M.Sc. Biomedical Science

[Choice Based Credit System (CBCS)]

Regulations, Description and Syllabus

[For those who join the course in July 2018 and after]

DEPARTMENT OF BIOMEDICAL SCIENCES

ALAGAPPA UNIVERSITY

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)

KARAIKUDI-630 004, TAMIL NADU, INDIA

ALAGAPPA UNIVERSITY

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC)

M.Sc BIOMEDICAL SCIENCE

(For those who join the Course in July 2018 and after)

REGULATIONS AND SYLLABUS

Regulations

1. Eligibility for admission

A candidate who has passed Bachelor's Degree in Biological Sciences (Microbiology, Biochemistry, Biotechnology, Genetics, Biomedical Science, Botany, Zoology, Bioinformatics, Marine Biology, Computational Biology, B. Pharm, B.Sc., Nursing (3or4years), Pharmacology) or any other Biological sciences degree with at least 55% of marks and 50% marks for SC/ST candidates as main course of study of any university accepted by the syndicate as equivalent thereto, subject to such condition as may be prescribed therefore shall be permitted to appear and qualify for the M.Sc. Degree in Biomedical Science of this University after a course of study of two academic years.

2. Duration of Course

The course shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

3. Teaching Methods

The class room teaching would be through conventional lecture, use of OHP, power point presentation and novel innovative teaching ideas like television and computer aided instruction. Periodic field visit enable the student for gathering the practical experience and up to date industrial scenario. Student seminars would be arranged to improve their awareness and communicative skill. In the laboratory, instruction would be given for the safe handling of chemicals and instruments. The practical experiments shall be conducted with special efforts to inculcate scientific knowledge among students. The students shall be

trained to handle advanced instrumental facilities and shall be allowed to do experiments individually. Periodic test would be conducted to students to assess their knowledge. Slow learners would be identified and will be given special attention.

4. Examinations

The examinations shall be conducted separately for theory and practical's to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment test I and II (CIA Test I & II). The internal assessment shall comprise of maximum 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory paper (Internal Assessment)

Average marks of two CIA test	- 10 marks
Attendance	- 5 marks
Seminar	- 5 marks
Assignment	- 5 marks
Total	- 25 marks

Practical's (Internal Assessment)

CIA tests	- 10 marks
Attendance	- 5 marks
Observation note book	- 10 marks
Total	- 25 marks

External Examinations

The external theory and practical examinations shall be conducted for three hours duration to each paper at the end of each semester. The external examinations shall comprise of maximum of 75 marks for each subject. The candidate failing in any subject will be permitted to appear for each failed subject in the subsequent examination. Practical examinations and demonstration of experiments shall be conducted at first, second and third semester. At the end of fourth semester, the project work viva-voce examination will be conducted on the basis of the dissertation report submitted by the student. Two examiners (one internal and one external) will jointly conduct the viva-voce examination for evaluation.

5. Scheme of External examination

The duration of examinations for theory and practical's shall be three hours.

Question paper pattern (Theory)

1. The question paper carries a maximum of 75 marks.
2. The question paper consists of three sections namely Part-A, Part-B and Part-C.
3. Part-A consists of 10 questions of 2 marks each (10 x 2 = 20 marks) with no choice. The candidate should answer all questions.
4. Part-B consists of 5 either or choice questions. Each question carries 5 marks (5 x 5=25 marks).
5. Part-C consists of 5 questions. Each question carries 10 marks. The candidate should answer any three questions (10 x 3 = 30 marks).

Question paper pattern (Practical) (Maximum 75 marks)

1.	Major practical	15 marks
2.	Minor practical	10 marks
3.	Experimental set up	5 marks
4.	Spotters	25 marks

5.	Viva voce	10 marks
6.	Practical record note	10 marks
	Total	75 marks

6. Passing minimum

a) There shall be no Passing Minimum for Internal.
b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.
d) Grading shall be based on overall marks obtained (internal + external).

