

Mahatma Gandhi University
of
Medical Sciences & Technology, Jaipur

Syllabus

M.Sc. Cardiac Perfusion Technology

**(2 Years Degree Course +
1 Year Internship)**

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.

**M.Sc. Cardiac Perfusion Technology
(Code)**

(2 Years Degree Course + 1 Year Internship)

Rules & Regulations

1. TITLE OF THE COURSE

The title of the course shall be “M.Sc. Cardiac Perfusion Technology”.

2. DURATION OF COURSE/TRAINING

The course shall be of two years duration and one year internship from the date of commencement of academic session.

3. MEDIUM OF INSTRUCTION

English shall be the medium of instruction

4. ELIGIBILITY FOR ADMISSION:

Candidate should have passed the Bachelor's Degree in Cardiac Perfusion Technology as one of the main subjects.

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 M.Sc. Course in Mahatma Gandhi Medical College & Hospital 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. TRAINING:

1. The period of training for M.Sc. shall be of two years from the date of admission.
2. Part – I and Part – II of the course shall be of one-year duration each.
3. The candidate will undertake the post graduate training as a full time post graduate in the department concerned.
4. The students will be required to complete the prescribed period of study and fulfill the requirement of attendance before they are allowed to appear in the University examination.

11. EXAMINATION AND ASSESSMENT

1. The examination of Part I shall consists of three theory papers and internal assessment and practical & viva-voce examination.
2. The examination of Part II shall consist of three theory papers & internal assessment and practical in the opted specialization.
3. A candidate shall be permitted a maximum of 4 years from the year of admission to complete the course and pass the examination failing which, the candidate will have to leave the course.
4. Only those candidates will be allowed to appear at Part II examination, who have passed Part –I examination completely.
5. Degree of M.Sc. Medical Physics will be awarded to a candidate only after his successful completion of one year compulsory internship.

12. 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.

13. SCHEME OF EXAMINATION

The Examination in Part I shall consist of:

Paper	Marks
Theory	
Paper I - Principles of Cardiac Science	100 Marks
Paper II -Pathophysiology and Hematology	100 Marks
Paper III - Biomedical Engineering and Patient Safety	100 Marks
Internal Assessment	100 Marks
Practical & Viva Voce Examination	100 Marks
Total Marks	500 Marks

Notes:

1. Each theory paper shall be of 3 hours duration.
2. Each paper will be set by the External Examiner of the subject concerned and will be assessed by the internal examiner of the subject concerned.

Pattern of questions to be set and answered shall be as follows:

Paper	No. of questions to be set	No. of questions to be answered
Paper I	4	4
Paper II	4	4
Paper III	4	4

3. In order to pass the University Examination, the candidate must secure a minimum of 50% marks in each theory paper including internal assessment and 50% marks in practical and viva-voce examination separately.
4. A candidate who has failed in one or more theory paper of Part-I Examination must appear in that theory paper in supplementary examination which will be conducted by university within 2 – 4 months.

The Examination in of Part II shall consist of:

Paper	Marks
Theory	
Paper I - CPB Management of Cardiac Surgery Cases	100 Marks
Paper II -Special Case Management on CPB	100 Marks
Paper III - Recent Advances and Medico-legal Education	100 Marks
Internal Assessment	100 Marks
Practical & Viva Voce Examination	100 Marks
Total Marks	500 Marks

Notes:

1. Each theory paper shall be of 3 hours duration.
2. All papers shall be set by the External Examiners.
3. Paper I will be assessed by the External Examiner and Paper II will be assessed by the Internal Examiner viz. Head of the Department of subject concerned. Paper III will be assessed by Professor / Associate professor / Assistant professor

Pattern of questions to be set and answered shall be as follows:

Paper	No. of questions to be set	No. of questions to be answered
Paper I	4	4
Paper II	4	4
Paper III	4	4

4. Practical examination shall be conducted by one Internal, one External Examiner which will be appointed by the university.
5. In order to pass the examination the candidate must secure a minimum of 50% marks in Theory papers including internal assessment and 50% marks in practical and viva-voce examination separately.
6. In case a student passes either in Theory or in Practical only, the student shall be considered to fail in the whole examination and he will have to appear in both the Theory and Practical in the subsequent examination.

