**CURRICULUM FOR**

**BS CARDIOLOGY TECHNOLOGY**

### SCHEME OF STUDIES

|  |  |  |  |
| --- | --- | --- | --- |
| Semester/Year | Name of Subject | COURSE CODE | Credits |
| First | MEDICAL BIOCHEMISTRY-I | PMS-601 | 3+1 |
|  | HUMAN PHYSIOLOGY-I | PMS-602 | 3+1 |
|  | HUMAN ANATOMY-I | PMS-603 | 3+1 |
|  | ENGLISH-I | PMS-604 | 2+0 |
|  | PAK STUDIES | PMS-605 | 2+0 |
|  | COMPUTER SKILLS | PMS-606 | 1+1 |
|  |  |  | 18 |
| Second | MEDICAL BIOCHEMISTRY-II | PMS-607 | 3+1 |
|  | HUMAN PHYSIOLOGY-II | PMS-608 | 3+1 |
|  | HUMAN ANATOMY-II | PMS-609 | 3+1 |
|  | ENGLISH-II | PMS-610 | 2+0 |
|  | ISLAMIC STUDIES | PMS-611 | 2+0 |
|  |  |  | 16 |
| Third | HEMATOLOGY-I | MLT-601 | 2+1 |
|  | MEDICAL MICROBIOLOGY-I | PMS-613 | 2+1 |
|  | CARDIOPULMONARY ANATOMY | CAR-**601** | 2+1 |
|  | PHARMACOLOGY-I | PMS-614 | 2+1 |
|  | COMMUNICATION SKILLS | PMS-**615** | 2+0 |
|  | GENERAL PATHOLOGY-I | PMS-612 | 2+1 |
|  |  |  | 17 |
| Fourth | HEMATOLOGY-II | MLT-604 | 2+1 |
|  | PHARMACOLOGY-II | PMS-616 | 2+1 |
|  | PATHOLOGY-II | PMS-617 | 2+1 |
|  | MEDICAL MICROBIOLOGY-II | PMS-618 | 2+1 |
|  | BEHAVIOURAL SCIENCES | PMS-619 | 2+0 |
|  | ELECTROCARDIOGRAPHY-I | CAR-602 | 2+1 |

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|  | CARIOPULMONARPHYSIOLOG Y | CAR-603 | 2+0 |
|  |  |  | 18 |
| Fifth | CLINICAL MEDICINE-I | CAR-604 | 2+1 |
|  | ELECTROPHYSIOLOGY | CAR-605 | 2+1 |
|  | ECHOCARDIOGRAPHY-I | CAR-606 | 2+1 |
|  | ELECTROCARDIOGRAPHY-II | CAR-607 | 2+1 |
|  | INTERVENTIONAL CARDIOLOGY | CAR-608 | 2+1 |
|  | MEDICAL PHYSICS | CAR-609 | 2+1 |
|  |  |  | 18 |
| Sixth | CRTICAL CARE | CAR-616 | 2+1 |
|  | CLINICAL MEDICINE-II | CAR-610 | 2+1 |
|  | CARDIAC SURGERY | CAR-618 | 2+1 |
|  | DIAGNOSTIC EQUIPMENTS IN CARDIOLOGY | CAR-611 | 2+1 |
|  | ECHOCARDIOGRAPHY-II | CAR-612 | 2+1 |
|  | PULMONARY DISEASES | CAR-613 | 2+1 |
|  |  |  | 18 |
| Seventh | NUCLEAR CARDIOLOGY | CAR-614 | 2+1 |
|  | HEART DISEASES | CAR-615 | 2+1 |
|  | RESEARCH METHODOLOGY | PMS-621 | 2+1 |
|  | PREVENTIVE CARDIOLOGY | CAR-617 | 2+1 |
|  | EPIDEMIOLOGY | PMS-623 | 2+0 |
|  | BIOSTATISTICS | PMS-622 | 2+1 |
|  |  |  | 17 |
| Eight | RESEARCH PROJECT | PMS-626 | 6+0 |
|  | SEMINAR | PMS-627 | 1+0 |
|  | SUBJECT OF OWN INTEREST | CAR-619 | 2+2 |

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| --- | --- | --- | --- |
|  | BIOETHICS | PMS-625 | 2+0 |
|  | TOTAL – 124-136 | PMS- | 11 |
|  | TOTAL CREDIT HOURS | PMS- | 133 |

**PMS-601 MEDICAL BIOCHEMISTRY-I Credit Hours: 4(3+1)**

**Aims and Objectives**

After successful completion of this course, students will be able to,

* Describe the chemical composition, biochemical role, digestion and absorption of macro and micro molecules of the cell.
* Discuss different biochemical reactions in cell
* Explain mechanism of action of hormones

### Course Detail:

Biochemical composition and functions of the cell membrane; Chemistry of signals and receptors; Structure and function of Carbohydrates, Proteins and lipids; biochemical functions of vitamins; biochemical function of Sodium, potassium, chloride, calcium, phosphorus, magnesium, sulfur, iodine and fluoride; Composition and function of saliva, gastric juice, gastric acid(HCL), pancreatic juice, bile and intestinal secretion; Digestion and absorption of proteins, carbohydrates, lipids, vitamins and minerals; Body buffers and their mechanism of action; Acid base regulation in human body; Biochemical mechanisms for control of water and electrolyte balance; Mechanism of action of hormones.

### Practical:

* Good laboratory Practices
* Preparation of Solutions
* Principles of Medical BIOCHEMISTRY analyzers (sphectrophometer, flame photometer)
* Determination of Cholesterol, Tg, HDL, LDL, sugar, calcium and phosphorus in blood
* Introduction to electrophoresis, PCR, gel documentation
* How to operate centrifuge, water bath and microscope

### Recommended Books:

* Harper‟s Medical BIOCHEMISTRY Robert K. Murray, Daryl K. Granner 28th edition 2009
* Medical Medical BIOCHEMISTRY Mushtaq Ahmad vol. I and II 8th edition 2013

### PMS-602 HUMAN PHYSIOLOGY-I Credit Hours: 4(3+1)

**Aims and Objectives:**

After successful completion of this course, students will be able to,

* Describe the basic concepts of physiology beginning from the cell organization to organ system function.
* Discuss the organization of cell, tissue, organ and system with respect to their functions.
* Explain the physiology of Respiration, G.I.T, Urinary system and Endocrine system

### Course Detail:

Functional organization of human body, Mechanism of Homeostasis, Cell structure and its function, function of different Tissue, Functions of the skin, , Types and function of muscle, Neuromuscular junction, functions of the endocrine glands, Breathing Mechanism, Exchange of respiratory Gaseous, Transport of respiratory gases, Function of different part of Digestive system, Function of liver and pancreas, Digestion and Absorption in Gastrointestinal tract, Patho-Physiology of Gastrointestinal Disorders, Formation of Urine by the Kidney, Glomerular filtration, Renal and associated mechanism for controlling ECF, Regulation of Acid-Base Balance, Male Reproductive System ( Male ), Prostate gland, Spermatogenesis, Female Reproductive System, Menstrual Cycle and Pregnancy and parturition, Mammary Glands and Lactation and Fertility Control

### Practicals:

1. Introduction to microscope
2. Bleeding time
3. Clotting time
4. WBCs count
5. RBCs count
6. Platelets count
7. Reticulocytes count

### Recommended Books:

* + Essentials of Medical Physiology K Sembulingam, Prema Sembulingam Sixth Edition 2013
	+ Concise Physiology Dr. Raja Shahzad 1st Edition 2012
	+ Guyton And Hall Textbook Of Medical Physiology John E. Hall, Arthur C. Guyton Professor
	+ and Chair 2006
	+ Ross and Wilson Anatomy and Physiology in Health And Illness 11th Edition Anne Waugh,
* Allison Grant 2010

### PMS-603 HUMAN ANATOMY-1 Credit Hours: 4(3+1)

**Course Objectives:**

After successful completion of this course, students will be able to,

* Identify the principle structures of tissues, organs and systems
* Discuss the different concepts and terms of general anatomy including skeleton and Musculo skeletal system.
* Explain the anatomy of Thorax, Abdomen and pelvis

### Course contents:

Musculo skeletal system(Axial and Appendicular),Axial Skeleton, Different bones of human body, Axial and Appendicular Skeleton, Classification on the basis of development, region and function, General concept of ossification of bones, parts young bone, Blood supply of long bones. Joints Structural Regional and functional classification of joints,Characteristics of synovial joints, Classification of synovial joints, Movements of synovial joints. Muscular System Parts of muscle Classification of muscles (skeletal, Cardiac, smooth) Thoracic wall: Muscles of thorax, Surface Anatomy, Trachea, lungs, pleura, mammary glands (breast), Heart and thoracic vessels. Thoracic cavity: Mediastinum, Lungs, bronchi, blood supply and lymphatic Abdominal wall: Skin, nerve and blood supply, Muscles of anterior abdominal wall. Abdominal cavity: General Arrangement of the Abdominal Viscera, Peritoneum, Omenta, mesenteries, Stomach, blood, nerve, lymphatic supply, Small intestine, blood, nervous and lymphatic supply, Large intestine: blood nerve and lymphatic supply. The pelvic wall: Anterior, posterior wall, diaphragm. Pelvic cavity: Ureters, urinary bladder Male genital organs, Female genital organs, Muscles of pelvic region, blood supply, nerve supply, Special Senses.

