Mahatma Gandhi University
Of
Medical Sciences & Technology, Jaipur

Syllabus
B.Sc. Cardiac Perfusion Technology

(3 Years Degree Course)

Notice

1. Amendments made by the University in Rules/ Regulations of the courses shall automatically apply.

2. The University reserves the right to make changes in the syllabus/ books/ guidelines, fee-structure or any other information at any time without prior notice. The decision of the University shall be binding on all.

3. The jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

SYLLABUS

B.Sc. Cardiac Perfusion Technology (CODE)

(3 Years Degree Course)

Rules & Regulations

1. TITLE OF THE COURSE

The title of the course shall be **"**B.Sc. Cardiac Perfusion Technology".

2. DURATION OF COURSE/TRAINING

The course shall be of three years duration from the date of commencement of academic session

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction.

4. **ELIGIBILITY FOR ADMISSION**:

- For admission a candidate should have passed the 10+2 (Senior Secondary) Examination or its equivalent Examination Science stream i.e. Physics, Chemistry and Biology with 45% marks in the aggregate for General Category and 40% for SC/ST/OBC/MBC candidates or as per Govt. Guidelines from a recognized Board.
- Candidate should have completed the minimum age of 17 years as on 31st December of the year of admission.

5. CRITERIA FOR ADMISSION

Selection shall be done by an Admission Board of the University strictly on merit. It will consist of two-step process –Written Entrance Examination followed by Counseling/Personal Interview (PI).

6. RESERVATION POLICY

Reservation shall be applicable as per policy of the State Government.

7. ENROLMENT

Every candidate who is admitted to the Course in Mahatma Gandhi Medical College shall be required to get himself/herself enrolled with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed eligibility and enrolment fees.

A candidate shall deposit enrolment fees along with tuition fees at the time of his/her admission to the course. Such a candidate who fails to submit, through the college Principal, duly filled enrolment form along with original documents including migration certificate required for enrolment within two months of his/her admission or up to November 30 of the year of admission whichever is later, he/she will have to pay late fee prescribed by the University.

8. MIGRATION RULES

- No student, once admitted to the course and enrolled by the University, will be permitted to migrate to any other Course/ University.
- No student will be admitted to the Course on migration from any other Course/ University.

9. ATTENDANCE

Minimum 75% attendance in each year, both for theory and practical classes separately. Student with deficient attendance will not be permitted to appear in University examination.

10. CONDUCTION OF THE UNIVERSITY EXAMINATION:

University examination shall be conducted twice in a year; that is Main and Supplementary Examination. Supplementary examination shall be conducted after 2-4 months of the main examination.

11. SCHEME OF EXAMINATION

i. Theory

(a) Each Theory paper examination shall be of 3 hours duration and of maximum marks **70**.

(b) Internal assessment shall be of **30** marks for each Theory Paper.

Theory Papers	Theory		Paper Set & Evaluated	
	Total Marks	Pass Marks	No. of Internal Paper Setters	No. of External Paper Setters
Ist Year: Three Theory Papers	300	150	3	-
IInd Year: Three Theory Papers	300	150	3	-
IIIrd Year: Three Theory Papers	300	150	2	1

(c) For the First and Second year examinations – these respective above theory papers shall be set by the Internal Examiners covering their respective areas of syllabus. For each question paper there shall be a separate Internal Examiner. The answer books shall be evaluated by the concerned Internal Examiners (Papers Setters).

(d) In Third (Final) Year examination, one of the papers shall be set and evaluated by an External Examiner. In other words, one of the Internal has to be substituted by the External Examiner. The External Examiner (Paper Setter) shall evaluate his/her paper.

(e) The Paper Setter shall set the questions within the prescribed course of study of the concerned paper. There will be a set pattern of question papers duly approved by Academic Council. Model question paper is annexed herewith.

(f) It is to be noted that the Internal and External Examiners of all the three years (First, Second and Third year) shall be appointed by the President of the University. This exercise shall be conducted through the office of the Controller of the Examinations of the University. The External Examiner of Third year shall also be appointed by the President out of the panel of names submitted by the Concerned Coordinator of the course through the Dean to the Controller of Examinations for appointment of Examiners by the President of the University.

(g) Passing Marks: A candidate will have to obtain at least 50% marks in each Theory paper including internal assessment to pass. This shall include the marks obtained in Theory paper of 70 marks and internal assessment for that paper of 30 marks.

ii. Practical and Viva-Voce Examination

(a) Each year there shall be practical and viva-voce examination of 100 marks. It shall consist of one University practical exam of 70 marks and internal assessment of 30 marks. It shall be conducted after the Theory examination is over. A candidate will have to obtain atleast 50% marks in practical and viva-voce examination inclusive of internal assessment to pass.

