections in healthcare professionals by respiratory route (tuberculosis, varicella-zoster, respiratory syncytial virus etc), blood borne transmission (HIV, Hepatitis B, Hepatitis C, Cytomegalovirus, Ebola virus etc), oro faecal route (*Salmonella*, Hepatitis A etc), direct contact (Herpes Simplex Virus etc). Preventive measures to combat the spread of these infections by monitoring and control. 6 Hours

3. Microbiological surveillance and sampling: Required to determine the frequency of potential bacterial pathogens including *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis* and also to assess the antimicrobial resistance. Sampling: rinse technique, direct surface agar plating technique. 6 Hours

4. Importance of sterilization:

- Disinfection of instruments used in patient care: Classification, different methods, advantages and disadvantages of the various methods.
- Disinfection of the patient care unit
- Infection control measures for ICU's 10 Hours

5. Sterilization:

- Rooms: Gaseous sterilization, one atmosphere uniform glow discharge plasma (OAUGDP).
- Equipments: classification of the instruments and appropriate methods of sterilization.
- Central supply department: the four areas and the floor plan for instrument cleaning, high-level disinfecting and sterilizing areas. 8 Hours

6. Preparation of materials for autoclaving: Packing of different types of materials, loading, holding time and unloading. 4 Hours

PRACTICALS- 30 HOURS

- Principles of autoclaving & quality control of Sterilization.
- Collection of specimen from outpatient units, inpatient units, minor operation theater and major operation theater for sterility testing.
- The various methods employed for sterility testing.
- Interpretation of results of sterility testing.
- Disinfection of wards, OT and Laboratory.

Scheme of Examination

Theory

There shall be one theory paper of three hours duration carrying 50 marks. Distribution of type of questions and marks for **Applied Microbiology** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	6 (To attempt 4)	4 x 5	20
Short Answer (SA)	7 (To Attempt 5)	5 x 2	10
Total Marks			50

PRACTICAL EXAMINATION - 40 Marks.

There will be a Combined Practical examination for Applied Pathology & Applied Microbiology.

Sl. No	Tests	Marks
01	Dry heat / Moist heat: Temperature recording charts interpretation	05
02	Dry heat / Moist heat: Color change indicators interpretation	05
03	Air sampling culture plates interpretation of Colony forming units based on air flow rate and sampling time	05
04	Interpretation of Sterility of Hemodialysis	05

	water/Distilled water /Deionised water based on growth of colonies in BHI agar to be reported as X CFU/mL	
	Total	20

iiSyllabus for Second BSc. Perfusion Technology

D MEDICINE RELEVANT TO PERFUSION TECHNOLOGY

Cardiovascular System

Ischaemic heart diseases. Rheumatic heart disease. Congenital heart disease. Hypertension
Aortic Aneurysms. Cardiomyopathy. Peripheral vascular disease. Pulmonary edema and LV failure

Hematology

Anaemia. Bleeding disorders. Laboratory tests used to diagnose bleeding disorders (in brief)

Respiratory System

Chronic obstructive airway diseases (COPD). Concept of obstructive versus restrictive pulmonary disease
PFT and its interpretation

Renal System

ARF & CRF. End stage renal disease. Role of dialysis and renal transplantation in its management

CNS

Automatic nervous system. (Sympathetic & Parasympathetic system). Brief mention of CNS disorders & their etiology

Others

DM. Obesity. Pregnancy. Paediatric Patient (neonate/Infant). Elderly patient

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 **Medicine relevant to Perfusion Technology** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	10 (To attempt 8)	8 x 5	40
Short Answer (SA)	12 (To Attempt 10)	10 x 2	20
Total Marks			80

NO PRACTICAL EXAMINATION

II Syllabus for Second year BSc. Perfusion Technology

E INTRODUCTION TO PERFUSION TECHNOLOGY

Basics of diagnostic techniques:

Chest of X-ray.ECG.Echo.Angiography.Nuclear Cardiology.Laboratory investigations in relation to perfusion technology.Cardiopulmonary bypass and perfusion technology

History of Cardiac surgery and perfusion.Specific reference of Gibbon Lillehei, carrel. Pre CPB surgery

- ☐ Azygous Flow principle.
- ☐ Hypothermic/nonhypothermic non-CPB surgery including gross's.Well technique and controlled cross circulation.