### Practicals:

* Study Axial and Appendicular skeleton on human skeletal model.
* Study musculoskeletal system on human musculoskeletal model.
* Study organs of special senses.
* Study and understand anatomy of Thorax, Abdomen and Pelvis through:
* Human Models
* Video demonstration.

### Recommended Books:

* Ross and Wilson Anatomy and Physiology in helth and illness 11th Edition Waugh Grant.
* Clinical Anatomy (By regions) 9th edition, Richard S. Snell.

### Reference books:

* Netter Atlas of human anatomy 5th Edition Saunders.
* Gray’s Anatomy for students 2nd Edition Drake Vogal Mitcell

### PMS-604 ENGLISH –I Credit Hours: 2+0 Aims and Objectives:

After successful completion of this course, students will be able to,

* Compose a well-constructed essay that develops a clearly defined claim of interpretation which is supported by close textual reading.
* Utilize literary terminology, critical methods, and various lenses of interpretation in their writing.
* Apply the rules of English grammar.
* Adhere to the formatting and documenting conventions of our discipline

### Course Contents:

Vocabulary Building Skills: Antonyms, Synonyms, Homonyms, One word Substitute, Prefixes and suffixes, Idioms and phrasal verbs, Logical connectors, Check spellings, Practical Grammar

& Writing Skill: Parts of Speech, Tenses, Paragraph writing: Practice in writing a good, unified and coherent paragraph, Précis writing and comprehension, Translation skills: Urdu to English, Reading skills: Skimming and scanning, intensive and extensive, and speed reading, summary and comprehension Paragraphs, Presentation skills: Developing, Oral Presentation skill, Personality development (emphasis on content, style and pronunciation)

### Recommended books:

* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
* Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

### PMS-605 Pakistan Studies Credit Hours: 2(2+0)

**Aims and Objectives**

After successful completion of this course, students will be able to,

* Develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
* Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.
* Inculcate patriotism in the hearts of students so that they may become a good citizen.

### Course Contents:

Historical Perspective: Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah, Factors leading to Muslim separatism, People and Land, Indus Civilization, Muslim advent, Location and Geo-Physical features. Government and Politics in Pakistan, Political and constitutional phases:1947-58,1958- 71,1971-77,1977-88,1988-99,1999 onward Contemporary Pakistan: Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

### Books Recommended:

* Akbar, S. Zaidi. *Issue in Pakistan’s Economy.* Karachi: Oxford University Press, 2000.
* Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
* Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.
* Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.

### PMS-606 COMPUTER SKILLS Credit Course: 2(1+1)

**Aims and Objectives**

After successful completion of this course, students will be able to,

* Use technology ethically, safely, securely, and legally.
* Identify and analyze computer hardware, software, and network components.
* Design basic business web pages using current HTML/CSS coding standards.
* Install, configure, and remove software and hardware

### Courses Contents:

Introduction to Computer and Window XP/7, MS Office 2007 (Word, Excel, PowerPoint); Internet access and different data bases available on the internet; Email

### Recommended Books:

* Computer science by Muhammad Ashraf, edition 1st 2010

**2nd Semester Courses**

1. Medical BIOCHEMISTRY-II

2. Human Physiology-II

1. Human Anatomy-II
2. English-II
3. Islamic Studies

### PMS-607 MEDICAL BIOCHEMISTRY-II Credit Hours: 4(3+1)

**Aims and Objectives:**

After successful completion of this course, students will be able to,

* Describe the synthesis of proteins, lipids, nucleic acids, carbohydrates and their role in metabolic pathways along with their regulation
* Discuss the clinical role of enzymes in human being.
* Interpret and apply nutritional concepts to evaluate and improve the nutritional health of individuals with medical conditions.

### Course Contents:

Balance food, Major food groups, Nutritional status of Pakistani nation, Metabolic changes in starvation, Protein energy malnutrition, Regulation of food intake, Obesity; metabolism of carbohydrates (Citric Acid Cycle, Glycolysis, Pentose Phosphate Pathway), proteins (urea and corie cycle), nucleotides (uric acid formation) and lipids (beta oxidation); Respiratory chain and oxidative phosphorylation, components of respiratory chain, electron carriers, ATP synthesis coupled with electron flow, phosphorylation of ADP coupled to electron transfer; clinical diagnostic enzymology: clinical significance of ALT, AST, ALP, LDH, CK, CKMB, Pancreatic lipase and amylase, cholinesterase, G6PD, GGT.

### Practicals:

1. Determination of liver, cardiac, pancreatic enzymes
2. Determination of urea and uric acid

### Recommended Books:

* + Harper‟s Medical BIOCHEMISTRY Robert K. Murray, Daryl K. Granner 28th edition 2009
	+ Medical Medical BIOCHEMISTRY Mushtaq Ahmad vol. I and II 8th edition 2013

### PMS-608 HUMAN PHYSIOLOGY-II Credit Hours: 4(3+1)

**Aims and Objectives**

After successful completion of this course, students will be able to,

* Demonstrate a systematic and coherent knowledge of the physiological functioning of the central nervous system, special senses (CNS & SS), cardiovascular system and respiratory system.
* Describe the formation of the formed element components of blood.
* Identify the components and function of the lymphatic system and discuss the role of the innate immune response against pathogens

### Course Contents:

Physiology of Nervous System, Function of various cranial nerves, Functions of somatic motor nervous system Functions of the autonomic nervous system, function of neurons, neuroglial cells and their components. Resting membrane potential and an action potential, function of a synapse and reflex arc, functions of the specialized sense organs: Eye, physiology of site, accommodation, optic nerve and optic chiasma, Ear, functions of the internal, middle and external ear Physiology of the hearing and balance, Smell, physiology of olfactory nerve. Taste, physiology of taste Location of the taste buds Physiology of speech, Blood: Composition and function of Blood , haematopoisis, Blood grouping, Coagulation mechanism, Physiology of Cardiovascular system The Physiology of Pulmonary Systemic Circulation: Arteries Veins Local Control of Blood Vessels Nervous Control of Blood Vessels Regulation of Arterial Pressure, The function of Lymphatic System, tonsils, lymph nodes, the spleen and the thymus, Classification and physiology of Immune system, Antigens and Antibodies, Primary and secondary responses to an antigen Antibody-mediated immunity and cell-mediated immunity Role of lymphocyte in immunity regulation.

### Practicals:

* Spirometry
* Electrocardiography
* Blood Pressure Measurement
* Normal and abnormal ECG interpretation
* Pulse rate measurement
* Heart sounds

### Recommended Books:

* Essentials of Medical Physiology K Sembulingam, Prema Sembulingam Sixth Edition 2013
* Guyton And Hall Textbook Of Medical Physiology John E. Hall, Arthur C. Guyton Professor and Chair 2006
* Ross and Wilson Anatomy and Physiology in Health And Illness 11th Edition Anne Waugh, Allison Grant 2010

### PMS-609 HUMAN ANATOMY-II Credit Hours: 4(3+1)

**Aims and objectives**

After successful completion of this course, students will be able to,

* Identify bones of the upper limb and bony landmarks that articulate at each joint with all muscular compartments of the upper limb.
* Discuss bones of the lower limb and bony landmarks that articulate at each joint with all muscular compartments of the lower limb and identify these structures on radiographic images.
* Describe the topographical and functional anatomy of the head and neck, in particular the arrangement, relations and structure of the major skeletal, muscular and neurovascular components of the head and neck

### Course Detail:

The upper limb Bones of shoulder girdle and Arm, Muscles, Axilla, Brachial plexus, Cubital fossa, the forearm, hand bones, muscles, Blood supply, Nerve supply, lymphatics, The lower limb Fascia, Bones, Muscles, Femoral triangle, Blood supply, Nerve supply, Lymphatic supply. Head and neck Skull, Mandible, Cranial nerves, cranial cavity, Meninges, Brain, Orbit, Neck, Endocrine System Classification of endocrine glands, Pituitary glands, Thyroid Glands, Adrenal gland and differences between the cortex and medulla.

### Practicals:

Study and understand the anatomy of Upper limb, Lower limb, Head and Neck through:

* + Human Models
	+ Video demonstration
	+ Study radiographs of upper and lower limb.

### Recommended Books

Essential books (text books)

* + Ross and Wilson Anatomy and Physiology in health and illness 11th Edition Waugh Grant.
	+ Clinical Anatomy (By regions) 9th edition, Richard S. Snell.

### Reference books

* + Netter Atlas of human anatomy 5th Edition Saunders.
	+ Gray’s Anatomy for students 2nd Edition Drake Vogal Mitcell.
* BD. Churasia Human Anatomy (All regions)

### PMS-610 ENGLISH –II Credit Hours: 2(2+0) Aim and Objectives:

After successful completion of this course, students will be able to,

* Develop writing, reading and listening skills.
* Demonstrate integrative and independent thinking, originality, imagination, experimentation, problem solving, or risk taking in thought, expression, or intellectual engagement.
* Participate in discussions by listening to others' perspectives, asking productive questions, and articulating original ideas.