7. Dissertation/Project work (Maximum 200 marks)

The duration of the dissertation research shall be a minimum of three months in the fourth semester.

a) Plan of work

The candidate shall undergo dissertation work during the fourth semester. The candidate should prepare plan of work for the dissertation and should get approval from the guide. The candidate after completing the dissertation work shall be allowed to submit to the university at the end of fourth semester. If the candidate is desirous of availing the facility from other university/laboratory, they will be permitted only after getting approval from the guide. In such case, the candidate shall acknowledge the same in their dissertation.

b) No. of copies of dissertation

The candidate should prepare four copies of dissertation and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library and one copy shall be held by the student.

c) **Format to be followed for dissertation**

The format /certificate for dissertation to be followed by the student are given below

1) Title page
2) Bonafide certificate
3) Acknowledgement
4) Table of content.

Format of the title page

Title of Dissertation

Dissertation submitted in partial fulfilment of the requirement for the degree of Master of Science in Biomedical Science to the Alagappa University, Karaikudi -630004.

By

(Student Name)

(Register Number)

Department of Biomedical Science

Alagappa University

(Re-accredited with "A^+" by NAAC)

Karaikudi – 630004.

(year)

Dissertation evaluation

Periodic presentation of learning	75 marks
Concise Dissertation	75 marks
Viva-voce	50 marks
Total	**200 marks**

Format of certificate

This is to certify that the dissertation entitled _____ Submitted in partial fulfilment for the requirement of the degree of Master of Science in Biomedical Science to the Alagappa University, Karaikudi is a bonafide research work carried out by _____ under my supervision and guidance and that no part of the dissertation has been submitted for the award of degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or in full in any scientific journal or magazines.

8. Village Placement Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people lives in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this village placement programme is to extend out to reach environmental awareness, hygiene and health to the rural people of this region.

The students in their third semester have to visit any one of the village within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three days.

1. Environmental awareness
2. Hygiene and Health

A minimum of two faculty members can accompany the students and guide them.

9. Maximum duration for completion of the course

The maximum duration for completion of M.Sc. degree in Biomedical Science shall not exceed eight semesters.

10. Commencement of this regulation

These regulations shall come into effect from the academic year 2018-19 for students who are admitted to the first year of the course during the academic year 2018-19.

11. Classification of successful candidate

Candidate who secured not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First class. All other successful candidates shall be declared to have passed in the Second class. Candidate who obtains 75% of marks in the aggregate shall be deemed to have passed the examination in first class with distinction provide they should have passed all the examination at the first appearance.

Candidates who passed all the examinations prescribed for the course in the first instance and within a period of two academic years from the year of admission to the course are alone eligible for university ranking.

A candidate is deemed to have secured first rank provided if he/she should have passed all the papers in first attempt itself and should have secured the highest overall grade point average (OGPA).

Each student should have taken 90 credits as core course, 4 credit in computer application/communication skill and 2 credits in village placement programme, thus totalling at least 90 + 6 credit to complete M.Sc. Biomedical Science degree course. Each paper carries 5 or 4 or 2 credits with 50% marks in the university examination and 50% marks in CIA.

Raw score	Grade	Description	Grade points
90 and above	O	Outstanding	9.0-10
80-89	A	Very good	8.0-8.9
70-79	B	Good	7.0-7.9
60-69	C	Very poor	6.0-6.9
50-59	D	Satisfactory	5.0-5.9
Less than 50	F	Failure	
I – inadequate attendance, W-withdrawal from the course			

CREDITS, INTERNAL ASSESSMENT MARKS AND END SEMESTER EXAM MARKS

Sl. No.	Course Code	Name of the Course	Credit	Mark		
				Int.	Ext.	Total
I SEMESTER						
1.	508101	Medical Biochemistry	4	25	75	100
2.	508102	Clinical Microbiology	4	25	75	100
3.	508103	Bio instrumentation and Analytical Chemistry	4	25	75	100
4.	508701	Molecular Cell Biology**(ID)**	3	25	75	100
5.	508501	Forensic Science or Medical oncology **(Elective-I)**	**3**	25	75	100
6.	508104	Practical-I Biochemistry and Microbiology	**3**	25	75	100
7.	508105	Practical-II Bioinstrumentation and Analytical chemistry	**3**	25	75	100
SEMESTER-II						
8.	508201	Anatomy and Physiology	4	25	75	100
9.	508202	Medical Genetics	4	25	75	100
10.	508203	Clinical pathology	4	25	75	100
11.	541001	Computer Applications and Office Automation **(ID)**	3	25	75	100
12.	508502	Hospital Management and Bioethics or Bio-imaging technology **(Elective-II)**	**3**	25	75	100
13.	508204	Practical-III-Anatomy,Physiology and Medical Genetics	**3**	25	75	100
14.	508205	Practical-IV-Clinical Pathology	**3**	25	75	100
SEMESTER-III						
15.	508301	Pharmaceutical Chemistry	4	25	75	100
16.	508302	Pharmacology and Toxicology	4	25	75	100
17.	508303	Biomaterials and Tissue Engineering	4	25	75	100
18.	508703	Introduction to Bioinformatics **(ID)**	**3**	25	75	100
19.	508503	Molecular advanced diagnostics or Artificial organs **(Elective-III)**	**3**	25	75	100
20.	508304	Practical-V-Pharmacology and Toxicology	**3**	25	75	100
21.	508305	Practical-VI-Biomaterials and Tissue Engineering	**3**	25	75	100
22.	COM001	Employability Enhancement Practices	**2**	100	-	100
SEMESTER-IV						
23.	508999	Project Report and Viva-voce	**16**	50	150	200
			90	**675**	**1725**	**2400**