14. APPOINTMENT OF EXAMINER AND PAPER SETTERS

- a. All the examiners, paper setters, theory examination answer books evaluators, Internal and External Examiners for Practical examinations shall be appointed by the President of the University.
- b. Qualification of the Paper setter / Examiner: Assistant Professor and above.
- c. Paper setter can be an examiner

15. GRACE MARKS

No grace marks will be provided in M.Sc. Examination

16. REVALUATION / SCRUTINY

No Revaluation of answer books shall be permitted in M.Sc. Examination. However, the candidate can apply for scrutiny of marks as per University Rules.

SYLLABUS

M.Sc.- Cardiac Perfusion Technology

(2 Years Degree Course)

Learning Objectives:

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

1. Able to execute all routine and complex 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 new equipment/technology.
3. Able to provide recent advance knowledge about the safe handling of various equipments and machinery related to perfusion technology.
4. Able to transfer advanced knowledge and skills to students as well as younger professionals.
5. Able to actively and independently work in 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 for candidates to provide advanced training 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 intended to build up confidence in candidates in all areas related to cardiac perfusion technology which 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.

Curriculum Outline

Distribution of Teaching hours

1ST Year Master of Cardiac Perfusion Technology

Course Title	Hours
Cardiac, Vascular and Respiratory Physiology and Anatomy	100
Pharmacology for Perfusion Technologists	70
Fundamentals of Medical science and biochemistry	80
Patho physiology of Extra Corporeal Circulation	150
Patho physiology of Adult heart diseases	100
Patho physiology of Complex congenital heart defects	100
Hematology and Coagulation System	100
Blood Transfusion and Adverse Reaction Management	100
Total Theory Hours	800
Practical	400
Total Hours :	1200

2nd Year Master of Cardiac Perfusion Technology

Course Title	Hours
Physiological Effect of Deep Hypothermic circulatory Arrest	80
Clinical Cardiology for Perfusionists (ECG,Echo, ABG, CAG, IABP)	120
CPB management of Adult heart surgery.	120
CPB management of Complex congenital heart defects surgery	120
CPB in Emergency Life saving situations	80
CPB in Non Cardiac Cases	80
Recent Advances in Perfusion Technology	80
Medicolegal implications and Record Keeping	60
Trouble shooting in Perfusion Technology	60
Total Theory Hours	800
Practical	400
Total Hours :	1200

SYLLABUS

M.Sc.CARDIAC PERFUSIONTECHNOLOGY(Code)

(2 Years Degree Course + 1 Year Internship)

Aims and objectives of the M.Sc.Cardiac Perfusion technology:

To develop human resources in the field of perfusion technology with teaching ability and research temperament, who shall:

1. Provide the life saving health care to the sickest patients in efficient way using hi-tech gadgets.
2. Teach and train future students in this field of perfusion technology - both undergraduates and post graduates, in colleges, institutions, hospitals and such educational initiatives
3. To undertake and guide research activities to improve the practice of perfusion technology.
4. To develop administrative and organizing capabilities in their area to manage the resources (men and materials) with the sense of cost-effectiveness.
5. To learn the sense of responsibility & accountability in their services.
6. To create the sense of adopting best practices with a focus centered on patient safety.
7. To develop the system of audit and introspection through regular morbidity and mortality meetings and to improve the quality of services.
8. To impart the communicative skills related to their profession
9. To develop the conscience of team spirit, passion of professionalism, collegiality and maintenance of good rapport and relations with the other health care members
10. To participate in health teams to provide care during natural or man-made calamities
11. To keep abreast with the latest developments by self-learning and / or participating in continuing medical education programmes.