### Course Contents

Writing Skill: CV and job application, Technical Report writing, Writing styles, Changing narration: Converting a dialogue into a report, Converting a story into a news report, Converting a graph or picture into a short report or story, Active and Passive voice, Letter / memo writing and minutes of the meeting, use of library and internet recourses, Essay writing, Phrases - Types and functions, Clauses - Types and functions, Punctuation: Tenses - Types, Structure, Function, Conversion into negative and interrogative. Speaking Skill: Group Discussion (Various topics given by the teacher), Presentation by the students (individually), Role Play Activities for improving Speaking. Listening Skill: Listening Various Documentaries, Movies, and online listening activities to improve the listening as well as pronunciation of the words.

### Recommended Books:

* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.
* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492.
* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
* Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
* Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

### PMS-611 ISLAMIC STUDIES Credit Hours: 2(2+0)

**Aims and Objectives:**

After successful completion of this course, students will be able to,

* Recognize basic concept of Islam (faith, pillars and systems etc.) and express their impact on society.
* Present Islam as complete code of life and demonstrate understanding of Islamic Ethics.
* Demonstrate the role of a medical professional in Islam.

### Course Contents:

Fundamental beliefs of Islam, Belief of Tawheed, Belief in Prophet hood, Belief in the Day of Judgment, Worships, Salaat / Prayer, Zakat /Obligatory Charity, Saum / Fasting, Hajj / Pilgrimage, Jihad, Importance of Paramedics In Islam, Ethics, Religion and Ethics, Higher Intents / Objectives of Islamic Sharia and Human Health, Importance and Virtues of Medical Profession, Contribution and Achievements of Muslim Doctors, Knowledge of the Rights, Wisdom and Prudence, Sympathy /Empathy, Responsible Life, Patience, Humbleness, Self Respect, Forgiveness, Kindhearted, Beneficence, Self Confidence, Observing Promise, Equality, Relation among the Doctors, Jealousy, Backbiting, Envy, Etiquettes of Gathering, Relation between a Doctor and a Patient, Gentle Speaking, Mercy and Affection, Consoling the Patient, To inquire the health of Patient, Character building of the Patient, Responsibilities of a Doctor

### Recommended Books:

* Islamiyat (Compulsory) for Khyber Medical University, Medical Colleges and Allied Institutes

**3rd Semester**

## Hematology – I

* 1. **Medical Microbiology – I**
	2. **Cardiopulmonary Anatomy**
	3. **Pharmacology – I**
	4. **Communication Skills**

**6. General Pathology – I**

### MLT-601 HEMATOLOGY-I Credit Hours: 3 (2+1) Course Objectives:

* + To introduce the students about the basic concepts in Hematology and acquire skill in practical work to produce students steeped in knowledge of Hematology.
* To equip students with latest advancements in the field of hematology.

### Course Contents:

Introduction to hematology, physiology of blood and composition, introduction to bone marrow, structure and function of bone marrow, blood formation in the body (Intra-uterine and extra-uterine), factors governing hematopoiesis, erythropoiesis, different stages and factor effecting on erythropoiesis, granulopoiesis, different stages and factor effecting on granulopoiesis, megakariopoiesis, different stages and factor effecting on megakariopoiesis, introduction to hemoglobin structure, synthesis and function, complete blood count and its importance, morphology of red blood cells and white blood cells, introduction to anemia and classification of anemia, introduction to hemolysis (physiological and pathological), introduction to WBC disorders, introduction to leukemia, etiology, pathogenesis and its classification, leukocytosis, leukopenia, neutrophilia, condition related to neutrophilia, neutropenia, condition related to neutropenia, eosinophilia, condition related to eosinophilia, eosinopenia, condition related to eosinopenia, monocytosis, condition related to monocytosis, monocytopenia, condition related to monocytopenia, lymphocytosis, condition related to lymphocytosis, lymphopenia, condition related to lymphopenia, basophilia, condition related to basophillia, introduction to hemostasis, mechanism of hemostasis, function of platelets and coagulation factors, coagulation cascade, quantitative disorder of platelets, , qualitative disorder of platelets.

### Practical:

* Collection of Blood Sample
* Preparation and Staining of Peripheral Blood Smear
* Total Leucocyte Count; Red Blood Cell Count, determination of Absolute Values; differential Leucocyte Count; Platelets count and Reticulocytes count
* To determine the ESR
* Determine Bleeding Time; Prothrombin Time; Activated partial thromboplastin time

### Recommended Books:

* Essential of Hematology,A.V Hoff Brand, 6thedition 2006
* Clinical Hematology, G.C Degrunchi, 5th edition 2002
* Practical Hematology,Dacie J.V. 10th edition 2012

### PMS-613 MEDICAL MICROBIOLOGY - I Credit hour: 3(2+1)

**Course objectives:**

* + To introduce the students with basic concepts in bacteriology and mycology
	+ To introduce the students with common bacterial and fungal infections
	+ To introduce the students with diagnosis of common bacterial and fungal infections

**Course contents:**

Historical review and scope of microbiology, sterilization, disinfection and antisepsis, structure and function of prokaryotic cell, difference between prokaryotic and eukaryotic cell, bacterial growth and metabolism, bacterial classification, normal microbial flora of human body, mechanism of bacterial pathogenesis, host parasite interaction, Immune response to infection, common bacterial pathogen prevailing in Pakistan, introduction to fungi, fungal characteristic, morphology, structure, replication and classification, mechanism of fungal pathogenesis, common fungal pathogen prevailing in Pakistan.

**Practicals:**

* + - Introduction and demonstration of Laboratory Equipments used in Microbiology.
		- Inoculation and isolation of pure bacterial culture and its antibiotic susceptibility testing.
		- Demonstration of different types of physical and chemical methods of sterilization, and disinfection.
		- Students should be thorough to work with compound microscope.
		- Detection of motility: Hanging drop examinations with motile bacteria, non-motile bacteria.
		- Simple staining methods of pure culture and mixed culture.
		- Gram‟s staining of pure culture and mixed culture.
		- AFB staining of Normal smear, AFB positive smear.
		- KOH preparation for fungal hyphae.
		- Germ tube test for yeast identification.
		- Gram stain for candida.

**Recommended books:**

* Sherris Medical Microbiology: An Introduction to Infectious Diseases. Ryan, K. J., Ray, C. G., 4th ed. McGraw-Hill, 2003.
* Clinical Microbiology Made Ridiculously Simple. Gladwin, M.,& Trattler, B., 3rd ed. MedMaster, 2004.
* Medical Microbiology and Infection at a Glance. Gillespie, S., H., Bamford, K., B., 4th ed. Wiley- Blackwell, 2012.
* Medical Microbiology, Kayser, F., H., & Bienz, K., A., Thieme, 2005.
* Review of Medical Microbiology and Immunology. Levinson, W., 10th ed. McGraw Hill Professional, 2008.
* Jawetz, Melnick, & Adelberg's Medical Microbiology. Brooks, G., Carroll, K., C., Butel, J., & Morse, S., 26th ed. McGraw-Hill Medical, 2012.

### CAR-601 CARDIOPULMONARY ANATOMY Credit Hours: 3(2+1)

**Course Objectives:**

* + To identify the bones, structures and their relations with other structures
	+ To examine the respiratory and cardiovascular system
	+ To analyze the effects of physical and pathological diseases on normal anatomy of systems.
	+ To explain clinical procedures related to cardiac and pulmonary anatomy
	+ To choose quality patient care in routine as well as advanced cardiopulmonary procedures

**Course Contents:**

Structure of the thoracic wall, Suprapleural Membrane, Diaphragm, The Thoracic Cavity Basic Anatomy, Anterior Chest Wall Posterior Chest Wall, Lines of Orientation Mediastinum and its contents Relations of the contents of the Mediastinum, Pleurae, Anatomy of Larynx and trachea, Anatomy of lungs, The anatomy of Heart, Relations of heart to other Structure within the Thorax, The general Structure of arteries and veins, The embryonic period and fetal development of the cardiovascular and respiratory systems, Cardiovascular and respiratory changes at birth

**Practical:**

* Identification of different organs and their components
* Radiological Presentation & Pathological Findings on Radiographs
* Identification of cardiac valve areas on the Thoracic wall
* Identification of labeled structures, their features and relations with other structures
* Identification of given ribs with their features
* Identification of normal apex beat anatomically
* To identify major coronary arteries and their branches

**Recommended Books:**

* **Clinical Anatomy** by Snell, in 2000 by Churchill living stone
* **Gray’s anatomy 2nd edition** by Williams warwic Dysone
* ***Lasts Anatomy 11th edition by R.M.H Mcminn***

### PMS-614 PHARMACOLOGY-I Credit Hours: 3(2+1)

**Course Objectives:**

After successful completion of this course, students will be able to,

* Describe common terms related to pharmacology and drug therapy.
* Identify a range of drugs used in medicine and discuss their mechanisms of action.
* Report the clinical applications, side effects and toxicities of drugs used in medicine.