(b) The pattern of practical examination shall be as follows –

B. Sc. Course	Practical		Practical Examiners
	Total Marks	Pass Marks	
First Year	100	50	Two Internal Examiner(s)
Second Year	100	50	Two Internal
Third Year	100	50	One Internal & One External Examiner

iii. Result

1. A candidate will have to obtain at least 50% marks separately in each Theory paper including internal assessment and a minimum of 50% marks in the practical examination inclusive of internal assessment for him to be declared pass.
2. A Candidate who has failed in theory paper/s will reappear in respective theory papers/s in supplementary examination.
3. Candidate who has failed in Practical examination only will reappear only in practical examination in Supplementary examination.

iv. Supplementary Examination

(a) Eligibility for the failed candidates to appear at the supplementary examination shall be as below –

i. Failed in Theory Paper(s) and failed in Practical – shall reappear in the respective failed Theory paper(s) and Practical examination.
ii. Failed in Theory paper/papers and passed in Practical examination – shall reappear only in the concerned failed Theory paper(s).
iii. Passed Theory papers but failed in Practical – shall reappear only in the Practical Examination.

(b) There shall be a supplementary examination within two months of the declaration of the result of the main examination. Internal assessment marks obtained in main examination in the concerned failed paper/papers/ practical shall be carried forward for working out the result of supplementary Theory paper(s) and or practical examination. Such candidate who has secured less than 50% marks in the internal assessment will be allowed to improve his internal assessment marks in the repeat supplementary internal assessment examination.

(c) Marks secured by the candidate in passed main examination/supplementary examination Theory paper(s) and/or practicals, as the case may be, will be carried forward for working out his result.

(d) **Result**:

i. A candidate obtaining at least 50% marks in the supplementary Theory paper(s) and 50% marks in the supplementary practical examination, as the case may be, shall be declared successful.

ii. A candidate who has failed in supplementary theory paper(s) examination shall have to reappear only in the failed theory paper(s) at the subsequent examination.
iii. A candidate who has failed in supplementary practical examination shall have to reappear both in theory (all papers) and practical at the next main examination.

v. Promotion to Second/Third Year

1. A candidate appeared in the University examination and failed in theory paper(s) /Practical examination shall be promoted to next year
2. A candidate will be allowed to appear for the Final (3rd) year examination only when the backlog of all papers (theory and practical) of first year and second year exams is cleared
3. The student is required to complete the course within 6 years from the joining of the course

vi. Result - Division: Successful candidates will be categorized as under –

1.	Those, securing 50% and above but less than 60% in the aggregate marks of First, Second & Third year taken together	-	Pass
2	Those, securing 60% and above but less than 75% in the aggregate marks of First, Second & Third year taken together	-	Pass with I Division
3	Those, securing 75% and above in the aggregate marks of First, Second & Third year taken together	-	Pass with Honours

12. GRACE MARKS

1. A student who appears in the whole examination in first attempt and obtains the required minimum pass marks in the total aggregate of an examination but fails to obtain the minimum pass marks in one subject (in theory and / or practical as the case may be) will be awarded the grace marks up to a maximum of 05 marks according to the following scale, provided the candidate passes the examination by award of such grace marks:

Marks obtained by the candidate above the required minimum aggregate pass marks		**Grace marks can be given up to**
Up to 6 marks	-	02
Up to 12 marks	-	03
Up to 18 marks	-	04
19 marks and above	-	05

2. No grace marks would be awarded to a candidate who appears in part/ supplementary/remand examination. Non appearance of a candidate in any part of the examination on account of any reason will make him ineligible for grace marks.
3. A candidate who passes the examination after the award of grace marks in a paper/practical or the aggregate will be shown in the marks sheet to have passed the examination by grace. Grace marks will not be added to the marks obtained by a candidate from the examiners.
4. If a candidate passes the examination but misses First or Second Division by one mark as applicable to the Faculty, he will be given one mark in the paper in which he gets the least marks and also in the aggregate of the subject as well as the complete examination to upgrade his division and make him entitled for the first or second division, as the case may be. Indication of this up-

gradation will be given in the tabulation register as well as in the marks sheet of the candidate.

5. Non appearance of a candidate in any part of the examination will make him ineligible for grace marks.
6. A candidate who is awarded grace marks in any subject to pass the examination will not be entitled for distinction in any subject.
7. The place of the candidate who is awarded given grace marks to pass the examination or given one mark for up-gradation of his division in the examination merit list will, however, be determined by the aggregate marks he secures from the examiners.

13. **REVALUATION / SCRUTINY**

Revaluation of answer book(s) of the B.Sc. Courses is permissible in not more than 25% of the theory papers within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form alongwith the requisite fees. Such answer book(s) shall be re-evaluated as per University rules. Revaluation of answer book(s) shall not be permitted for second attempt in any paper.

Scrutiny (re-totaling) of answer book(s) of the B.Sc. Courses is permissible within 15 days from the date of declaration of examination result on submission of his/her application on the prescribed form alongwith the requisite fees as per University Rules.