Monitoring and instrumentation

☐ Concepts of monitoring – instrumentation technology of ECGmachine, pressure transducer, syringe and peristaltic pumps,monitors, ventilators, pulse oximeters, temperature probes and thermo regulatory monitoring, defibrillators and fibrillators. Piped and non-piped gas delivery systems and connections. Basic physics related to medically used gases.

- ☐ Haemodynamic monitoring
- ☐ Haemostatic monitoring
- ☐ Haemotologic monitoring
- ☐ Maintenance of oxygen, carbon dioxide and acid-base status and their monitoring
- ☐ Neurological monitoring (SSPE, EEG and cerebral function monitor)
- ☐ Aseptic technique.
- ☐ Cardiac surgery team, profession and terminology, scope of perfusion technology

Physiology of Extracorporeal circulation

Heart – Lung machine

- ☐ Principles of extracorporeal circulation
- ☐ Materials used in EC circuit
- ☐ Principles of extracorporeal gas exchange

Various types of oxygenators

- ☐ Bubble oxygenators
- ☐ Rotating spiral/cylinder/disc oxygenators
- ☐ Membrane oxygenators
- ☐ Mechanism of action components defoaming, rated flow.

Theory of blood pumps

☐ Ideal blood pump, pulsatile versus non-pulsatile flow, occlusive and non-occlusive pumps, various types of pumps roller, bellow, sigmamotor, diaphragm, ventricular and centrifugal pumps.

Element of extracorporeal circulation/hazards of:

- a. blood failure
- b. Bubble trap
- c. Flow meters
- d. Temperatures
- e. Heat exchanger
- f. Regulating devices

Connection of the vascular system with extracorporeal circulation:

- ☐ Arterial and venous cannulae.
- ☐ Connecting tubes and connectors
- ☐ Vents
- ☐ Suckers
- ☐ Cardioplegia delivery system
- ☐ Venous drainage.
- ☐ Haemodynamic of arterial return, venous drainage, cardioplegiaDelivery and venting.Blood banking, handling of blood products and their management. Blood components and their use.

Scheme of Examination Theory

There shall be one theory paper of three hours duration carrying **100** marks. Distribution of type of questions and marks for **Introduction to Anaesthesia Technology** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	14 (To attempt 8)	12 x 5	60
Short Answer (SA)	12 (To Attempt 10)	10 x 2	20
Total Marks			100

PRACTICAL EXAMINATION - 40 Marks.

III Syllabus for Third year B.Sc Perfusion Technology**A Paper-I Perfusion Technology Clinical**

1. Pharmacokinetics and Pharmacodynamics of Cardiopulmonary bypass
2. Drugs (including anesthetic drugs) used in cardiopulmonary bypass
3. Conduct and monitoring of Cardiopulmonary bypass
4. Adequacy of perfusion – General considerations, specific aspects of perfusion, monitoring, other concomitants which may affect its adequacy
5. Pulsatile perfusion – Introduction, theory & physiology of pulsatile flow, hemodynamic, metabolic effects, Clinical use, hematological effects
6. Cannulation techniques during cardiopulmonary bypass
7. Termination of cardiopulmonary bypass – principles and methodology
8. Myocardial protection and cardioplegia- pretreatment of the Myocardium, cardioplegia, hypothermia, controlled reperfusion, myocardial protection for specific clinical problems, Complications of cardioplegia. Non cardioplegic methods during cardiac surgery on cardiopulmonary bypass
9. Oxygenation – general consideration, bubble & membrane (including assessment and comparison of oxygenator function)
10. Heat exchangers-principles function of heat exchangers & their assessment. Complications related to heat exchange and their management
11. Priming fluids and hemodilution

Scheme of Examination Theory

There shall be one theory paper of three hours duration carrying **100** marks. Distribution of type of questions and marks for **Paper-I - Perfusion Technology - Clinical** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	14 (To attempt 8)	12 x 5	60
Short Answer (SA)	12 (To Attempt 10)	10 x 2	20

Total Marks			100
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PRACTICAL EXAMINATION

One common practical for all the three papers with equal weight age of marks i.e. 40 practical marks for each paper.