### Course Contents:

Introduction to Pharmacology, Pharmacokinetics, Pharmacodynamics, Adverse effects of drugs, Classification of drugs, Drugs affecting the Autonomic Nervous System, NSAID, Opioids, Drugs Affecting Endocrine system(Corticosteroids, Thyroid and Anti Thyroid), Gastrointestinal Drugs(PPI,H2 blockers and Antacids), Anti-Histamines, Anesthetics(General and local anesthetics),

### Practical:

* + Introduction to drug dosage form 2. Study of the action of drugs (Atropine) on the rabbit's eye

### Recommended books:

* + Lippincott s pharmacology (text book) by Mycek 6th Edition published by Lippincott Raven 2012.
	+ Katzung textbook of pharmacology (Reference Book) by Bertram Katzung 12th Edition, Published by Appleton.

### PMS-615 Communication Skills Credit hours: 2(1+1)

**Course Objectives:**

After successful completion of this course, students will be able to,

* Communicate effectively both verbally and non-verbally
* Apply the requisite academic communication skills in their essay writing and other forms of academic writing
* Use various computer-mediated communication platforms in their academic and professional work
* Relate the interpersonal and organizational dynamics that affect effective communication in organizations..

**Course Contents:**

Introduction to Communication , Meaning and definition of Communication, The process of communication, Models of communication, Effective Communications in Business, Importance and Benefits of effective communication, Components of Communication, Communication barriers, Nonverbal communication, Principles of effective communication, Seven Cs, Communication for academic purposes, Introduction to academic writing, Summarizing, paraphrasing and argumentation skills, Textual cohesion, Communication in Organizations, Formal communication networks in organizations, Informal communication networks, Computer- mediated communication (videoconferencing, internet, e-mail, Skype, groupware, etc.), Business Writing , Memos, Letters, Reports, Proposals, Circulars, Public Speaking and Presentation skills, Effective public presentation skills, Audience analysis, Effective argumentation skills, Interview skills.

**Recommended Books:**

* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition.

Oxford University Press 1986. ISBN 0 19 431350 6.

* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492.
* Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506
* Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-

41.

* Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

### PMS-612 GENERAL PATHOLOGY-I Credit Hours: 3(2+1)

**Course Objectives:**

After successful completion of this course, students will be able to,

* Specify the abnormalities of cell growth and differentiation.
* Describe cellular responses to stress and noxious stimuli and inflammation.
* Discuss cell injury, cell death and mechanisms involved in wound healing.
* Explain the hemodynamic disorders and neoplasia.

### Course Contents:

Introduction to pathology, Cell injury, Cellular adaptation, Acute Inflammation, Chronic Inflammation, Cell Repair & Wound Healing, Regeneration & Repair, Haemodynamic Disorders**,** Edema, Haemorrhage, Thrombosis, Embolism, Infarction & Hyperaemia, Shock, compensatory mechanism of shock, possible consequences of thrombosis & difference between arterial & venous emboli, Neoplasia, Dysplasia, benign and malignant neoplasms, metastasis

### Practicals:

* Estimation of Prothrombin Time
* Estimation of Clotting Time
* Estimation of Bleeding Time
* Estimation of Activated Partial Tromboplastin Time

### Recommended Books:

* Robbins Basic Pathology Kumar Abbas Aster 9th Edition 2013
* Review Of General Pathology Moh. Firdaus 9th Edition
* Short Text Book of Pathology Moh. Inam Danish 3rd Edition 2006

**4th Semester**

# General Pathology-II

1. **Medical Microbiology-II**
2. **Electrocardiography-I**
3. **Cardiopulmonary Physiology**
4. **Haematology-II**
5. **Pharmacology-II**
6. **Behavioral Sciences**

### PMS-617 PATHOLOGY-II Credit Hours: 3(2+1)

**Course Objectives:**

* To introduce students with different environmental hazards
* To gain knowledge of some basic systemic diseases

### Course Details:

Health effects of climate change, toxicity of chemical and physical agents, environmental pollution, effect of tobacco, effect of alcohol, injury by therapeutic drugs and drugs of abuse, general principles of microbial pathogenesis, special techniques for identifying infectious agents, agents of bioterrorism, heart failure, congenital heart diseases, ischemic heart diseases, hypertensive heart diseases, arrhythmias, atelectasis, chronic obstructive pulmonary disease, asthma, bronchiactasis, pneumonias, pneumothorax, hemothorax, nephrotic syndrome, renal stone, hydronephrosis, aphthous ulcer, gastritis, peptic ulcer, hemorrhoid, jaundice, liver cirrhosis, viral hepatitis, cholecystitis, urinary tract infections, arthritis, facial palsy

### Practical:

1. Helicobacter pylori test
2. Diagnosis methods of UTI
3. Determination of renal function tests
4. Determination of liver function tests
5. Determination of cardiac profile

### Recommended Books:

* Robbins Basic Pathology Kumar Abbas Aster 9th Edition 2013
* Review Of General Pathology Moh.Firdaus, 9th Edition
* Short Text Book of Pathology Moh. Inam Danish 3rd Edition 2006

### PMS-618 Medical Microbiology-II Credit Hours: 3(2+1)

**Course objectives:**

* + To introduce the students with basic concepts in virology and parasitology.
	+ To introduce the students with common viral and parasitic infections.
	+ To introduce the students with diagnosis of common viral and parasitic infections.

**Course Contents:**

Biosafety levels, control of hospital infection, biomedical waste management, introduction to virology, Viral morphology, structure, replication and classification, general properties of virus, pathogenesis and control of virus, common viral pathogen prevailing in Pakistan, introduction to parasitology, Parasite (protozoan and helminthes) morphology and classification, general principal of pathogenesis, immunology and diagnosis of parasitic infection, common parasitic pathogen prevailing in Pakistan.

**Practical:**

* Cleaning of new and used glass wares for microbiological purposes.
* Students should be familiar to use autoclave, hot air oven, water bath, steamer etc.
* Macroscopic and microscopic examination of stool for adult worms, ova, cysts, larvae.
* Visit to hospital for demonstration of biomedical waste management.
* Demonstration of common serological tests used for the diagnosis of viral and parasitic infection.
* Demonstration of malarial parasites in blood and bone marrow.
* Demonstration of leishmania in blood film.
* Concentration techniques for intestinal parasites in stool.

**Recommended books:**

* Sherris Medical Microbiology: An Introduction to Infectious Diseases. Ryan, K. J., Ray, C. G., 4th ed. McGraw-Hill, 2003.
* Clinical Microbiology Made Ridiculously Simple. Gladwin, M.,& Trattler, B., 3rd ed.

MedMaster, 2004.

* Medical Microbiology and Infection at a Glance. Gillespie, S., H., Bamford, K., B., 4th ed.

Wiley-Blackwell, 2012.

* Medical Microbiology, Kayser, F., H., & Bienz, K., A., Thieme, 2005.
* Review of Medical Microbiology and Immunology. Levinson, W., 10th ed. McGraw Hill Professional, 2008.
* Jawetz, Melnick, & Adelberg's Medical Microbiology. Brooks, G., Carroll, K., C., Butel, J., & Morse, S., 26th ed. McGraw-Hill Medical, 2012.

### CAR-602 ELECTROCARDIOGRAPHY - I Credit Hours: 3(2+1)

* **Course Objectives:**
	+ To describe the basic concepts of EKG
	+ To recognize the basic electro-physiology using EKG
	+ To compute different basic technical ECG abnormalities
	+ To infer different types of arrhythmias
	+ To identify different heart pathologies on the basis of EKG

### Course Contents:

Basic Concepts; Rate, Rhythm, intervals, Cardiac axis, Wave morphologies, Step-by-Step Method for Accurate reporting and interpretation, P, Q, R and T Wave Abnormalities, Bundle Branch Blocks, ST Segment Abnormalities

### Practical:

* Identification of different EKG electrodes
* Placement of Electrodes on the body
* Demonstration of EKG procedure
* Finding heart rate, Rhythm, axis and intervals
* Different types of EKG waves and correlation with different heart chambers

### Recommended Books:

* + EKG by Dale Dubin 6th edition
	+ ECG made Easy by Jhon R 6th edition
	+ Rapid ECG interpretation by Mr. M. Gabriel Khan 3rd edition
	+ An Introduction to ECG by Leo Schamroth 6th edition
	+ ECG Interpretation for the clinical exercise 3rd edition
	+ EKG book by Malcolm. S 4th edition
	+ Manual Of ECG 4th edition

### CAR-603 CARDIOPULMONARY PHYSIOLOGY Credit Hours: 3(2+1)

**Course Objectives:**

* To describe the physiology of Cardiovascular and Respiratory system
* To illustrate the normal physiological parameters related to systems
* To compute the effect of certain factors affecting normal physiology
* To explain advance concepts and calculation related to the physiological functions
* To assess the normal physiological functions for the understanding of different pathologies

### Course Contents:

Cellular Membrane structure & function, Physiologic anatomy of the Heart, Propagation of cardiac Impulse, The cardiac cycle, Pressure change during cardiac cycle. The stroke volume and Stroke out-put, Cardiac out-put regulation of cardiac function. The special excitatory and conductive system of the heart and their control Abnormalities of the cardiac rhythms, The heart sounds. Functional classification of blood vessels, Peripheral circulation: pressure and resistance, The Arterial Blood Pressure, Hypertension, The Arterial Pressure Pulse, The Physiology Of The Veins, The Jugular Venous Pulse, The Physiology Of The Capillaries, Lymph And Lymphatics, The Cutaneous Circulation, Coronary Circulation, Cerebral Circulation And Pulmonary Circulation, Gas Exchange & Diffusion. Perfusion and Ventilation/Perfusion. Acid - base imbalances: pathophysiology of acidosis and alkalosis Heat Exchange, Filters and Reservoirs.

