BACHELOR OF PARA MEDICAL TECHNOLOGY (BPMT)

Course Name :- Perfusion

Learning Objectives:

By the end of the course, the student should be able to :

1. Understand the history and development of perfusion technology and cardiopulmonary bypass
2. Describe the basic anatomy of cardiac system, respiratory system, renal system and basic anatomy of other systems.
3. Describe basic biochemical parameters and physiological changes
4. Describe physiologic details of cardiac system
5. Describe basic pathologic disorders related to the cardiac system
6. Identify common drugs used for cardiac conditions
7. Demonstrate knowledge of history of
8. Describe working of a heart- lung machine.
9. Describe basics of perfusion technology
10. Describe recent advances of perfusion technology
11. Demostrate skills of a perfusion technician and ability to assist in routine, emergency and complicated cases.

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1st Year: Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
				IA	Final	Total	IA	Final	Total	
1	Paper – I	Basic Sciences		30	60	90	30	80	110	200
2	Paper – II	Applied Anatomy & Other Applied Basics		30	60	90	30	80	110	200
3	Paper – III	Applied Physiology		30	60	90	30	80	110	200

Paper – I
Basic Sciences

Sr. No.	Topics	Lectures	Practical/ Demo
	Section- A		
1	Introduction to Perfusion technology	2	2
2	Role and responsibilities of Perfusion Technician	2	2
3	General precautions in laboratory	2	2
4	Laboratory safety measures	2	2
5	Methods of collection of biological specimens	4	2
6	Preservation and disposal of biological specimens	2	1
7	Modes of transmission of diseases	2	1
8	Control and prevention of infections	2	1
	Section- B		
9	Medical ethics & the relevant medico legal aspects	1	-
10	Medico legal aspects & its relation to consumer protection act	3	-
11	Basics of Medical Statistics	1	-
12	Common statistical terms, Mean & SD.	2	-
13	Basics of computer application	3	-
14	Biomedical waste & its management	1	-
15	Electricity & Electro medical equipments & safe guards	1	-
16	Basics of electricity & functioning of electro medical equipments. Earthing & Care of apparatus. Static electricity.	1	-
17	Basic Principles of blood transfusion & Fluid therapy	1	-
18	Sterilization	4	--

Paper – II
Applied Anatomy & Other Applied Basics

Sr. No.	Topics	Lectures	Practical/ Demo
	Section A		
1	Location, size, surface features, venous area, septum and atrial appendage.	4	4
2	Right atrium structural features, venous area, septum and appendage.	4	4
3	Left atrium structural features venous area, septum and appendage.	4	4
4	Right ventricle structural features inflow and outflow characteristics.	6	4
5	Left ventricle structural features inflow and outflow characteristics.	6	4
6	Valves location, structure and functions of each valve.	6	4
7	Blood supply of Heart in brief: Coronary arteries.	1	3
8	Innovation: Sympathetic and parasympathetic sensory.	1	3
9	Mediastinum and its divisions	3	1
10	Great vessels	4	1
11	Major Arteries and their branches	4	1
12	Major veins and their tributaries	4	4
13	Concepts of coronal, sagital and oblique sections	1	2
14	Cross sectional Anatomy of Heart	8	4
	Section B		
15	Details Anatomy & 3 system	6	3
	A)Cardio thorax	6	3
	B)Respiratory System	6	3
	C)Renal System	6	3
16	Introductory Anatomy & other systems	6	3
17	Histology of Myocardium	2	3

Paper – III Applied Physiology

PHYSIOLOGY OF CARDIOVASCULAR SYSTEM - To be attended along with MBBS undergraduate class. The practical consists of daily posting in CTU where all aspects are taught and reinforced hands on.