III Syllabus for Third year B.Sc Perfusion Technology**B Paper-II Perfusion Technology – Applied**

1. Blood cell trauma – analysis of forces of fluid motion, effects of physical forces of blood cell, clinical effect. Complications of blood transfusion.
2. Anticoagulation on bypass, its monitoring, its reversal and complications. Heparinless bypass. Platelet aggregation and platelet dysfunction. Coagulopathies due to cardiopulmonary bypass and its management.
3. Inflammatory response to cardiopulmonary bypass & its clinical effects. Methods to minimise the same. Immune response, neuroendocrine, renal, metabolic splanchnic response, pulmonary response and electrolyte response to cardiopulmonary bypass
4. Blood conservation hemofiltration & dialysis during cardiopulmonary bypass including modified ultra filtration reverse autologous priming and other methods
5. Micro emboli- gaseous and particulate, filters used in cardiopulmonary bypass circuit.
6. Micro pore filtration during cardiopulmonary bypass
7. Counter pulsation techniques and assist devices

Scheme of Examination Theory

There shall be one theory paper of three hours duration carrying **100** marks. Distribution of type of questions and marks for **Paper-II - Perfusion Technology Applied** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	14 (To attempt 8)	12 x 5	60
Short Answer (SA)	12 (To Attempt 10)	10 x 2	20
Total Marks			100

PRACTICAL EXAMINATION

One common practical for all the three papers with equal weight age of marks i.e. 40 practical marks for each paper.

III Syllabus for Third year B.Sc Perfusion Technology**C Paper-III Perfusion Technology – Advanced**

1. Perfusion techniques for Paediatric cardiac surgery
2. ECMO- special perfusion techniques for special cardiac surgeries and medical conditions (including thoracic aortic surgeries deep hypothermia and circulatory arrest). Perfusion for non cardiac surgery, invasive cardiology and outside the operation suite.
3. Perfusion as a method of cardiopulmonary bypass
4. Complications and safety during cardiopulmonary bypass – bypass safety, organizational aspects, accidents, coagulopathies, mechanical and electrical failures, perfusion management, perfusion systems, safety for the perfusionist and surgical team management of perfusion accidents.

5. Minimally invasive surgery and the perfusionist
6. Recent advances in perfusion techniques
7. Experimental perfusion

Scheme of Examination Theory

There shall be one theory paper of three hours duration carrying **100** marks. Distribution of type of questions and marks for **Paper-III - Perfusion Technology Advanced** shall be as given under.

Type of Questions	No. of Questions	Marks	Sub-total
Long Essay (LE)	3(To attempt 2)	2 x 10	20
Short Essay (SE)	14 (To attempt 8)	12 x 5	60
Short Answer (SA)	12 (To Attempt 10)	10 x 2	20
Total Marks			100

PRACTICAL EXAMINATION

One common practical for all the three papers with equal weight age of marks i.e. 40 practical marks for each paper

QP Code:

Reg. No.:.....

First Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Basic Anatomy (Including Histology)

Time: 3hrs

Maximum marks: 80

- Answer all questions
- Draw diagrams wherever necessary

Essay

(2x10=20)

1. Describe heart under the following headings:

- Coverings
- Surfaces
- Arterial supply
- Right atrium
- Applied importance
- (2+2+2+3+1=10)

2. Describe right lung under the following headings:

- Surfaces and borders
- Hilum
- Microscopy
- Broncho pulmonary segments
- (2+2+3+3=10)

Short notes

(6x5=30)

3. Kidney

4. Connective tissue cells

5. Skin

6. Spleen

7. Prostate

8. Uterus

Answer briefly

(10x3=30)

9. Circle of Willis

10. Deltoid

11. Cornea

12. Transitional epithelium

13. Appendix

14. Fertilization

15. Gall bladder

16. Haversian system

17. Aorta

18. Left and right coronary artery

QP Code:

Reg. No.:.....

First Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Physiology

Time: 3hrs

Maximum marks: 80

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x10=20)

1. Define coagulation of blood and name the coagulation factors. Explain the intrinsic mechanism of blood coagulation (1+4+5=10)
2. Define blood pressure and mention its normal values. What are the determinants of blood pressure. Add a note on regulation of stroke volume. (2+3+5=10)

Short notes

(6x5=30)

3. Plasma proteins
4. Heart sounds
5. Rh factor
6. Refractive errors
7. Factors affecting glomerular filtration rate
8. Action potential on a nerve and its ionic basis

Answer briefly

(10x3=30)

9. Surfactant
10. Vital capacity
11. Cretinism
12. Triple response
13. E.S.R
14. Anticoagulants
15. Tests of ovulation
16. Selection criteria of a blood donor
17. Hemoglobin
18. conducting system of heart

QP Code:

Reg. No.:.....

First Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Microbiology

Time: 3hrs

Maximum marks: 80

- Answer all questions
- Draw diagrams wherever necessary

Essay

(2x10=20)

1. Define sterilization. List the different methods of sterilization and explain the principles involved in the functioning of autoclave and diagram. Mention the articles which can be sterilized by autoclave (2+2+4+2=10)
2. Describe the clinical features, laboratory diagnosis, prophylaxis and treatment of tetanus (3+3+4=10)

Short notes

(6x5=30)

3. Hospital acquired infections
4. Bacterial growth curve
5. Infective endocarditis
6. Biomedical waste management
7. Hydatid cyst
8. Laboratory diagnosis of pulmonary tuberculosis

Answer briefly

(10x3=30)

9. Differential staining
10. Morphology of bacteria
11. Bacterial filters
12. Anaerobic culture methods
13. Hot air oven
14. Candidiasis
15. Enrichment media
16. Immunization schedule
17. Antiseptics
18. Antibiotic sensitivity testing

QP Code:

Reg. No.:.....

First Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Pathology

Time: 3hrs

Maximum marks: 80

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x10=20)

1. Describe the microscopic examination of urine in detail
2. Explain the tissue processing for routine paraffin sections in detail

Short notes

(6x5=30)

3. H & E staining
4. PCV
5. Normal haemostatic pathway
6. Stool examination
7. Classification of fixatives with examples
8. Mounting technique and various mountants used

Answer briefly

(10x3=30)

9. Findings of CSF in TB meningitis.
10. Horning and stropping.
11. Sputum examination.
12. Prothrombin time
13. Biomedical waste
14. Differences between transudate and exudate
15. Normal constituents of blood.
16. Cross matching.
17. Different types of urine sample.
18. Specific gravity estimation of urine.

QP Code:

Reg. No.:.....

First Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Biochemistry

Time: 3hrs

Maximum marks: 80

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x10=20)

1. Explain the Henderson – Hasselbach equation. Describe the important body buffers.

(6+4=10)

2. Define normality. Explain the preparation of exactly 0.1 N HCl solution by secondary titration procedure

(2+8=10)

Short notes

(6x5=30)

3. Ionization of water

4. Anticoagulants

5. Principle, parts and use of colorimeter

6. Care and cleaning of glass wares

7. Centrifuge

8. Estimation of serum electrolyte

Answer briefly

(10x3=30)

9. Lipid profile

10. Basal metabolic rate

11. Pre analytical variables

12. Pauli's exclusion principle

13. Roth era's test

14. Blood urea estimation

15. Safety measures in the laboratory

16. Metabolic acidosis

17. pH meter

18. What is the normality of 12% NaOH solution

QP Code:

Reg. No.:.....