**Practical:**

* Measurement of Blood Pressure
* Demonstration on ECG
* Heart sounds
* Measurement of JVP
* Cardiac output measurements
* Measurement of pulses from various regions of the body
* Interpretation of Arterial blood gases
* Interpretation of different lung volumes and capacities from Lung function test
* Nebulization procedure

**Recommended books:**

* Physiology by Jypee 5th edition
* Cardiovascular Physiology by J.R Levick 2nd edition
* Human Physiology By Guyton and Hall 12th edition
* Illustrated Physiology B. R Mackena 5th edition

### MLT-604 HEMATOLOGY-II Credit Hours: 3(2+1)

**Course Objectives:**

* + To introduce the students about the basic concepts in Hematology and acquire skill in practical work to produce a team of Medical Technologists steeped in knowledge of Pathology
	+ To equip Medical Technologists with latest advancements in the field of hematology.

**Course Contents:**

Iron metabolism, introduction to iron deficiency anemia, different stages and diagnosis, introduction to thalassemia, classification, pathophysiology and its diagnosis, introduction to Sidroblastic

anemia, etiology and diagnosis, folat and vitamin B12 metabolism, introduction to megaloblastic

anemia, etiology and diagnosis, introduction to G6PD deficiency anemia, pathophysiology and diagnosis, introduction to sickle cell anemia, pathophysiology and diagnosis, introduction to hereditary spherocytosis, pathophysiology and diagnosis, introduction to hemolytic anemia,

Immune hemolytic anemia, non-immune hemolytic anemia, aplastic anemia, etiology and diagnosis. ABO and Rh D group system, kell blood group system, ked blood group system, duffy blood group

system, donor selection criteria, phlebotomy of donor, blood products, preparation, storage and its importance, hem vigilance in blood bank, cross match, types of cross match, procedure and its importance, blood grouping and its importance, coomb’s test, types and importance , introduction to

hemolytic disease of newborn, types, pathophysiology, diagnosis and management, hemolytic transfusion reactions and management.

**Practicals:**

* 1. ABO blood grouping (Forward and Reverse grouping)
	2. Rh Blood grouping
	3. Antibodies screening
	4. Cross matching (Major and Minor)
	5. Coombs tests (Direct and Indirect)
	6. Separation of different blood components
	7. Du Test

**Recommended books:**

* + - Essential of Hematology, A.V Hoff Brand, 6th edition 2006
		- Clinical Hematology, G.C Degrunchi, 5th edition 2002
		- Practical Hematology, Dacie J.V. 10th edition 2012

### PMS-616 PHARMACOLOGY-II Credit Hours: 3(2+1)

**Course objectives:**

To provide quality patient care in routine as well as advanced procedures. To understand the mechanism of drug action at molecular as well as cellular level, both desirable and adverse. To understand the principles of pharmacokinetics i.e. drug absorption, distribution, metabolism and excretion and be able to apply these principles in therapeutic practice.

### Course contents:

Drugs acting on cardiovascular system; Drugs for heart failure, anti-hypertensive drugs, antianginal drugs, Anti Hyperlipidemic drugs, Blood drugs(Anticoagulants), Diuretics, Chemotherapeutics drugs([Anti- protozol, Anti-Malarial], Anti-Fungal, Anthelmintic), Antibiotics(Penicillin’s, cephalosporin’s, macrolides, aminoglycosides, fluroquinolones), Drugs acting on Respiratory system(Asthma).

### Practical:

* Routes of drug administration
* Study of action pilocarpine on rabbit eye

### Recommended books:

* Lippincott s pharmacology (text book) by Mycek 6th Edition published by Lippincott Raven 2012.
* Katzung textbook of pharmacology (Reference Book) by Bertram Katzung 12th Edition, Published by Appleton.

### PMS-619 BEHAVIORAL SCIENCES Credit Hours: 2(2+0)

**Course Objectives:**

* To introduce about various diagnostic interviews
* Formulating and clarifying diagnostic findings and treatment recommendations
* Documenting evaluation and treatment procedures, involving duties such as recording results of diagnostic interviews, lab studies, and/or treatment plans in a timely way according to the medical records protocols of the rotation site

### Course Contents:

Introduction to Behavioral Sciences and its importance in health: Bio-Psycho-Social Model of Health Care and the Systems Approach, Normality vs Abnormality, Importance of Behavioral sciences in health, Desirable Attitudes in Health Professionals Understanding Behavior: Sensation and sense organs, Perception, Attention and concentration, Memory, Thinking, Communication, Individual Differences: Personality, Intelligence, Emotions, Motivation, Learning, Stress and Stressors, Life Events, Stress, Management, Interviewing / Psychosocial History Taking, Allied Health Ethics-Hippocratic oath, Culture and Allied Health practice, Psychological reactions, Breaking Bad News, Pain, Sleep, Consciousness.

### Recommended Books:

* + Behavioral Sciences by M.H Rana 2007
	+ Sociology in a Changing World by William Kornblum 8th edition 2007
* Changing Behavior: Immediately Transform Your Relationships with Easy-to-Learn, Proven Communication Skills by Georgiana Donadio 2011

**5th Semester**

# Clinical medicine – I

**Electrophysiology**

**Echocardiography – I**

**Electrocardiography – II**

**Interventional cardiology**

**Medical physics**

### CAR-604 CLINICAL MEDICINE-I Credit Hours: 3(2+1)

**Course objectives:**

* Students will be able to record clinical history, Physical examination and correlate the knowledge to make differential diagnosis of various diseases
* To justify patients, families and caregivers the diagnosis, prognosis and treatment plan for their condition, and educate them about beneficial lifestyle behaviors and preventive health measures.
* To judge routine procedures commonly required for the evaluation and care of patients

### Course Contents:

Introduction of diseases; their clinical features, signs, symptoms and management of diseases. Investigations and their interpretation for various diseases of the following systems: Diseases of Cardiovascular System, Diseases of Respiratory System, Diseases of the Kidney & Urinary System, Diseases of Endocrine system

### Practical:

* Patient History and clinical Examination (General)
* Systematic Examination
* Radiological and Physical Investigations
* First Aid
* Concept of Holistic Health
* Interpretation of investigation
* Diagnosing clinical problems

### Recommended Books:

* + Davidson's Principles and Practice of Medicine, 21st edition
	+ Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine)**, 8th edition**
* Clinical Medicine by Parveen Kumar, Michalclark in by ELBS

### CAR-605 ELECTROPHYSIOLOGY Credit Hours: 3(2+1)

**Course objectives:**

* To describe electrophysiology of the heart
* To list the various cardiac arrhythmias
* To illustrate various protocols for various procedures
* To select an appropriate procedure to treat arrhythmias
* To plan and prepare for Holter monitoring
* To design set up for permanent pace maker
* To set up Electrophysiology laboratory

### Course Content:

Introduction to Electrophysiology, Basic arrhythmia physiology and mechanisms , Electrophysiology device lab set-up , Holter and event monitor laboratory set-up , Bradyarrhythmia and their management by pacing and cardiac resynchronization therapy , Supraventricular tachyarrhythmia , Atrial flutter and fibrillation, Ventricular tachyarrhythmia , Device procedures , Performing basic EP studies , Basic intervals and intracardiac ECGs , Basic EP study protocols , Ablation of SVT , Management and ablation of atrial flutter , Ablation of normal heart ventricular tachycardia .