Permission for revaluation / scrutiny

1. In 1st Attempt – Revaluation shall be permitted in 25% of the appeared papers. Scrutiny shall be permitted for all the papers.
2. In 2nd Attempt – Only scrutiny shall be permitted in all the papers. Revaluation shall not be permitted.
3. Revaluation shall also be permitted in 25% of such papers in which a candidate appears for the 1st time irrespective of his attempt in the whole examination.
4. Candidates passing all the subjects of one examination at different times shall be issued their mark-sheets showing actual attempts taken by them in passing the particular examination.
5. For determining the attempt, following criteria shall be followed –

S. No.	Situation	Attempt in next examination	
1.	Candidate is detained in all subjects	His attempt in all the subjects in the next examination will be treated as	1st Attempt
2.	Candidate permitted in all subjects But did not appear in all permitted subjects	His attempt in the next examination will be treated as	1st Attempt
3.	Candidate is detained in one / few subjects Permitted for the rest of the subjects Appeared in permitted subjects	His attempt in the detained subject(s) in the next examination will be treated as	2nd Attempt
4.	Candidate is detained in one / few subjects Permitted in the rest of the subjects Did not appear in the permitted subjects	His attempt in the next examination In detained subject(s) will be treated as In permitted subject(s) will be treated as	1st Attempt
5.	Candidate permitted in all subjects But did not appear in few subjects	His attempt in the permitted subjects in the next examination will be treated as	2nd Attempt

Curriculum Outline

Distribution of Teaching hours

1ST Year B.Sc. Cardiac Perfusion Technology

Course Title	Hours
Applied Anatomy of Cardio Vascular, Respiratory, Renal and Nervous system	100
Applied physiology of Cardio Vascular, Respiratory, Renal System	150
Applied Biochemistry and biophysics	80
Cardiac Pharmacology	160
Basics of Perfusion Equipment	80
Principles of Perfusion Technology	70
Sterilization and Disinfection	80
Cardiac operation Theatre Etiquette	80
Total Theory Hours	**800**
Practical	400
Total Hours :	**1200**

2nd Year B.Sc. Cardiac Perfusion Technology

Course Title	Hours
Basic Pathology of Caardio vascular, Respiratory and Renal system	150
Basic Haematology and Coagulation System	150
Clinical Cardiac Diagnostics : CXR, ECG, ABG, 2D Echo & CAG	150
Extra Corporeal Circulation Physiology and Pharmacology	150
Mechanism and functioning of CPB Machine	100
Biomedical Waste Management	100
Total Theory Hours	**800**
Practical	400
Total Hours :	**1200**

3rd Year B.Sc. Medical Physics

Course Title	Hours
Introduction to CTVS surgical Techniques	150
CPB in Adults case wise management	150
CPB in Congenital Defects	150
CPB for non cardiac cases	100
Blood Transfusion during CPB, Precautions and Adverse events	100
Recent Advances in Cardiac Perfusion Technology IABP and ECMO	100
Medico legal Considerations and Record Keeping	50
Total Theory Hours	**800**
Practical	400
Total Hours :	**1200**

SYLLABUS

B.Sc.- Cardiac Perfusion Technology

(3 Years Degree Course)

Learning Objectives:

At the completion of this course, the student should be –

1. Able to execute all routine cardiac perfusion related management of cardiac surgical cases and procedures as per requirement of CTVS surgeon and cardiologist.
2. Able to assist treatment of CTVS surgeon and cardiologist in planning & procedures, and implementation of newequipment/technology.
3. Able to provide adequate knowledge about the safe handling of various equipments and machinery related to perfusion technology.
4. Able to transfer knowledge and skills to students as well as younger professionals.
5. Able to actively participate and also independently work in research in the field of cardiac perfusion technology /clinical research/trials and related areas.

Expectation from the future graduate in the providing patient care

1. The course work is designed to train students to work in conjunction with CTVS team including CTVS Surgeon, cardiac anesthesiologists and other members, in the management of all types of cardiac surgical cases and emergencies.
2. Course work includes physics, anatomy and physiology, clinical cardiology, biomedical

safety, research methodology, patient data management and teaching methodologies. The student will be skilled in extra corporeal perfusion management of patients, administration of IABP and ECMO, provision of circulatory system support and imparting education to students and young professionals in the field.

B. Sc (Cardiac Perfusion Technology)

Syllabus First Year

Theory Paper :

Paper-I – Applied Anatomy and Physiology

Paper-II - Basic Biochemistry and Pharmacology

Paper-III - Physics for Perfusionists

Paper-I Applied Anatomy and Physiology

1. ANATOMY OF CARDIOVASCULAR SYSTEM

- Gross anatomy and structural features of heart
- GREAT VESSELS: Structure of blood vessels and its organization.