M. Sc (Cardiac Perfusion Technology)

Syllabus First Year

Theory Paper :

Paper-I – Principles of Cardiac Science

Paper-II - CPB Pathophysiology and Hematology

Paper-III - Biomedical Engineering and Patient Safety

Paper-I – Principles of Cardiac Science

- a. Advanced cardiac, vascular and respiratory physiology
- b. Fundamentals of molecular science & Biochemistry – Carbohydrates, proteins, lipids, trace elements, iron, calcium, cellular metabolism, ionic transport across cell membranes, chemical mediators.
- c. Drugs Used during CPB
- d. Pharmacology of Cardiovascular drugs
- e. Pharmacological protection of organs during CPB
- f. Emergency drugs.

Paper-II - CPB Pathophysiology and Hematology

1. Pathological considerations of Adult cardiovascular system
2. Pathological considerations of Congenital cardiovascular system : Neonatal physiology, general homeostasis & fluid management in pediatric age group, CPB effects on children.
3. Pathological considerations of Extra cardiac system
4. Pathological considerations of Respiratory system

5. Hematology : Hemodilution and its effect on Extra Corporeal Ciculation
6. Coagulation Pathophysiology
7. Blood Transfusion and Conservation during CPB

Paper-III - Biomedical Engineering and Patient Safety

- a. Health-economy. Biomedical engineering - equipment principles and maintenance.
- b. Biostatistics, basics of research and publishing & community healthcare.
- c. Common basic concepts: Patient safety, biomedical wastemanagement, audit, database maintenance, quality in perfusion technology,

Syllabus Second Year

Theory Paper :

Paper-I – CPB Management of Adult and Paediatric Cardiac Surgical Cases

Paper-II -Special Case Management on CPB

Paper-III - Recent Advances and Medico-legal Education

Second year: Paper-I – CPB Management of Adult and Paediatric Cardiac Surgical Cases

- I. General bypass : Management of Adult cardiac cases and Myocardial preservation
- II. Coronary Artery Bypass Graft Surgery
- III. Valvular Replacement Surgery
- IV. Perfusion techniques in congenital non cyanotic heart disease
- V. Perfusion techniques in congenital cyanotic heart disease
- VI. Perfusion techniques in newborn with complex congenital heart disease
- VII. Accidents and safeguards

Paper-II -Special Case Management on CPB

- I. Perfusion techniques in patients with coagulopathy
- II. Perfusion techniques in patients with Renal Dysfunction
- III. Perfusion techniques in patients with co morbidities
- IV. Fem-Fem bypass Emergency
- V. Perfusion techniques for Pregnant Patients.
- VI. Malignant Hyperthermia.
- VII. Re-Operations

Second year: Paper-III - Recent Advances and Medico-legal Education

Recent advances and updates in Cardiopulmonary bypass (CPB) and perfusion technology under thesections:

- i. Inflammatorymediators,
- ii. Heart lung machine,
- iii. Oxygenators,
- iv. Heater-coolerequipment,
- v. Heatexchanger,
- vi. Arterialfilters,
- vii. Hemofiltration & hemofilters,
- viii. Pumps in extracorporeal circulation,
- ix. Circuit and cannulae forCPB,
- x. Hypothermia, circulatory arrest, normothermia inECC,
- xi. Myocardial protection andCardioplegia,
- xii. cellsaver,
- xiii. IABP
- xiv. ECMO,
- xv. Non-cardiac application ofECC.
- xvi. Ventricular assistdevices
- xvii. Artificialheart.

b. Recent advances in perfusion in specialcondition:

1. Aorticaneurysms
2. Pregnancy
3. Complex congenital cardiacmalformations
4. Transplantation
5. Traumacare
6. Malignancy
7. Organtransport

List of skills to be learnt at the end of the program:

- The candidate is expected to provide high quality in services related to perfusion technology with advanced skills and knowledge in operating the high end equipment of perfusiontechnology
- Should be able to perform simple biomedical repairs concerned with their gadgets
- Should develop research temperament and teaching potential inperfusion technology.

Teaching learning methods: Bedside rounds, journal club, topic review, clinical case presentation, group discussion, intraoperative hands-on experience, CME's, seminars, conferences, etc.

Posting in various units (if applicable):

- Biostatistics and Preventive and social medicine.
- Department of neonatal & pediatric ICU
- Bloodbank
- Cardiology
- Biochemistry
- Physiology
- Biomedical engineering.