Sr. No.	Topics	Theory
1	Introduction to CVS physiology	4
2	Functions of CVS and blood circulation ; Tissue perfusion and microcirculation	4
3	Cardiac output definition, measurements, regulation and control	4
4	Stroke volume, Arterial pressure and its regulation	4
5	Peripheral resistance, Venous return, Heart rate	4
6	Cardiac cycle with special reference to waveforms of pressure tracing	4
7	Heart as a pump physical characteristics of atria, ventricles and valves	4
8	Mechanism of contraction	4
9	Description and organization of pacemaker and conduction system	4
10	Specialized conduction tissues, Sinus node, Inter nodal tracts	4
11	Atrioventricular node, His bundle, Bundle branches	
12	Nodal electricity	1
13	Nervous control of heart rate	1
14	Cardiovascular regulatory mechanism.	1
15	Vasodilation, Auto regulation (myogenic theory)	1
16	Baro and chemo receptors	1
17	Physics of ventilation- principles of elasticity compliance and airway resistance.	1
18	Mechanism and regulation of respiration, Principles of gaseous exchange	1
19	Pulmonary function studies, lung volumes and capacities by use of spirometry	1

20	Brief concept of artificial ventilation	1
21	Components of blood-their normal values and function	1
22	Blood groups and briefly procedures involved in blood transfusion	1
23	Briefly coagulation factors and coagulation cascade	1
24	Renal Physiology Renal function tests	1
25	Routine biochemical investigations	1
26	Cardiac profiles – biochemical markers of myocardial infarction, basic principles, evaluation and application	1
27	Basic principles and estimation blood gas and PH	1
28	Basic principles and estimation of electrolytes	1
29	Transport across cell wall	1
30	Action Potential	1
31	ECG Introductory level	1

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2nd Year : Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
				IA	Final	Total	IA	Final	Total	
1	Paper – I	Applied Pathology & Pharmacology-I		30	60	90	30	80	110	200
2	Paper – II	Basics of Perfusion technology-II		30	60	90	30	80	110	200
3	Paper – III	Applied Perfusion technology-III		30	60	90	30	80	110	200

Paper – I
Applied pathology & pharmacology

Sr. No.	Topics	Lecture /Demo Hours
	Pathology	
	CARDIOVASCULAR SYSTEM	
1	Atherosclerosis – Definition, risk factors, briefly pathogenesis and morphology, clinical significance and prevention	1
2	Hypertension – Definition, types and briefly pathogenesis and amd effects pf hypertension	1
3	Pathophysiology of heart failure	1
4	Ischaemic heart diseases – definition, types. Briefly pathophysiology,pathology and complication	1
5	Valvular heart diseases – cause, pathology and complication	1
6	Congenital heart diseases briefly about pathogenesis and basic effects	1
7	Rheumatic fever & rheumatic cardiac disease	1
	HAEMATOLOGY	
1	Anaemia – definition, morphological types and diagnosis of anemia brief concept about haemolytic anaemia and polycythaemia.	4
2	Leukocyte disorders – briefly leukaemia, leukocytosis, agranulocytosis etc.	4
3	Bleeding disorders – definition, classification, causes and effects of important types of bleeding disorders. Briefly various laboratory tests used to diagnose bleeding disorders.	4
	RESPIRATORY SYSTEM	
1	Pulmonary congestion and edema	2
2	Pleural effusion – causes, effects and diagnosis	2
	RENAL SYSTEM	
1	Clinical manifestation of renal disease Briefly causes, mechanism, effects and laboratory diagnosis of acute renal failure and chronic renal failure. Briefly glomerulonephritis and pyelonephrits	2
2	Brief concept about obstructive uropathy.	2
	Pharmacology	
1	Terminology – Classification of drugs	**1**
2	Principles of drug administration and routes of administration, absorption, distribution, metabolism, excretion of drugs, factors influencing	**1**