2. ANATOMY OF RESPIRATORY SYSTEM

- Organization of the respiratory system
- Gross structure and features of trachea and bronchial tree
- Gross structure and histology of lungs

Pulmonary circulation – pulmonary arteries, pulmonary veins and bronchial arteries.

3. ANATOMY OF NERVOUS SYSTEM

- Brain – location, gross features, parts, functional areas, cerebral

blood circulation.

- Spinal cord – gross features, extent, blood supply and coverings.

4. ANATOMY OF RENAL SYSTEM

- Organization of renal system
- Kidneys: location, gross features, structure, blood supply and nerve supply

- Ureters and urinary bladder – location, gross features and structure.

APPLIED PHYSIOLOGY

1 **Physiology of cardiovascular system**

- INTRODUCTION – Functions of CVS and blood circulation. Tissue perfusion and microcirculation
- CARDIAC CYCLE – Various phases

- Cardiac output – definition, measurements, regulation and control

- Stroke volume, Arterial pressure and itsregulation

Peripheral resistance, Venous return, Heart rate

- LOCAL

- Vasodilation, Auto regulation (myogenic theory)

Vasodilator metabolites, kinins and vasoconstriction

- SYSTEMIC

- Circulatory vasoconstrictors

- Neural and hormonal regulatory mechanism

- Cardio inhibitory center

- Baro and chemo receptors

- Movement of fluids and dissolved solutes in the body

- Basics of electro cardio gram – Definition, electrical condition, atrial activation, atrial complex, ventricular activation, ventricular complex and normal values

2 **PHYSIOLOGY OF RESPIRATORY SYSTEM**

- Upper airway – nose, pharynx, larynx

- Lower airway – trachea bronchial tree

- The mucus blanket – mucus and cilia

- Lung parenchyma – alveoli, gaseous exchange, alveolar macrophages and surfactant.

- Physics of ventilation – principles of elasticity compliance and airway resistance.

- Mechanism and regulation of respiration

- Principles of gaseous exchange

- Concept of physiological shunt and its effect Brief concept of artificial ventilation

3 **HAEMATOLOGY**

- Components of blood – their normal values andfunctions
- Blood groups and briefly procedures involved in blood transfusion
- Briefly coagulation factors and coagulation cascade (Hemostasis)

4 **PHYSIOLOGY OF RENAL SYSTEM**

- Organization and functions of renal system
- Renal circulation and glomerular filtration rate
- Mechanism of urine formation and excretion
- Renal function tests

PAPER 2 **APPLIED BIOCHEMISTRY and PHARMACOLOGY**

APPLIED BIOCHEMISTRY

- Proteins I: Composition and Structure
- Proteins II: Structure-Function Relationships in Protein Families
- Enzymes: Classification, Kinetics, and Control
- The Cytochromes P450 and Nitric Oxide Synthases
- Biological Membranes: Structure, Receptors, and Solute Transport
- Fundamentals of Signal Transduction
- Bioenergetics, Mitochondria, and Oxidative Metabolism
- Carbohydrate Metabolism I: Major Metabolic Pathways and Their Control
- Carbohydrate Metabolism II: Special Pathways and Glycoconjugates
- Lipid Metabolism I: Synthesis, Storage, and Utilization of Fatty Acids and Triacylglycerols
- Lipid Metabolism II: Pathways of Metabolism of Special Lipids
- Amino Acid and Heme Metabolism
- Purine and Pyrimidine Nucleotide Metabolism
- Metabolic Interrelationships
- Biochemistry of Hormones

APPLIED BIOPHYSICS

- The Biochemical Structure and Function of the cell membrane
- Transport across cell membrane
- Active Transport Sodium and potassium channels
- Osmotic Pressure of Cells
- *Oncotic pressure and fluid mechenics*
- Solvent Accessible Surface Area
- Ion Channels and Ion Pumps
- Cytochrome Oxidase Enzymes
- A Simplified Model Calculation

- Principal of Fluid mechanics
- Gas liquid interphase
- Unit conversion to SI system.

APPLIED PHARMACOLOGY

1. Cardiovascular drugs

- Antihypertensives
- Beta Adrenergic antagonists
- Alpha Adrenergic antagonists
- Peripheral Vasodilators
- Calcium channel blockers
- Antiarrhythmic drugs
- Cardiac glycosides
- Sympathetic and non sympathetic inotropic agents.
- Coronary vasodilators.
- Antianginal and anti failure agents
- Lipid lowering & anti atherosclerotic drugs.
- Drugs used in Homeostasis – anticoagulants Thrombolyticsand antithrombolytics, Fibrinolysis inhibitor
- Cardioplegic drugs- History, Principles and types of Cardioplegia.
- Priming solutions – History, principles & types.
- Drugs used in the treatment of shock.