Second Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Applied Pathology & Applied Microbiology

Time: 3hrs

Maximum marks: 100

- Answer all questions
- Draw diagrams wherever necessary
- Write Section A and Section B in Separate answer book (32 Pages). Do not mix up questions from Section A and Section B

SECTION A

Applied Pathology

50

Essay

(2x10=20)

1. Briefly describe the causes, mechanism, effects and laboratory diagnosis of acute renal failure
2. Define anemia. Mention the classification and diagnosis of anemia. What are the causes of haemolytic anemia.

Short notes

(4x5=20)

3. Laboratory tests used to diagnose bleeding disorders.
4. Pneumoconiosis.
5. Pericardial effusion.
6. Pathophysiology of heart failure.

Answer briefly

(5x2=10)

7. Risk factors of hypertension.
8. Pathogenesis of atherosclerosis.
9. Causes of cardio myopathy.
10. Classify congenital heart disease with suitable examples.
11. Pathology of mitral stenosis.

SECTION B

Applied Microbiology

50

Essay

(2x10=20)

1. Briefly describe the health care associated infections.
2. Briefly describe the different methods of bio-medical waste management.

Short notes

(4x5=20)

3. Mycobacterium tuberculosis.
4. Pseudomembranous colitis.
5. Antibiotic sensitivity tests.
6. Emerging infections.

Answer briefly

(5x2=10)

7. Passive immunisation.
8. Toxoids.
9. Antimicrobial resistance.
10. Normal flora of genito urinary tract.
11. Coliform count.

QP Code:

Reg. No.:.....

Second Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Introduction to Perfusion Technology

Time: 3hrs

Maximum marks: 100

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x15=30)

1. Discuss the various types of oxygenators. What is an Ideal blood pump. Differentiate between • pulsatile and non-pulsatile flow. • Occlusive and non-occlusive pumps.
2. Describe the Principles of extracorporeal circulation. Discuss the Materials used in EC circuit. Explain the principles of extracorporeal gas exchange.

Short notes

(5x7=35)

3. Haematological monitoring in CPB.
4. Bubble trap.
5. Connection of the vascular system with extracorporeal circulation.
6. Hazards of extra corporeal circulation.
7. Neurologic complications of CPB.

Answer briefly

(7x5=35)

8. Azygous flow principle.
9. Controlled cross circulation.
10. Artificial heart valves.
11. Cardioplegia delivery system.
12. Management of hyperkalaemia.
13. Coronary vasodilators.
14. Anticoagulants.

QP Code:

Reg. No.:.....

Second Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Pharmacology

Time: 3hrs

Maximum marks: 80

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x10=20)

1. Classify anti- hypertensive. Describe the mechanism of action, dosage, side effects, contra indications and uses of Metaprolol.
2. Classify general anaesthetics. Describe the pharmacokinetics and pharmaco dynamics of inhaled anaesthetic agents. Mention the uses and side effects of halothane.

Short notes

(6x5=30)

3. Drugs used in metabolic and electrolyte imbalance
4. Immunosuppressive agents
5. Mechanism of action, dosage, side effects and route of administration of diuretics
6. Pharmacotherapy of bronchial asthma.
7. Classification, mechanism of action, adverse effects and complications of corticosteroids
8. Classification, spectrum of activity, routes of administration and adverse effects of Penicillin.

Answer briefly

(10x3=30)

9. Advantages of enteral route of drug administration
10. First pass metabolism of drugs
11. Name 3 sympathomimetic drugs. Mention its uses
12. Name 3 cardiac glycosides .Mention its uses.
13. Management of digoxin toxicity.
14. Management of hyperkalaemia.
15. Coronary vasodilators.
16. Lipid lowering agents.
17. Anticoagulants.
18. Drugs used in the treatment of shock .

QP Code:

Reg. No.:.....