### Practicals:

* Analysis of various arrhythmias
* Designing lab set up for electrophysiology procedures
* Steps and protocol of Permanent pace maker
* Application of Holter monitor and reporting
* To design set up for Ablation procedures

### Recommended Books:

* Handbook of Cardiac Electrophysiology by Andrea Natale. Informa Healthcare 2007
* Practical Electrophysiology by Todd J 2nd edition
* Clinical Electrophysiology by Andrew J 3rd edition
* Electrophysiology of Arrhythmias by Reginald T 2nd edition

### CAR-606 ECHOCARDIOGRAPHY – I Credit Hours: 3(2+1)

**Course objectives:**

* To explain basic physical principles of ultrasound and instrumentation.
* To Correlate cardiac gross pathology with echocardiography images.
* To evaluate cardiac chamber size, left ventricular systolic and diastolic function and right ventricular systolic function.
* To Analyze and interpret echocardiographic derived hemodynamic data.
* To interpret trans esophageal images and distinguish attributes and limitations versus transthoracic echocardiography

### Course Contents:

History of echocardiography, Development of various echocardiographic Technologies, Recording Echocardiograms, Cardiac Sonographers, Physics and Instrumentation, Physical Principles, Definition of Basic Terms**,** Principles of cardiac ultrasonography, Principles of ultrasound physics and instrumentation, The Doppler principles, The anatomical echocardiographic examinations (Basic Views), Examination and appearance of the normal heart, Quantification of the ventricular performance, Principles of the Doppler examination, Additional imaging formats and techniques, Contrast echocardiography, Artifacts

### Practical:

Clinical application of echocardiography in:

* + Acquired valvular heart disease
	+ Evaluation of prosthetic heart valves
	+ Congenital heart disease of the pericardium
	+ Cardiomyopathies
	+ Ischemic heart disease
	+ Diseases of the aorta
	+ Cardiac masses and tumors
* Pericarditis

### Recommended Books:

* Feigunbaum’s Echocardiography,6th Edition
* Echo Made Easy, by Sam Kaddoura, 2nd Edition

### CAR-607 ELECTROCARDIOGRAPHY – II Credit Hours: 3(2+1)

**Course objectives:**

* To describe the basic concepts of EKG
* To recognize the basic electro-physiology using EKG
* To compute different basic technical ECG abnormalities
* To infer different types of arrhythmias
* To identify different heart pathologies on the basis of EKG
* To relate the EKG abnormalities with the heart and lung pathologies

### Course Contents:

Review of Electrocardiography-I, Q Wave Abnormalities, Atrial and Ventricular Hypertrophy, T Wave Abnormalities, Electrical Axis and Fascicular Block, Miscellaneous Conditions, Arrhythmias, EKG of different Myocardial infarctions, EKG of Different congenital as well as acquired Heart pathologies; Aortic disease, valvular diseases, Pericardial disease, dextrocardia and EKG of different syndromes causing heart disease

### Practical:

* Identification of different EKG electrodes
	+ Placement of Electrodes on the body
	+ Demonstration of EKG procedure
	+ Finding heart rate, Rhythm, axis and intervals
	+ Different types of EKG waves and correlation with different heart chambers
	+ Interpretation of different type of arrhythmias
	+ Interpretation of Myocardial infarction
	+ Interpretation of cardiac chamber hypertrophy and enlargements
	+ Interpretation of Cardiac myopathies
	+ Interpretation of valvular pathologies
	+ Interpretation of different aortic pathologies

### Recommended Books:

* + - EKG by Dale Dubin 6th edition
		- ECG made Easy by Jhon R 6th edition
		- Rapid ECG interpretation by Mr. M. Gabriel Khan 3rd edition
		- An Introduction to ECG by Leo Schamroth 6th edition
	+ ECG Interpretation for the clinical exercise 3rd edition
	+ EKG book by Malcolm. S 4th edition
	+ Manual Of ECG 4th edition

### CAR-608 INTERVENTIONAL CARDIOLOGY Credit Hours: 3(2+1)

**Course objectives:**

* To outline various interventional procedures in cardiology
* To identify various catheters, wires and balloons used in interventional cardiology
* To select various catheters and wires for a particular procedure
* To recognize various interventional procedures
* To predict possible complications of various procedures
* To set up the machine and other necessary equipment’s needed
* To judge the procedure and finding out any problem
* To prepare the things for the smooth running of the procedure
* To plan a particular procedure with a cardiologist

### Course Contents:

An introduction to Interventional Cardiology, Various sites of vascular access , Angiographic views , Practical analysis of guide design of catheters, Guide wires, Balloon angioplasty , Stenting , Transradial approach , Left main artery procedures, Chronic total occlusion , Ostial lesions ,Interventions in acute ST-segment elevation myocardial infarction, Interventions in Patients after Coronary artery bypass graft Surgery , Bifurcation lesion , Complications , High- risk patients , Removal of embolized material , Inoue balloon mitral valvuloplasty , Renal artery interventions, Percutaneous intervention of cardiac congenital anomalies

### Practical:

* Identification of various catheters, wires and balloons
* Identification of Catheter types and procedure they are used for
* Analyzing the procedure by knowing the disease
* Steps of various procedures
* Identification of various lesion’s
* Handling the complications

### Recommended Books:

* + Practical Handbook of Advanced Interventional Cardiology by Thach Nguyen. 4Th edition Wiley & Sons, Ltd., Publication
	+ Oxford Handbook of Interventional Cardiology

### CAR-609 MEDICAL PHYSICS Credit Hours: 3(2+1)

**Course objectives:**

* To list S.I units of physical quantities
* To describe the various conversions of S.I units into other units
* To interpret various equations used in medical physics
* To recognize various principles of fluid dynamics
* To sketch different graphs and their interpretation
* To relate various relations using equations

### Course Contents:

Introduction to medical physics, Physical measurement and calibration, The SI units, The gas laws, Laminar flow, Turbulent flow , Bernoulli, Venturi and Coanda, Heat and temperature, Latent heat, Isotherms, Solubility and diffusion, Osmosis and colligative properties, The valves and their types with their principle, Resistors and resistance, Defibrillators, Resonance and damping, Pulse oximetry, Capnography, Absorption of carbon dioxide, Cardiac output measurement, The echo principle, The Doppler effect, Neuromuscular blockade monitoring, Lung volumes, Spirometry, Flow–volume loops, The alveolar gas equation, The shunt equation, Pulmonary vascular resistance, Ventilation/perfusion mismatch, Dead space, Fowler’s method, The Bohr equation, Oxygen delivery and transport, The oxyhaemoglobin dissociation curve, Carriage of carbon dioxide, Cardiac action potentials, The cardiac cycle, Pressure and flow calculations, Central venous pressure, Pulmonary arterial wedge pressure, The Frank–Starling relationship, Venous return and capillary dynamics, Ventricular pressure–volume relationship, Systemic and pulmonary vascular resistance, The Valsalva manoeuvre.

### Practical:

* + Measurements of length and volume
	+ Measurement of temperature using various thermometer
	+ Calculations to find out various parameters like cardiac output, dead space, Pulmonary artery wedge pressure,
	+ Principle of Sphygmomanometer and measurement of blood pressure
	+ Identification of spirometer, its various parts and analysis of lung function test
	+ Analyzing the resistance of body using Psulli,s equation
	+ To find the gradient across the valves using various equations

### Recommended books:

* + - Physics, Pharmacology and Physiology for Anaesthetists by Matthew E. Cross.

Cambridge latest edition

* + - Medical Physics
		- Physics and body by John R 2nd edition

**6TH SEMESTER**

# Critical care

1. **Clinical Medicine-II**
2. **Cardiac surgery**
3. **Diagnostic Equipments in Cardiology**
4. **Echocardiography-II**

**6. Pulmonary Disease**

### CAR-616 CRITICAL CARE Credit Hours: 3(2+1)

**Course objectives:**

* To outline critical cardiovascular situations
* To recognize critical cardiovascular care in various situations
* To categorize the patient situation
* To plan the right procedure in cardiovascular critical situations
* To access the critically ill patients
* To select various pharmacological and mechanical procedures

### Course Contents:

An introduction to critical care, Shock, Resuscitation in intensive care, Cardiovascular monitoring in critical care, Cardiovascular investigation of the critically Ill, Hematological Aspects of cardiovascular critical care, Cardiovascular support: Pharmacological , Arrhythmias , Mechanical heart failure therapy, Care of the high risk patient undergoing surgery , Common complications of cardiovascular critical illness , Acute coronary syndromes and myocardial infarction , Cardiogenic shock , Aortic dissection , Emergency management of cardiac trauma , Hypertensive crises , Endocrine problems and cardiovascular critical care.

### Practical:

* Assessment of shock and its types
* Assessment of arrhythmias
* Management of shock
* Management of arrhythmias
* Management of Cardiac arrest
* Management of acute Myocardial infarction
* Management of Hypertensive crisis
* Analysis of arterial blood gases
* Management of Cardiac trauma and aortic dissection

### Recommended Books:

* Cardiovascular Critical Care by Mark J.D. Griffiths, Jeremy J. Cordingley and Susanna. 010 Blackwell Publishing Ltd.
* Critical care by Andrea G 4th edition
* Critical care Current diagnosis and treatment by Frederic S 3rd edition

### CAR-610 CLINICAL MEDICINE-II Credit Hours: 3(2+1)

**Course objectives:**

* Students will be able to record clinical history, Physical examination and correlate the knowledge to make differential diagnosis of various diseases
* To justify patients, families and caregivers the diagnosis, prognosis and treatment plan for their condition, and educate them about beneficial lifestyle behaviors and preventive health measures.
* To judge routine procedures commonly required for the evaluation and care of patients

### Course Contents:

Introduction of diseases; their clinical features, signs and symptoms, management of diseases. Investigations and their interpretation for various diseases of the following systems: Diseases of the Alimentary Tract, Diseases of the Liver & Biliary System, Diseases of the Joints & Bones, Diseases of the Nervous System

### Practicals:

1. Checking up patients
2. Systematic Examination
3. Radiological and Physical Investigations
4. First Aid
5. Concept of Holistic Health

### Recommended books:

* + Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine), 8th edition
	+ Davidson's Principles and Practice of Medicine, 21st edition

### CAR-618 CARDIAC SURGERY Credit Hours: 3(2+1)

**Course objectives:**

* To describe various cardiac surgical procedures
* To identify the pathologies
* To prepare the required investigation for a specific surgery
* To prepare the patient for surgery
* To evaluate the condition of the patient
* To predict an appropriate procedure in case of an emergency

### Course Contents:

Surgical approaches to the heart and great vessels (An introduction), Preparation for cardiopulmonary bypass, Surgery of various heart valves; valve repair and replacement, Surgery for coronary disease, Surgery of cardiac tumors, Coarctation of the aorta, Atrial septal defect, Patent ductus arteriosus, Transposition of the great vessels, Coronary artery anomalies surgery.