	drug action dosage and factors modifying it.	
3	Drug allergy and toxicity, mechanism of drug action (various ways in which they act)	**1**
4	Cardiovascular drugs- (Only introduction, classification and action)	
5	a. Antihypertensives example : beta adrenergic antagonists, alpha adrenergic antagonists etc.	**2**
6	Antiarrythmic drugs	**2**
7	Cardiac glycosides	**2**
8	Sympathetic and nonsympathetic inotropic agents	2
9	Coronary vasodilators	2
10	Antianginal and anti failure agents	2
11	Drugs used in haemostasis –anticoagulants	2
12	Thrombolytics and antithrombolytics	2
13	Cardioplegic drugs – history, principles and types of cardioplagia	2
14	Primary solutions – history, principles and types	2
15	Drugs used in the treatment of shock	2
16	Drugs acting on autonomous nervous system;	2
17	Introduction to following drugs (Only introduction, classification and action) Antihistamines and antiemetics – Analgesics Anaesthetic agents Bronchodialtors Diuretics	8
18	Endocrine Pharmacology: Thyroid hormones, glucocorticoids, anabolic steroids, calcitonin, insulin and oral hypoglycemic agents.	2
19	Pharmacological protection of organs during cardio pulmonary by pass	2
20	Inhalation gases, preparation, classification mechanism of action.	2
21	Pharmacodynamics	2
22	Pharmacokinetics: Haemodilution, hypothermia perfusion, acidbase status, sequestration and pharmacodynamics: Binding (to tissue, protein), age, tissue penetration, temp, acid base status, anaesthetic agents, specific drugs with CPB influence, properties, opiods, neuromuscular blocking drugs, calcium channel blockers, vasodilators, nitraters, beta- blockers, calcium entry blocking drugs in pulmonary bypass surgery.	10
23	Drugs used in cardiopulmonary bypass: premedication drugs used by anaesthesiologists example beta adrenergic blocking agents, calcium entry blocking drugs, antihypertensive drugs, anticholinergic drugs, sedative/hypnotics drugs etc.	10

Paper – II
Basics of Perfusion technology

Sr. No.	Topics	Theory	Practical
1	ECG – Normal electro cardio graph different waves, its significance, atrial arrhythmias, ventricular arrhythmias, heart blocks etc.	2	4
2	Angiography – coronary angio, peripheral angio, coronary- normal coronary and its branches, indications and limitations. Peripheral – cerebral, renal, limbs (upper and lower). Nuclear cardiology – thallium scan, indications, advantages and disadvantages.	12	12
3	Echo- trans thoracic echo, transesophageal echo, indications applications.	12	48
4	Laboratory investigations in relation to perfusion technology Hemoglobin, blood grouping, urine analysis, mini-renal etc.	24	24
5	History of cardiac surgery and perfusion Specific reference of Gibbon Lillehei, Carrel Pre cardio pulmonary bypass surgery Axygous flow	48	48

	principle Hypothermic / nonhypothermic non-cardio pulmonary surgery including gross's well technique and controlled cross circulation.		
6	Monitoring and instrumentation Concepts of monitoring- instrumentation technology of ECG machine, pressure transducers, syringe and peristaltic pumps, monitors, 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.	48	48
7	Haemodynamic monitoring	48	48
8	Haemostatic monitoring	12	12
9	Haemotologic monitoring	12	12
10	Maintenance of oxygen, carbon dioxide and acid base status and their monitoring	12	12
11	Neurological monitoring (SSPE, EEG and cerebral function monitor)	8	8
12	Aspetic technique	4	4

Paper – III
Applied Perfusion Technology

Sr. No.	Topics	Theory	Practical
1	Introduction to extra-corporeal circulation.	12	24
2	Introduction to instruments used in extra-corporeal circulation.	12	12
3	Demonstration of instruments used in extra-corporeal circulation.	12	12
4	Physiology of extra-corporeal circulation Materials used in extracorporeal circuit	8	8
5	Principles of extracorporeal gas exchange.	12	12
6	Various types of oxygenators Bubble oxygenators Rotating spiral / cylinder / disc oxygenators Membrane oxygenators.	24	24
7	Theory of blood pump, 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.	24	24
8	Element of extracorporeal circulation / hazards of: a. Blood Failure b. Bubble trap c. Flow Meters d. Temperatures e. Heat exchanger f. Regulating devices	48	48
9	Connection of the vascular system with extracorporeal circulation: a) Arterial and venous cannulae, connection tubes and connectors vents, suckers, cardioplegia delivery system, venous drainage.	24	24
10	Haemodynamics of arterial return, venous drainage, cardioplegia delivery and venting.	12	12
11	Blood grouping, handling of blood products and their management blood components and their use.	8	8
12	Calculations a. Body Surface Area b. Flows c. Circulating Hb d. Oncotic Pressure e. Sheep Flow	8	8
13	Correction Formulas a. Electrolyte b. Gases	24	24