2. Pharmacological protection of organs during CPB

3. **Inhalational gases and emergency drugs.**

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

5. Diuretics

6. Detailed review of drugs and fluids commonly added to the pump by the perfusionist and/or anaesthetist

- Mannitol
- Sodium bicarbonate
- Cardioplegic solutions

- Potassium, magnesium, and calcium ions
- * Heparin
- * Blood and blood products
- * Crystalloid and colloid solutions
- * Vasoactive drugs
- Anaesthetic vapour agents

PAPER 3 APPLIED PHYSICS FOR PERFUSIONISTS

An introduction to the properties of liquids and gases and the medical application of pressures in fluids and the cardiovascular system, mass and heat transfer as they apply to equipment used in extra- corporeal perfusion.

1. Introduction to thermal sciences, review of calculus

2. Pressure, hydrostatics, and intro concepts in thermodynamics

3. Conservation of mass

4. The first law of thermodynamics and mechanical energy balance

5. Applications of conservation of energy

6. Integral conservation of linear momentum

7. Concepts in cardiovascular fluid mechanics

Flow through tubes

8. Intro to differential analysis and the continuity equation

9. The Navier-Stokes equations

10. Transport applications in cardiopulmonary bypass: oxygenation andultrafiltration

11. Mass transfer and the differential component mass balance

12. Gas laws, solubility of gases

13. Volume, pressure, flow

14. Mass, density, viscosity

15. Heat units, temperature scales, heat transfer

16. Diffusion/osmosis

17. Molarity, concentrations

- Sterilization and Disinfection
- Cardiac operation Theatre Etiquette

Reference Books:

1. B.D.Chaurasia Human Anatomy
2. Khurana: Human Physiology
3. A. K. Jain Textbook of Physiology
4. U. Satyanarayna : Medical Biochemistry
5. K D Tripathi Pharmacology
6. Gravlee Cardiopulmonary Bypass: Principles and Practice

B. Sc (Cardiac Perfusion Technology)

Syllabus Second Year

Theory Paper :

Paper-I – **Applied Pathology and Hematology**

Paper-II - **Clinical Diagnostics**

Paper-III - **Principles of Perfusion Technology**

Second Year Syllabus Paper-I – Applied Pathology and Hematology

1 **CARDIOVASCULAR SYSTEM**

- Atherosclerosis
- Ischemic heart disease
- Valvular heart disease
- Cardiac hypertrophy and hypertensive heart disease
- Cor pulmonale and pulmonary hypertension
- Myocarditis
- Cardiomyopathies
- Pericardial disease
- Endocrines and the heart
- Heart tumors
- Arrhythmias and conduction disorders
- Diseases of the aorta: Aneurysms and dissections

2 **HAEMATOLOGY**

- Anaemia – definition, morphological types and diagnosis of anemia

brief concept about haemolytic anaemia and polycythemia.

- Leukocyte disorders – briefly leukaemia, leukocytosis,

agranulocytosis etc.,

- Bleeding disorders – definition, classification, causes and effects of

important types of bleeding disorders. Briefly various laboratory tests

used to diagnose bleeding disorders.

. Blood Transfusion Techniques

- Blood grouping
- Minor and Major cross matching
- Venous Sample Collection
- Storing Techniques of Blood Products
- Blood collection from Donor
- Separation of the Blood products

3.RESPIRATORY SYSTEM

- Chronic obstructive airway diseases – definition and types
- Briefly concept about obstructive versus restrictive pulmonary diseases
- Pulmonary congestion and edema
- Pleural effusion – causes, effects and diagnosis

5. RENAL SYSTEM

- Clinical manifestation of renal diseases
- Briefly causes, mechanism, effects of acute renal failure and

chronic renal failure. Briefly glomerulonephritis and pyelonephritis

Brief concept about obstructive uropathy

Second Year Syllabus Paper-II – Clinical Diagnostics

1. Basics of diagnostic techniques-

A. Laboratory investigations in relation to perfusion technology
B. Chest of X-ray,
C. ECG,
D. ABG
E. Angiography,
F. 2 D Echo
G. TEE

2. Monitoring and instrumentation-

A. Instrumentation technology of ECG machine, pressure transducers, syringe and
B. peristaltic pumps, monitors, ventilators, pulse oximeters, temperature probes
C. and thermo regulatory monitoring,defibrillators.
D. Hemodynamic monitoring, Haemostatic monitoring.
E. Maintenance of oxygen, carbon dioxide and acid base status andtheir monitoring
F. Coagulation Monitoring
G. • Coronary artery and graft flow measurement
H. • Resuscitation and support
I. • Catheterisation
J. • Angiography
K. • Angioplasty
L. • EPS Studies
M. • Valvuloplasty
N. • Intra-aortic balloon