Second Year B.Sc Perfusion Technology Degree Examinations

(Model Question Paper)

Medicine Relevant to Perfusion Technology

Time: 3hrs

Maximum marks: 80

- *Answer all questions*
- *Draw diagrams wherever necessary*

Essay

(2x10=20)

1. Discuss rheumatic heart disease. Describe the pathology , clinical features, diagnosis and management of mitral stenosis.
2. Classify anti -hypertensive. How will you investigate a case of primary hypertension. What is malignant hypertension. .

Short notes

(5x7=35)

3. Rheumatic carditis.
4. Aortic aneurism.
5. Management of pulmonary oedema.
6. Pharmacotherapy of bronchial asthma.
7. Anaemia.

Answer briefly

(5x5=25)

8. Coronary vasodilators.
9. Drugs used in the treatment of shock
10. Infective endocarditis.
11. Artificial heart valves.
12. Cardiac glycosides.

Q.P. CODE: -----

Reg. No: -----

Third Year B.Sc Perfusion Technology Degree Examinations, September 2015

Paper-I Perfusion Technology Clinical

Time: 3 Hrs

Max. Marks: 100

*Answer all questions
Draw diagram wherever necessary*

Essays:

(2×15=30)

1. A 62 years old man was diagnosed to have triple vessel disease. His height is 165cm, and weight 80 Kg. How will you proceed to conduct and monitor cardio pulmonary bypass?

2. Discuss the principles and methodology for termination of cardio pulmonary bypass.

Short notes:

(5×7=35)

3. Pulsatile flow.

4. Cardioplegia.

5. Priming Fluids.

6. Complications of heat exchanger and its management.

7. Haemodilution.

Answer briefly:

(7×5=35)

8. Changes in Drug Pharmacokinetics due to CPB.

9. Controlled reperfusion.

10. Myocardial protection.

11. Bubble oxygenators.

12. Non -cardioplegic methods during cardiac surgery on CPB.

13. Adequacy of perfusion.

14. Amidarone.

Q.P. CODE: -----

Reg. No: -----

Third Year B.Sc Perfusion Technology Degree Examinations, September 2015

Paper-II Perfusion Technology .Applied

Time: 3 Hrs

Max. Marks: 100

*Answer all questions
Draw diagram wherever necessary*

Essays:

(2×15=30)

1. Discuss in detail inflammatory responses during cardiopulmonary bypass & its clinical effects. What are the methods to minimise them?

2. Discuss the principles of anticoagulation on cardio pulmonary bypass. How will you monitor and reverse heparin effect. What are its complications?

Short notes:

(5×7=35)

3. Modified ultra filtration.

4. Methods of blood conservation during cardiopulmonary bypass.

5. Priming fluids.

6. IABP.

7. Coagulopathies during CPB and its management.

Answer briefly:

(7×5=35)

8. Prevention & treatments of Acute Lung Injury in CPB.

9. Thrombo elastogram.

10. Aprotinin.

11. Unusual problems in CPB.

12. Bivalirudin.

13. Management of protamine reaction.

14. Complications of blood transfusion.

Q.P. CODE: -----

Reg. No: -----

Third Year B.Sc Perfusion Technology Degree Examinations, September 2015

Paper-III Perfusion Technology. Advanced

Time: 3 Hrs

Max. Marks: 100

*Answer all questions
Draw diagram wherever necessary*

Essays:

(2×15=30)

- 1. Discuss the indications, contra-indications and complications associated with ECMO.**
- 2. What are the complications during CPB? Describe how you will manage each complication.**

Short notes

(5×7=35)

- 3. Perfusion for minimally invasive cardiac surgery**
- 4. Uses of CPB in non cardiac surgery**
- 5. Special considerations in perfusion during cardiac surgery in infants.**
- 6. Spinalcord protection in aortic surgery.**
- 7. Recent advances in perfusion techniques.**

Answer briefly:

(7×5=35)

- 8. Measures to improve cardiac surgery teamwork.**
- 9. Left heart bypass.**
- 10. Myocardial protection and preservation for neonates and infants.**
- 11. Milrenon.**
- 12. Coronary angiogram.**
- 13. Deep hypothermic circulatory arrest.**
- 14. Non cardiac uses of CPB.**