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3rd Year : Assessment System & Syllabus

Sr. No	Paper	Subject	Subject Code	Theory			Practical			Total Marks
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1	Paper – I	Applied Perfusion Technology - I		30	60	90	30	80	110	200
2	Paper – II	Applied Perfusion Technology - II		30	60	90	30	80	110	200
3	Paper – III	Recent Advances - III		30	60	90	30	80	110	200

Paper – I
Applied Perfusion Technology-I

Sr. No.	Topics	Theory	Practical
1	Pharmacokinetics and pharmacodynamics of the drugs used in cardiopulmonary by pass	12	12
2	Physiology of pulsatile perfusion technology	12	12
3	Principles and methodology of cardiopulmonary bypass	12	12
4	Oxyginators : general considerations and principles	12	12
5	Heat exchangers : general considerations and principles and complications	12	12
6	Priming fluids:its principles and hemodilution	12	12
7	Blood cells trauma	12	12
8	Anticoagulation in bypass : its monitoring and complications	12	10

Paper – II
Applied Perfusion Technology-II

Sr. No.	Topics	Theory	Practical
1	Inflammatory response to cardiopulmonary bypass	24	24
2	Blood conservations and dialysis during cardiopulmonary bypass	24	22
3	Micro pore filters	24	24
4	Perfusion as a method of cardiopulmonary bypass	24	24
5	Complications and its management during cardiopulmonary bypass	24	24
6	Perfusionist in minimal invasive surgery	24	24

Paper – III
Recent Advances

Sr. No.	Topics	Theory	Practical
1	Recent advances in perfusion technology	4	-
2	Cardiopulmonary resuscitation	12	12
3	Pediatric cardiac surgery*	48	48

* It is a highly skilled work and required advanced and elaborate training to be a paediatric perfusion technician

PRACTICALS – PERFUSION TECHNOLOGY

1. Calculation of PCV on CPB and amount of blood to be added to bring the PCV on CPB to particular level
2. Interpretation and correction of a given arterial blood gas
3. Interpretation and correction of a given electrolyte abnormally
4. Calculation of body surface area
5. Performing an ACT estimation and interpretation of results
6. Setting of a dummy CPB circuit
7. Managing a simulated perfusion accident on a dummy CPB circuit including changing oxygenators when on CPB, managing falling/leaking reservoir levels, venous airlocks, air in the arterial line, cardioplegia delivery failure, increased arterial line pressure, recognition of a possible dissection, run a way pump head, recognition of heat exchanger water leak into the CPB circuit, components and their uses, method of sterilization and complications related to them
8. Identification of various CPB circuit components and their uses, method of sterilization and complications related to them
9. Identification of drugs and their pharmacology
10. Calculating vascular resistance on CPB and management of increased perfusion pressure on bypass

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Course Name :- Perfusion

List of Suggested Books for reading

Subject / Topic	Author/ Editor	Title of Book	Publisher
Anatomy	BD Chaurasia		
Physiology	Chandhary		
Biochemistry	Satyanarayana		
Pathology	Hash Mohan		
Phamacology	Tripathi		
Microbiology	Anatnarayan		
Perfusion technology	Gravlee Marce		
Perfusion technology	Christina Vora		
Bypass technology	Charles Reed		
Management of Adult Cardiac Surgery	Bojar		