Second Year Syllabus Paper-III – Principles of Perfusion Technology

1.Physiology of extra-corporeal circulation

1. Assessment of patients before bypass; going on & coming offbypass.
2. Hemodilution and priming solutions
4. Principles of extracorporeal gas exchange
5. Analyzing & correction of ABG,VBG and other blood investigations

2. Perfusion Equipment - Hardware:

1. Heart-lung machines/centrifugal pumps
2. Pressure and low level alarm devices
3. Heart-lung heater/coolers
4. Mechanical/electronic flow meters, blenders
5. Perfusion data's recording, store keeping
6. In-line oxygen saturation devices
7. In-line blood gas devices
8. Oxygen analyzers
9. Cell savers
10. Intra-aortic balloon pump

3. Pathophysiology of cpb

1. Blood cells trauma & Anticoagulation in bypass: its monitoring and complications Blood conservation & Auto transfusion

- Risks of blood transfusion
- Blood conservation techniques

2. Myocardial Protection & Cardioplegia

- History
- Various methods of myocardial protection
- Reperfusion injury, oxygen free radicals ,myocardial edema
- myocardial protection for specific clinical problems
- problems during Cardioplegia delivery
- Hot shot

3 Effects of CPB

- Immune and inflammatory response
- Fluid balance and interstitial fluid accumulation
- Nervous system
- Renal function
- The lungs
- The liver

4 Hypothermia

- Physiology
- Deep Hypothermic Circulatory Arrest
- Alterations with temperature change
- Acid-base
- Organ function

Reference Books:

1. Pathology and Genetics for nurses K. Swaminathan

2. Text Book of pathology Harsh mohan

3. P J Mehta: Practical Medicine
4. Gravlee Cardiopulmonary Bypass:

Third Year Syllabus Paper-I– CLINICAL APPLICATION OF CPB TECHNIQUES

1. **Conduct, Monitoring & Termination of CPB**

Check lists

* Flow/pressure
* Hemodilution
* Acid/base balance
* Oxygen and carbon dioxide exchange
* Patient core temperature
* Anticoagulation
* Hypothermia

* Pressure, flow, resistance

* Adequacy of perfusion

* Myocardial preservation

General bypass : Management of Adult cardiac cases

Coronary Artery Bypass Graft Surgery

Valvular Replacement Surgery

Fem-Fem bypass Emergency

2. Accidents and safeguards

Third Year Syllabus Paper-II– PERFUSION FOR SPECIAL PROCEDURES

1. **Aortic Surgery**

2. **Management of Unusual Problems & Special Consideration in Perfusion**

I. Sickle cell

A. Pathophysiology

B. Considerations for CPB

C. Other blood disorders

II. Methemoglobinemia

A. Pathophysiology

B. Considerations for CPB

III. Thalassemia

IV. Spherocytosis & elliptocytosis

V. Hemosiderosis & hemochromatosis

VI. Erythrobolastosis fetalis

VII. Hereditary coagulation disorders

A. Von Willebrand's disease

a) Type I

b) Type II

c) Type III

B. Hemophilia A

C. Hemophilia B

VIII. Acquired coagulation disorders

A. Disseminated intravascular coagulation (DIC)

B. Primary fibrinolysis

C. Vitamin K dependent deficiency

IX. Platelet disorders

1. Thrombocytopenia

2. Cold Agglutinin

X. Perfusion techniques for Pregnant Patients.

XI. Malignant Hyperthermia.

XII Re-Operations

Third Year Syllabus Paper-III ADVANCED PERFUSION TECHNIQUES

1. ECMO

2. Counter pulsation and VENTRICULAR ASSIST DEVICES(VAD)

3. Minimally Invasive Cardiac Surgery(MICS)

4. Perfusion for Non cardiac Procedures

- Liver transplant
- Isolated Limb Perfusion

6. Recent advances in Perfusion Techniques

PEDIATRIC PERFUSION

1. Preparation for CPB: Equipment

Preparation of the Patient for CPB

2. Blood Flow, ECC component and circuit selection

Cannulation

3. Priming

Conduct of Bypass

CO2 management & Choice of Acid Base management

Fluid Management and Drug management during CPB

Myocardial Protection

4. ECMO for Neonates, Infants and Children – Components

Circulatory assist devices for Infants and children

Blood Conservation Techniques

1. Preparation for CPB:

Equipment Preparation of the Patient for CPB

2. Blood Flow, ECC component and circuitselection Cannulation

3. Priming

Conduct of Bypass

CO2 management & Choice of Acid Base management Fluid

Management and Drug management during CPB Myocardial

Protection

ECMO for Neonates, Infants and Children – Recent Advances in Cardiac Perfusion Technology IABP and ECMO Medico legal Considerations and Record Keeping

Reference Books:

1. Gravlee Cardiopulmonary Bypass: Principles and Practice
2. Robert Bojar Manual of Perioperative Care in Adult Cardiac Surgery
3. Hensley martin A Practical Approach to Cardiac Anesthesia
4. Principles and PracticeCardiac Surgery In Adults – by LawrenceCohn
5. Pediatric Cardiac Surgery – by Constantine Mauroudi - 4thedition.