CORE COURSE

I SEMESTER

CODE: 508101- MEDICAL BIOCHEMISTRY [4CREDITS]

Unit- I

Cell- Structure & Function of Cell Membrane, Subcellular Organelles and their Functions. Carbohydrates- Definition, Classification & Biological importance of carbohydrates, Derivatives of Monosaccharides. Proteins- Definition & Classification of amino acids & Proteins, Biologically important peptides, Plasma proteins, Immunoglobulins. Lipids- Definition, Classification & Biological importance and Functions of Lipids. Structure and functions of Cholesterol, types and functions of Lipoproteins. Nucleotides- Structure and Functions of DNA & RNA. Biologically important nucleotides.

Unit- II

Enzymes- Definition and Classification. Factors affecting enzyme activity. Coenzymes and Cofactors. Enzyme inhibition & Regulation of enzyme activity. Acid Base balance- Acids, Bases & Body Buffers, Regulation of pH, Acid base disorders.

Unit- III

Vitamins-Classification, Sources, RDA, Functions (in brief), deficiency manifestations and hypervitaminosis. Minerals- Classification, Sources, RDA, Functions (in Brief), deficiency manifestations of the following: calcium, phosphorous, iron, copper, iodine, zinc, fluoride, magnesium, selenium, sodium, potassium and chloride.

Unit- IV

Nutrition- Nutrients, Calorific value of food, BMR, SDA, respiratory quotient and its applications, Balanced diet based on age, sex and activity, biological value of proteins, nitrogen balance, Protein energy malnutrition, Total parenteral nutrition, dietary fibers. Blood chemistry- Biochemical components & their reference ranges in normal & diseased states. Urine chemistry- Biochemical components & their reference ranges in normal & diseased states.

Unit- V

Clinical Biochemistry**-**Specimen Collection- Blood, Urine and Body fluids. Preanalytical, analytical and postanalytical errors. Clinical Biochemistry- Parameters to diagnose Diabetes & Cardiovascular diseases. Diagnostic enzymology, Assessment of arterial Blood gas status and electrolyte balance, Point of Care Testing. Renal Function tests (in brief), Liver function tests(in brief), Biomedical Waste Management.

Reference:

1. Textbook of Biochemistry -D.M.Vasudevan
2. Biochemistry -PankajaNaik
1. Clinical Biochemistry-Principles and Practice-Praful.B.Godkar
2. Textbook of Biochemistry-Chatterjea and Shinde
3. Textbook of Clinical Chemistry-Norbert W Teitz
4. Harpers Biochemistry
5. Clinical Biochemistry-Michael L.Bishop
6. Textbook of Biochemistry-Rafi M.D
7. Lippincott's Illustrated review of Biochemistry
8. Practical Clinical Biochemistry-Harold Varley

CODE: 508102-CLINICAL MICROBIOLOGY [4CREDITS]

Unit - I

General Microbiology-Morphology and classification of microorganisms. Growth, nutrition and multiplication of bacteria. Sterilization and Disinfection - Principles and use of equipment's of sterilization namely hot air oven, autoclave and serum inspissator, pasteurization, antiseptics and disinfectants. Immunology - antigen, Antibodies, Immunity, vaccines, types of vaccine and immunization schedule. Hospital acquired infection - Causative agents, transmission methods, investigation, prevention and control of hospital Acquired infections.