### Practical:

* + Clinical examination
	+ History taking
	+ Pre-Op requirements of a particular procedure
	+ Patient assessment
	+ Investigation required and their interpretation with their importance
	+ Post-Op care of the patients

### Recommended Books:

* + Cardiac Surgery by Siavosh Khonsari. Lippincott 4th edition
	+ Cardiac Surgery by Kerklin 4th edition
	+ Cardiac Surgery by C Narian 2nd edition
	+ Cardiothoracic Surgery by Micheal S 2nd edition

### CAR-611 DIAGNOSTIC EQUIPMENTS IN CARDIOLOGY Credit hours: 3(2+1)

**Course objectives:**

* To name the various equipments used in cardiology
* To describe the indications of the tests
* To prepare the patient for a specific test
* To explain the test procedure and protocol
* To design an appropriate test relating a disease
* To predict the possible complications
* To interpret the results of a test

### Course Contents:

Introduction, Principle, Indications, Contraindications, Complications and uses of diagnostic equipments in cardiology. Following devices will be included: ECG machine, ETT machine, Pulse oximetry, Cardiac monitors, Defibrillator, Echocardiography machine, Ultrasound machine, Cardiac CT, Cardiac MRI, Cardiac X-Ray, Angiography machine, Holter monitors, Equipments used in Electrophysiology Laboratory, Swan Gans cathter, Temporary pacemaker.

### Practical:

* To identify the shown equipments
* To label the parts of given equipment
* Basic knowledge of operation of an equipment
* To eradicate the basic technical fault in the equipment
* To interpret the report of the equipments
* To calibrate the equipments

### Recommended Books:

Not a single book but different books describing the equipment and procedure protocols

### CAR-612 ECHOCARDIOGRAPHY – II Credit Hours: 3(2+1)

**Course objectives:**

* + To recognize the basic concept and principal of Echocardiography
	+ To operate Echocardiographic machine
	+ To identify normal cardiac functions using echocardiography
	+ To express different cardiac pathologies
	+ To explain the use of echocardiography for various procedures
	+ To interpret echocardiography of different diseases of the heart

**Course Contents:**

Overview of the Echocardiography-I, Echocardiography of Tricuspid and Pulmonary valves, Infective Endocarditis, Prosthetic valves, Stress Echo, Cardiomyopathies, Congenital anomalies, ICU and operative uses of Echocardiography, Diseases of Aorta, Masses, Tumors and source of Embolus and their findings, Echocardiography and clinical problems.

**Practical:**

* Basic demonstration of Echocardiographic machine
* Identification of various parts of machine and their functions
* Normal parameters of heart like chamber pressures, wall thicknesses, pressure gradients across valves
* Basic technique to perform the Echocardiography
* Demonstration of different Echocardiographic views of the heart
* Interpretation of Echocardiographic images
* Interpretation of different Congenital anomalies by performing Echocardiography
* Interpretation of different chambers; their wall motion thickness and any masses in them
* Interpretation of transposition of great arteries by performing Echocardiography
* Interpretation of cardiac valves; their normal function and malformations or pathologies as stenosis or regurgitation
* Interpretation of Different types of Cardiomyopathies

**Recommended Books:**

Echocardiography by Feigenbaum 7th edition

Echocardiography by Gabrial A 2nd edition

Clinical Echocardiography by Micheal Y 2nd edition

### CAR-613 PULMONARY DISEASES Credit Hours: 3(2+1)

**Course objectives:**

* To write the investigations used in respiratory medicine
* To describe various diseases of respiratory tract
* To diagnose various respiratory tract diseases
* To plan treatment for various respiratory diseases

### Course Contents:

Examination of the respiratory system, Investigation used to investigate respiratory diseases, Diseases of the upper respiratory tract, Diseases of the lower respiratory tract, Asthma, Pneumonia, Tuberculosis, Diseases of the Respiratory system, Congenital anomalies, Carcinoma, Infections, Adult respiratory distress syndrome, Chronic obstructive pulmonary disease, Pulmonary hypertension, Lung Transplantation, Lung reduction surgery

### Practical:

* History taking in pulmonary diseases
* Clinical Examination in pulmonary diseases
* Interpretation of investigations
* Diagnose of various respiratory diseases
* Management plan for various respiratory diseases

### Recommended Books:

* + Kumar and Clark's Clinical Medicine (Kumar, Kumar and Clark's Clinical Medicine), 8th edition
	+ Davidson's Principles and Practice of Medicine, 21st edition

**7th Semester**

# Nuclear Cardiology

* 1. **Heart Disease**
	2. **Research Methodology**
	3. **Preventive Cardiology**
1. **Biostatistics**
2. **Epidemiology**

### CAR-614 NUCLEAR CARDIOLOGY Credit Hours: 3(2+1)

**Course objectives:**

* Demonstrate a thorough knowledge of the clinical indications, general procedures (including radiopharmaceutical and dose) and Normal/ Abnormal findings in Cardiac nuclear scan.

### Course Contents:

Discuss the basic physical principles of nuclear medicine imaging and instrumentation, Basic atomic and nuclear physics, safe handling of radioactive materials, Identify the isotopes (including physical and chemical properties) that are used routinely in the compounding of radiopharmaceuticals for nuclear Cardiology procedures. Technical aspects of image acquisition, Display, and interpretation, Myocardial blood flow, myocardium metabolism and ventricular function, Disease detection, risk stratification and clinical decision making, molecular imaging of cardiovascular system. Radiation protection in cardiology (interventional and nuclear), the Gama camera, Collimation and collimators, Quality assurance and Quality control in nuclear cardiology, standard operation procedures in nuclear cardiology, patient preparation ,scanning protocols and imaging guidelines in nuclear cardiology

### Practical:

* Preparations of patients for MIBI Scan/Thallium scan
* Viability scan and ischemic scan protocols
* Gamma camera settings for different protocols
* Patient’s education regarding radiation safety

### Recommended Books:

* Braunwalds Heart Disease: A textbook of Cardiovascular medicine 11th Edition by Zipes, Libby, Bonow, Mann and Tomaselli
* Introduction to Health Physics 4th Edition

(Herman Cember & Thomas E.Johnson) Mc Graw Hill Medical Publisher.

* Essential Nuclear Medicine Physics 2nd Edition

(Rachel A. Powsner & Edward R. Powsner) Blackwell Publisher.

* Nuclear Medicine Technology Procedures and Quick Reference 2nd Edition (Pete Shackett) Lippincott Williams & Wilkins Publisher.
* The Physics of Radiology 4th Edition

(Harold Elford Johns & John Robert Cunningham) Charles C Thomas Publisher.

* Clinical Nuclear Medicine

(H.J Biersack & L.M Freeman) Springer Publisher.

* Quantitative analysis in Nuclear Medicine Imaging by (Habib Zaidi) Springer Publisher.
* Practical Nuclear Medicine 3rd Edition

(Peter F.Sharp, Howerd G. Gemmell & Alison D. Murray) Springer Publisher

* Radiation Detection and Measurement 3rd Edition (Glenn F. Knoll) John Wiley & Sons Publishing.
* Basic Sciences of Nuclear Medicine by (Magdy M. Khalil) Springer Publisher.
* ASNC Imaging Guidelines for SPECT Nuclear Cardiology Procedures.
* Radiation Protection, Radiation Emergency and Radiation Waste Management

### CAR-615 HEART DISEASES Credit Hours: 3(2+1)

**Course objectives:**

* To describe various risk factors in CVD
* To recognize various cardiovascular risk factors
* To estimate the progression of the disease
* To modify life style in the prevention of the disease progression
* To select an appropriate intervention to minimize risk factors
* To design a set of care

### Course Contents:

Atrial septal defects, Ventricular septal defects, Persistent atrioventricular canal defects d.