First Year B.Sc Cardiac Perfusion Technology Degree Examinations

Paper 1. Applied Anatomy and Physiology

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

Long Question **(2x10=20)**

1. Define coagulation of blood and name the coagulation factors. Explain the intrinsic mechanism of blood coagulation.
2. Describe right lung under the following headings:
   (2+2+3+3=10)

Surfaces and borders • Hilum • Microscopy • Broncho pulmonary segments

Short notes any five (5x7=35)

1. Kidney function test
2. Cardiac output
3. Cerebral Protection
4. Adequate visceral perfusion
5. Cardioplegia
6. mean arterial blood pressure

Answer briefly any nine (9x5=45)

a) Circle of Willis
b) GCS
c) Oligouria
d) Difference between artery and vein
e) Normal ABG
f) .Hematocrit Value on CPB
g) .Metabolic acidosis
h) .Normal pressure in different chambers of heart
i) Aorta and main branches
j) Left and right coronary artery

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First Year B.Sc Cardiac Perfusion Technology Degree Examinations

Paper 2. Basic Biochemistry and Pharmacology

Long Question **(2x10=20)**

1. What are vasopressors. What are indications and side effects of vasopressors (5+5=10)

2. Describe the pharmaco-kinetics and pharmacodynamics of heparin. Enumerate its clinical indication and adverse effects. (3+3+4=10)

Short notes any five (5x7=35)

I. Insulin
II. TXA
III. Propofol
IV. Midazolam
V. Nitroglycerine
VI. Albumin

Answer briefly any nine (9x5=45)

1. Lipid profile
2. Basal metabolic rate
3. Drugs used in CPR
4. Lasix
5. Roth era's test
6. Blood urea estimation
7. Metabolic acidosis
8. Mannitol
9. NaHCo3
10. Protamine

First Year B.Sc Cardiac Perfusion Technology Degree Examinations

Paper 3. Physics for Perfusionists

Your answers should be specific to the questions asked

Draw neat labeled diagrams wherever necessary

LONG ESSAYS (Answer any Two) 2 x 10 = 20 Marks

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

(5+5=10)

2. Define Osmotic Pressure. Explain importance of osmosis during CPB. Enumerate factor affecting osmotic pressure. How to maintain good osmotic pressure during CPB. (2+2+3+3)

3. Short notes any five (5x7=35)

I. Viscosity
II. Gas exchange through membrane oxygenator
III. Effect of change in temperature on perfusion
IV. Partial pressure of oxygen
V. Pulsatile flow versus non pulsatile flow
VI. Boyle's law

4.Answer briefly any nine (9x5=45)

1. Sweep rate
2. Calibration of CPB machine
3. Flow -resistance reltionship
4. Bernoulli's theorum
5. Arterial wave form
6. pH
7. Metabolic acidosis correction
8. Base excess
9. Hand cranking
10. Einthoven triangle

CARDIAC PERFUSION TECHNOLOGY (PAPER 1 Clinical Pathology)

II Year B.Sc. Cardiac Perfusion Technology Degree Examination

Your answers should be specific to the questions asked

Draw neat labeled diagrams wherever necessary

LONG ESSAYS 2 x 10 = 20 Marks

1. Discuss the Pathophysiology and complications of myocardial infarction

2. Define and enumerate different types of heart failure

SHORT ESSAYS (Answer any five) 5 x 7 = 35 Marks

I. Pulmonary oedema
II. Peripheral vascular disease
III. Fallot's tetrology
IV. Pulmonary atresia
V. Polycythemia
VI. Renal hypertension

SHORT ANSWERS (answer any nine) 9x 5= 45Marks

a) Aortic regurgitation
b) Pulmonary blood circulation
c) Obstructive airway diseas
d) Pericarditis
e) Renal dysfunction
f) Jugular vein cannulation
g) ECMO in COPD or ARDS patients
h) Pericardial effusion
i) Tissue valve
j) Laboratory diagnosis of vitamin B12 deficiency anemia

II Year B.Sc. (Cardiac Perfusion Technology) Degree Examination

Paper 2 Hematology and Clinical diagnostics

Time: Three Hours Max. Marks: 100 Marks

Your answers should be specific to the questions asked

Draw neat labeled diagrams wherever necessary

LONG ESSAYS 2 x 10 = 20 Marks

1. Heparin and its monitoring during cardiopulmonary bypass

2. Diagnosis of myocardial infraction.

SHORT ESSAYS answer any five 7 x 5 = 35 Marks

a. Atrial fibrillation
b. DC shock
c. Cell saver
d. Hemeturia during CPB
e. ACT
f. Super oxide ion