Other requirements:

1. Should prepare and submit the log book of his activities of the year
2. Should prepare a dissertation
3. Preferably publish at least 1 paper in an indexed / national / international journal
4. Preferably present 2 papers at national/international level conference
5. Should have attended at least 3 zonal / national / international conferences related to this specialty.
6. Should attend 3 CME programmes/workshops or wet labs during the training period.

2. DISSERTATION / PROJECT WORK

The Dissertation / Project work shall be conducted under the supervision of an allotted guide of the opted subject. The work shall relate to the lab investigations and quality management of the specialisation area.

The candidate shall submit the Dissertation / Project work as a printed copy to the Head of Department at least one month before commencement of University Theory paper examination otherwise permission to appear in the University examination shall not be granted. The same shall be presented and assessed at the time of Examination.

3. REFERENCE BOOKS

1. Cardiac surgery – by Kirklin and Barrat Boyes – 4th edition.
2. Manual Of Perioperative Care In Adult Cardiac Surgery – by Robert M. Bojjar
3. Cardiac Surgery In Adults – by Lawrence H. Cohn – 4th edition.
4. Pediatric Cardiac Surgery – by Constantine Mauroudi - 4th edition.
5. A Practical Approach To Cardiac Anesthesia - by Glenn p. Gravlee
6. The ICU book – by Paul L. Marino - 4th edition.
7. Kaplan's Cardiac anaesthesia – by Kaplan Reich Sarino – 6th edition
8. Cardiopulmonary Bypass - by Gravlee – 3rd edition.
9. Cardiopulmonary bypass – by Sunit Ghosh – 1st edition.

Journals:

1. Perfusion
2. Circulation
3. Journal of Extracorporeal Technology
4. The Indian journal of Thoracic and Cardio Vascular Surgery
5. The Journal of Thoracic and Cardio Vascular Surgery
6. The Annals of Thoracic Surgery
7. European Journal of Cardio Thoracic Surgery
8. The Asian Annals of Cardio Thoracic Surgery

M.Sc. .Cardiac Perfusion Technology

Part-I (Main) Examination Month Year

Paper 1. Principles of Cardiac Science

Time: Three HoursMaximum Marks: 100

All the parts of one question should be answered at one place in sequential order.

Illustrate your answers with suitable diagrams, wherever necessary

Attempt all questions

Q.1.	Describe causes of metabolic acidosis during extra corporeal perfusion and its management?	[25]
Q.2.	2. Describe cardioplegia. Explain different type's of cardioplegia and their composition.	[25]
Q.3.	a) Discuss hypothermia & it's physiological effects.	[12 ¹ / ₂]
	b) Explain with circuit diagram the various components of CPB circuit.	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	a)Boyle's law.	
	b) ET CO ₂ .	
	c) Graham's Law of diffusion?	
	d) Body surface area.	
	e) Partial pressure of oxygen.	
	f) Controlled cross circulation	
	g) Antisepsis.	

MODEL PAPER
M.Sc. Cardiac Perfusion Technology

Part-I (Main) Examination Month Year

Paper – II
CPB Pathophysiology and Hematology

Time: Three Hours

Maximum Marks: 100

All the parts of one question should be answered at one place in sequential order.

Illustrate your answers with suitable diagrams, wherever necessary

Attempt all questions

Q.1.	1. Write an essay on effect of hemodilution on perfusion technique.	[25]
Q.2.	How do you judge the adequacy of perfusion while conducting Cardiopulmonary Bypass ?	[25]
Q.3.	a) Deep hypothermic circulatory arrest	[12 ¹ / ₂]
	b) Blood gas management on pump perfusion	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	a) Advantages and disadvantages of hemodilution	
	b) Sources of blood returning to the left ventricle and purpose of venting during CPB	
	c) Arterial filters and Bubble traps	
	d) Advantages of pulsatile perfusion	
	e) Membrane Oxygenators	
	f) Crystalloid versus Blood Cardioplegia	
	Changes in pharmacodynamics during CPB	