Unit - II

Bacteriology-Classification of bacteria, morphology, infections, lab diagnosis, treatment and prevention of common bacterial infections. Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Corynebacteriumdiphtheriae, Clostridia, Enterobacteriaceae - Shigella, Salmonella, Klebsiella, E.coli, Proteus, Vibrio cholerae, Pseudomonas and Spirochetes

Unit- III

Mycobacteriology& Parasitology-Mycobacteria- classification, pathogenesis, lab diagnosis and prevention. Classification, infections and lab diagnosis of following parasites. Entamoeba, Giardia, Malaria, Hookworm, Roundworm and Filarial worms.

Unit- IV

Mycology-Morphology, disease caused and lab diagnosis of following fungi. Candida, Cryptococcus, Dermatophytes, opportunistic fungi (Aspergillus, Zygomycetes and Penicillium)

Unit- V

Virology-General properties of viruses, diseases caused lab diagnosis and prevention of following viruses, Herpes, Hepatitis, HIV, Dengue, Influenza, Chikungunya, Rabies and Poliomyelitis

Reference:

1.Anathanarayana&Panikar: Medical Microbiology - Revised 8th edition University Press.
2.Parasitology by Chatterjee - Interpretation to Clinical Medicine.
3.Textbook of Microbiology - Baveja, 5th edition, Arya Publications
4.Textbook for Laboratory technicians by RamnikSood. Jaypee Publishers
5.Textbook of Parasitology by Paniker. 7th edition
6. Microbiology by Lansing M. Prescott and John P. Harley and Donald Klein; Ed. 6th; McGraw-Hill Science, 2004.
7. Color ATLAS and textbook of diagnostic microbiology by Elmer W Koneman and Stephen D Allen and William M Janda and Paul C Schreckenberger and Washington C Winn; Ed. 6th; Lippincott Williams & Wilkins, 2005.
8. Medical microbiology: a guide to microbial infections: pathogenesis, immunity, laboratory diagnosis and control by David Greenwood and Richard C. B. Slack and John F. Peuthere, ed. 17th Ed. Churchill Livingstone; 2007.
9. Essentials of diagnostic microbiology by Lisa Anne Shimeld and Anne T. Rodgers; Delmar Publishers, 1999.
10. Medical Microbiology by Geo. Brooks and Karen C. Carroll and Janet Butel and Stephen Morse; Ed. 24th; McGraw-Hill Medical, 2007.
11. Topley and Wilson's Microbiology and Microbial Infections by Leslie Collier and Albert Balows and Max Sussman; Ed. 9th; 6-Volume Set; A Hodder Arnold Publication, 2000.

CODE: 508103 BIOINSTRUMENTATION AND ANALYTICAL CHEMISTRY [4CREDITS]

Unit-I

Biopotential electrodes-Origin of bio potential and its propagation. Electrode - electrolyte interface, electrode –skin interface, half cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes -surface, needle and micro electrodes and their equivalent circuits. Recording problems -measurement with two electrodes.

Unit-II

Electrode configurations-Biosignals characteristics –frequency and amplitude ranges. ECG –Einthoven's triangle, standard 12 lead system. EEG –10-20 electrode system, unipolar, bipolar and average mode. EMG, ERG and EOG –unipolar and bipolar mode.

Unit-III

Bio-amplifier-Need for bio-amplifier -single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers –transformer and optical isolation -isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

Unit-IV

Measurement of non-electrical parameter-temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers -systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

Unit-V

Centrifugation: Basic principle and application; Differential, density and Ultracentrifugation. Principle of biophysical method and used for analysis of biopolymer structure; X- ray diffraction, flurorescence, Principle and applications of tracer technique in biology: Radioactive Isotopes and half life of isotopes; Effect of radiation on biological system; autoradiography; Cerenkov radiation; radiation dosimetry; scintillation counting. Biosensors: Principle and application.

Reference:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004
2.Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.
3. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
4. KhandpurR.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, NewDelhi, 2003.
5. Standard Handbook of Biomedical Engineering & Design –Myer Kutz, McGraw-Hill Publisher, 2003.

CODE: 508201 ANATOMY AND PHYSIOLOGY[4CREDITS]

Unit-I Cell-Structure of Cell – Function of each Components of the cell – Membrane Potential – Action Potential – Generation and Conduction – Electrical Stimulation. Blood Cell – Composition – Origin of RBC – Blood Groups – Estimation of RBC, WBC and platelet.