SHORT NOTES answer any nine 5 x 9 = 45 Marks

I. Heart block
II. Echocardiography
III. Syringe pumps
IV. Venting of the heart
V. Roller pump
VI. Venous reservoir
VII. Sweep gas flow
VIII. Treatment of VF
IX. Membrane oxygenator
X. Vortex pump

II Year B.Sc. (Cardiac Perfusion Technology) Degree Examination

Paper 3 Principles of Perfusion Technology

Time: Three Hours Max. Marks: 100 Marks

I. Elaborate on **2x 10 = 30**

1. Hemodynamic aspects of Cardio Pulmonary Bypass
2. Effect of cardioplegia on Cardiac Cycle and its reversal

II. Write Notes (answer any five) **5x 7 = 35**

1. Coronary Perfusion
2. Oxygen Toxicity
3. Biocompatible materials
4. Nervous Control of Heart
5. Priming solution
6. Pre Cardio Pulmonary Bypass check list

III. Short Answers (answer any nine) **9 X 5 = 45**

1. Extra corporeal membrane oxygen
2. Intra Aortic Balloon Pump
3. Circuit alarms
4. Hematocrit
5. Auto transfusion
6. Roller pumps
7. Electrolyte imbalance
8. Venting of the heart
9. Priming volume
11. Oxygen transport in Blood

B.Sc., CARDIO PULMONARY PERFUSION CARETECHNOLOGY
THIRD YEAR

PAPER I – CPB management in CTVS OR and CSSD

Time :Threehours **Maximum : 100**

Marks Answer allquestions

I. Elaborateon:(2 x 10 =20)

1. Describe the steps in weaning off from cardiopulmonarybypass..
2. Myocardial Protection in cardiacsurgery.

II. Write notes:answer any five (7 x 5 =30)

1. Total circulatory arrest
2. Alternatives toHeparin?
3. Intra-aortic balloon pump - principle, indications andcontraindications.
4. Veno-Arterial Extracorporeal membraneoxygenation.
5. Peripheral Canulation sites for CP bypass.
6. Disposal of biomedical waste

III. Short answers:answer any nine (9 x 5=45)

1. Write notes on Low urine output in the post operativeperiod.
2. Complications of BloodTransfusion.
3. ECG changes inHyperkalemia.
4. Write on the principle ofHemodialysis.
5. Disinfection and sterilization practice .
6. Write notes on venting of theheart.
7. Describe the contributions of Walton Lillehei to Cardiacsurgery.
8. Write notes on Autotransfusion.
9. Describe Heparin InducedThrombocytopenia.
10. Machine failure during CPB.

III Year B.Sc. (Cardiac Perfusion Technology) Degree Examination

PAPER II - Perfusion for special cases

Time :Threehours **Maximum : 100**

Marks Answer allquestions

I. Elaborateon **2 x 10 =20**

1. Cardioplegia solution & itsdelivery in AVR
2. Cardiopulmonary bypasscircuit in femoral access CPB

II. WriteNotes answer any five **7 x 5 =30**

1. Coagulation pathways
2. Draw Rough Diagram of a extracorporealcircuit
3. PumpPriming.
4. Air lock & itssolution.
5. Periodic maintenance of heart lungmachine
6. Checklist before going on cardiopulmonarybypass

III. Short Answers answer any nine **9 X 5 =45**

1. Factors activated on contact of blood with extracorporealcircuit
2. Centrifugalpumps
3. MembraneOxygenator
4. Preoperative investigations forCPB
5. Mean arterial pressure duringCPB
6. Steps for aspesis during assemblingcircuit
7. Hemotherm
8. Arterial linefilter
9. Cooling and rewarming for circulatoryarrest.
10. Hemofilter

III Year B.Sc. (Cardiac Perfusion Technology) Degree Examination

Paper 3 Advanced Perfusion Techniques and ECMO

Time: Three Hours Max. Marks: 100 Marks

Your answers should be specific to the questions asked

Draw neat labeled diagrams wherever necessary

LONG ESSAYS **2 x 10 = 20 Marks**

1. Differences between CPB and ECMO circuit. Explain Principles of Extracorporeal gas exchange during ECMO.

2. Enumerate differences between CPB management of adult and pediatric cardiac surgery case.

Write Notes answer any five 7 x 5 = 35 Marks

a) Alpha stat
b) Cerebral protection
c) Total circulatory arrest
d) Aprotinin
e) BIS
f) Vortex pump

SHORT ESSAYS answer any five **9 x 5 = 45 Marks**

1) Blood Salvage techniques
2) Heparin coated circuit
3) Recent advances in perfusion medicine
4) Post pump syndrome
5) Adverse reaction during Blood transfusion
6) Disposal of biomedical waste
7) Vasovagal shock
8) Digoxin toxicity
9) Stuck mechanical valve
10) Acute lung injury