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M.Sc. Cardiac Perfusion Technology

Part-I (Main) Examination Month Year

Paper – III
Biomedical Engineering and Patient Safety

Time: Three Hours
Maximum Marks: 100

All the parts of one question should be answered at one place in sequential order.
Illustrate your answers with suitable diagrams, wherever necessary

Attempt all questions

Q.1.	1. Write an essay on Effects of CPB on Lungs and Filters.	[25]
Q.2.	Discuss identification and management of adverse blood transfusion reaction on CPB.	[25]
Q.3.	a) CO ₂ management: Alphastat Vs phstat	[12 ¹ / ₂]
	b) Platelet dysfunction drug CPB (ECMO)	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	1.Heparin Coated oxygenerators	
	2.Tubing volume per feet for 1/2 inch, 3/8 inch, ¼ inch	
	3.Quality control assessment in perfusion technology	
	4.Safe disposal of biomedical waste	
	5.Contraindications for IABP	
	6.Bubble detectors	
	7. Reverse autologous priming	

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MODEL PAPER
M.Sc. Cardiac Perfusion Technology
 Part-II (Main) Examination Month Year

Paper – I
CPB Management of Surgical Cases

Time: Three Hours
Maximum Marks: 100

All the parts of one question should be answered at one place in sequential order.
 Illustrate your answers with suitable diagrams, wherever necessary
Attempt all questions

Q.1.	Write an essay on pediatric perfusion techniques and how is it unique from adult cardiac surgery	[25]
Q.2.	Discuss perfusion strategy for 3 year old 9 kg patient of TOF come for total correction surgery.	[25]
Q.3.	a) Changes in ECG during cardioplegia	[12 ¹ / ₂]
	b) cerebral protection during total circulatory arrest.	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	1 Body surface area	
	2. Advantages of hemofilter during neonatal CPB	
	3. Selection of cannula size in pediatric case.	
	4.Composition of ideal priming solution for pediatric case.	
	5. SNP	
	6. Blood salvage techniques	
	7. Blood gas management in pediatric perfusion	

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M.Sc. Cardiac Perfusion Technology
Part-II (Main) Examination Month Year

Paper – II
Special Case Management on CPB

Time: Three Hours
Maximum Marks: 100

All the parts of one question should be answered at one place in sequential order.
Illustrate your answers with suitable diagrams, wherever necessary
Attempt all questions

Q.1.	Write an essay on inflammatory response after extra corporeal circulation.	[25]
Q.2.	Discuss perfusion strategy for minimal invasive mitral valve replacement.	[25]
Q.3.	a) Post pump lung injury	[12 ¹ / ₂]
	b) Adequacy of visceral perfusion during CPB	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	1 ACT Management for ECMO patient	
	2. Mention two surgeries where CPB is used outside cardiac theaters	
	3. Retrograde cerebral perfusion	
	4. Smart cannulae	
	5. Advantages of pulsatile perfusion	
	6. Changes in drug pharmacodynamics during CPB	
	7. Organ Autoregulation	

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MODEL PAPER
M.Sc. Cardiac Perfusion Technology
 Part-II (Main) Examination Month Year

Paper – III
Recent Advances and Medico-legal Education

Time: Three Hours
Maximum Marks: 100

All the parts of one question should be answered at one place in sequential order.
 Illustrate your answers with suitable diagrams, wherever necessary

Attempt all questions

Q.1.	Write an essay on indication of ECMO and explain with circuit diagram the various components of ECMO.	[25]
Q.2.	Discuss new avenues for perfusion technology in current scenario.	[25]
Q.3.	a) Role of perfusionist in organ procurement.	[12 ¹ / ₂]
	b) Medico legal issues in perfusion technology practice.	[12 ¹ / ₂]
Q.4.	Short Notes (any 5 out of 7)	[5x5=25]
	1 Medical record keeping	
	2. Indemnity	
	3. LVAD	
	4. Renal dysfunction after CPB	
	5. Mechanical machine failure.	
	6. ISECT	
	7. History of perfusion technology	

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