Patent ductus arteriosus, Coarctation of the aorta, Aortic stenosis, Hypoplastic left heart syndrome, Right ventricular outflow obstructions, Tetralogy of Fallot, Tricuspid atresia, Ebstein anomaly of the tricuspid valve,

Transposition of the great arteries, Total and partial anomalous pulmonary venous return, Univentricular heart, Malposition of the heart, Anomalous left coronary artery arising from the pulmonary artery, Cardiac Transplantation

Atherosclerosis, Ischemic heart disease, Valvular heart disease, Cardiac hypertrophy , 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, Cardiac Transplantation, Diseases of the Respiratory system

Congenital anomalies, Carcinoma, Infections, Adult respiratory distress syndrome, Chronic obstructive pulmonary disease, Pulmonary hypertension, Lung Transplantation, Lung reduction surgery

### Practical:

* Assessment of the patient's risk factors
* Physical Examination
* Heart sounds and their interpretation
* Analysis of investigations used
* Interventions to reduce CVD
* Management of the patient's at risk
* Exercise treadmill stress testing

### Recommended Books:

* Braunwald`s Heart Disease, 9th Edition
* Harrisons Cardiovascular Medicine 2nd Edition

### PMS-621 RESEARCH METHODOLOGY Credit hours: 3(2+1)

**Course Objectives:**

After successful completion of this course, students will be able to,

* Recognize the basic concepts of research and the research process.
* Develop understanding on various kinds of research, objectives of doing research, research designs and sampling.
* Conduct research work and formulating research synopsis and report.

### Course Contents:

Introduction to research (in simple term and a scientific term), concept of research, why do need research, advantage and scope of research, identification of research needs and its qualities, Types of research; Qualitative, Quantitative and their sub types, Research process Introduction (Deciding, formulating research questions, planning, conduct of study, data collection, processing and analysis, Research writing and reporting), Literature review (What, why, where from, how and qualities of good literature and its use), Writing a research problem/question and selection of the title of study, Identification of various research variables, Hypothesis its types, formulation and testing of hypothesis, Research study designs used in qualitative and quantitative studies, Designing of data collection tools/questionnaires, Selection of appropriate sampling technique in various study designs, Concept of validity and reliability, Research proposal writing, Ethical principles of Research and their examples to apply those principles, Data collection and processing/displaying techniques, Writing of research report (Chapters in research report/thesis, Outline/Abstract of research, Referencing and Bibliography0

### Practical Work:

* + Literature Search
	+ Survey conduct
	+ Citation and Referencing
	+ Proposal writing
	+ Data collection and displaying

### Recommended Books:

* Research Methodology by Ranjit Kumar 3rd Edition
* Foundation of Clinical Research by Portney LG Walkais MP in 1993, Publisher by Appleton and lauge USA
* A guide to Research Methodology, Biostatistics and Medical writing by college of physicians and surgeons Pakistan by WHO collaboration center
* Health system research project by Corlien M Varkerisser, Indra Pathmanathan, Ann Brownlee in 1993 by International Development Research Center in New Dehli, Singapore.

### CAR-617 PREVENTIVE CARDIOLOGY Credit Hours: 3(2+1)

**Course objectives:**

Fundamental understanding of atherosclerotic vascular disease risk assessment, screening, diagnosis, and management; cardiovascular risk reduction strategies; and management of cardiovascular risk factors.

### Course Contents:

The vascular biology of atherosclerosis, risk markers and primary prevention of cardiovascular disease, systemic hypertension, lipo-protein disorders and cardiovascular disease, nutrition and cardiovascular and metabolic diseases, obesity and cardio-metabolic disease, , diabetes and cardiovascular system, air pollution and cardiovascular disease, exercise and sports cardiology, Exercise-based, comprehensive cardiac rehabilitation, integrative approaches to the management of patients with heart disease.

### Practical:

* + BMI measurement
	+ BP measurement
	+ Lipid profile and Blood glucose measurement
	+ Treadmill exercise by Bruce protocol

### Recommended Books:

* Braunwalds Heart Disease: A textbook of Cardiovascular medicine 11th Edition by Zipes, Libby, Bonow, Mann and Tomaselli

### PMS-623 EPIDEMIOLOGY Credit Hours: 3(2+1)

**Course objectives:**

* After studying this course the students will be able to:
* Explain epidemiological terminologies
* Apply the knowledge to calculate disease risk, prevalence and incidence
* Select and choose an appropriate study design in research
* Explain confounding and Biases in studies
* Appraise SWOT analysis

### Course Contents:

Introduction to Epidemiology and basic terms used in Epidemiology, Measures of Disease Occurrence; Incidence and Prevalence, Incidence, Rates and its types, Dynamics of disease transmission, Measurement of disease frequency, risk, rate and proportion, Calculation of: Prevalence, Incidence, Duration, Mortality and Morbidity, Study Design Options, Research study Designs, Case Control Study, Cohort Study, Experimental Study, RCT, Meta-analysis and systematic review, The Cross-Sectional Study, Case-Reports, Sources of Error; Confounding and Biases, Odds ratio and relative risk, SWOT analysis, Reliability of tests by using Sensitivity and specificity

### Practical Work:

* Calculation of Sensitivity and specificity
* Calculation of Incidence and prevalence
* Finding risk of disease, rate and frequency
* SWOT analysis

### Recommended Books:

* An\_Introduction\_to\_Epidemiology\_for\_Health\_Professionals
* Epidemiology by Leon Gordis 5th Edition

### PMS-622 BIOSTATISTICS Credit Hours: 3(2+1)

**Course objectives:**

After successful completion of this course, students will be able to,

* State the principal concepts about biostatistics; collect data relating to variable/variables.
* Examine and calculate descriptive statistics from collected data.
* Interpret data via binomial distribution and the concept of sampling.
* Apply hypothesis testing via some of the statistical distributions.

### Course Contents:

Introduction to Biostatistics and its types; Descriptive and inferential statistics, Measure of central tendency, Measure of dispersion, Statistical data, Presentation of Data by Graphs, Data and its types, Data collection tools, Data analysis tools Health Related Data, Presentation of quantitative data**,** The concept of sampling, types and methods of sample, sample distribution, error of sampling, Variable and its types, Tests used in biostatistics their use and interpretation( t-tests, Chi-square ANOVA, Regression and correlation) Hypothesis formulation and testing on the basis of statistics and statistical tests, Sample and population, Basic considerations in sampling, random sampling, stratified random sampling, cluster sampling, systematic sampling, determination of sample size, elimination of sampling bias**,** two types of errors, acceptance and rejection Regions, Tow sided and one sided tests, general steps in hypothesis testing, test about means, confidence interval for mean, Preparing data analysis by various software, Use of SPSS

### Practical Work:

* + Manual calculation related to measure of central tendency and measure of Dispersion
	+ Defining variables in SPSS
	+ Entry of data in SPSS
	+ Analysis of data in SPSS

### Recommended Books:

* + - A quide to research methodology, biostatistics and medical writing by college of physicians and surgeons Pakistan by WHO collaboration center
		- Reading understanding multivanant statistics giimm LG Yard AD PR, publisher American Psychological association
		- Ilyas Ansari’s community medicine (Text Book) by Ilyas and Ansari 2003 published by Medical division Urdu Bazzar Karachi

**8th Semester**

**Research Project Seminar BIOETHICS**

**Subject of own interest**

### Adult Echocardiography

* + **Pediatrics Echocardiography**
	+ **Electrophysiology**
	+ **Interventional Cardiology**
	+ **Electrocardiography**
	+ **Medical Physics**
	+ **Preventive Cardiology**

**PMS-626 RESEARCH PROJECT Credit Hours: 6**

**Course Objectives:**

* The student will learn some basic research methodology, gain knowledge of the specific area of radiology being researched and have the opportunity for more extensive one-on-one interaction with a member of the radiological staff. It will hopefully result in some form of presentation or publication for the student. This is most suitable for students planning to enter radiology as a career.

**Course Contents:**

During last year each student should select a topic of research report with consultation of his/her supervisor and shall prepare and submit research report to Khyber Medical University by the end of last year.

**Practicals:**

Students will prepare a comprehensive report on their selected research topic and will submit hard copy to following:

* One Copy to Examination Department
* One Copy to the Library KMU
* One Copy to the Supervisor

### PMS-627 SEMINAR Credit Hours: 1

**Objective of the seminar:**

During last year each student should select a topic of research work with consultation of his/her supervisor and shall present his/her research work through a seminar.

### PMS-625 BIOETHICS Credit Hours 2(2+0) Course Objectives:

After successful completion of this course, students will be able to,

* Identify ethical issues in medicine, health care and life sciences.
* Describe rational justification for ethical decisions.
* Practice the ethical principles of the Universal Declaration on Bioethics and Human Rights.
* Recognize and distinguish an ethical issue from other issues.

### Course Contents:

Introduction to bioethics, ethical principles, autonomy , informed consent, intentional non-disclosure , patient self- determination act, the health insurance portability and accountability act of 1996 (HIPAA) privacy and security rules, non-maleficence, slippery slope arguments, beneficence, paternalism, justice, social justice, the patient protection and affordable care act, professional patient relationship, unavoidable trust, human dignity , patient advocacy, moral suffering, ethical dilemmas.

### Recommended Books:

I Introduction to bioethics and ethical decision making by Karen L. Rich (chapter 2) 2015

### CAR-619 SUBJECT OF OWN INTEREST Credit Hours: 4(2+2)

**Student will have to select one optional subject from the following subjects.**

* **Echocardiography**
* **Electrophysiology**
* **Interventional Cardiology**
* **Electrocardiography**
* **Medical Physics**
* **Preventive Cardiology**
* **Pediatrics Echocardiography**