Unit-II Cardiac and nervous system**:** Structure of Heart, Pericardium, Chambers, Major Blood Vessels, Blood Supply. Cardiac Cycle – ECG – Blood Pressure – Feedback Control for Blood Pressure – Structure of Nervous System – Functions of Neurons, Synapse, Reflexes and Receptors, Brain, Brainstem, Ventricles and Spinal Cord. Peripheral and Automatic Nervous System and function of Nervous tissue – Reflex action – Velocity of Conduction of Nerve Impulses. Electro Encephalograph – Autonomic Nervous System.

Unit-III Respiratory system**-** Respiratory System - Trachea and Lungs. Physiological aspects of respiration. Exchange of gases – Regulation of Respiration. Disturbance of respiratory function. Pulmonary function test.

Unit-IV Digestive and excretory system-Organization of GI system, Digestion and absorption – Movement of GI tract – Structure of Nephron – Mechanism of Urine formation – Urine Reflex – Skin and Sweat Gland – Temperature regulation.

Unit-V Special sense: Structure of Eye ,Optics of Eye – Retina - Photochemistry of Vision – Accommodation Neurophysiology of Vision – EOG. Structure of Ear, Physiology of Internal Ear - Mechanism of Hearing – Auditory pathway, Hearing Tests.

Reference:
1. Ranganathan T.S, "Text Book of Human Anatomy", S.Chand & Co., Ltd, Delhi, 1996.
2. Sarada Subramanyam, K.Madhavan Kutty and H.D.Singh – Text book of 'Human Physiology' – S.Chand & Company, 1996.(Unit I –IV).
3. Sujit K.Chaudhuri – Concise Medical Physilogy – New Central Book agency, 1997. (Unit V).
4. Arthur.C.Guyton – Textbook of Medical Physiology – Prism Book (p) Ltd. 1996.
5. Cyril A.Keele Eric Neil and Neil Norman Joels Samson Wrigths' Applied Physiology – Oxford University Press – 1983.
6. Tobin C.E., "Basic Human Anatomy", McGraw-Hill Publishing Co., Ltd., Delhi 1997.
7. Gibson .J, "Modern Physiology & Anatomy for nurses", Blackwell SC Publishing 1981.

CODE: 508202 MEDICAL GENETICS [4CREDITS]

Unit- I Introduction-History of Human Genetics- Pedigrees- gathering family history, pedigree symbols, construction of pedigrees, presentation of molecular genetic data in pedigrees.

Unit-II Human cytogenetics-Techniques in human chromosome analysis including molecular technique)-Human karyotype: banding, nomenclature of banding-Pathology of human chromosomes-Nomenclature of aberrant karyotypes-Chromosomal aberration-Numerical and Structural aberrations. Common chromosome abnormalities in cancer-Genetics of fetal wastage.

Unit-III-Biochemical genetics-Inborn errors of metabolism, molecular and biochemical pathways and their basis of Phenylketonuria, Alkaptonuria, Maple syrup urine disease, Mucopolysaccharide and Galactosemia, Albinism

Unit-IV Pharmacodynamics- Definition, drug metabolism, Genetic variation by the effect of drugs, Hereditary disorders with altered drug response, Evolutionary origin of variation in drug responses, Pharmacogenomics, Ecogenetics, Animal models in pharmacogenomics.

Unit-V Haematology genetics-haematological disorders like thalassemia, sickle cell anemia, hemoglobinopathies. Molecular pathology-Classes of gene mutations in humans, Human mitochondrial diseases, Loss of Function and Gain of functional mutations in humans, Agammaglobinemia, Diseases of collagens.

Reference:

1. Edward S.Tobias, Michael Connor and Malcolm Ferguson-Smith,1993. Essentials of Medical Genetics. Wiley & Blackwell, A John Wiley & Sons, Ltd., Publication.
2. Davies,K.E.1993. Human Genetic Disease Analysis.A Practical Approach (Practical Approach Series). Oxford University press, USA.
3. Dorian J Pritchard, Bruce R Korf.2003.Medical Genetics at a glance. Wiley-Blackwell,pp:232.
4. Peter D Turnpenny & Sian Ellard .2017.Emery's Elements of Medical Genetics. Elsevier.
5. Peter Sudbery. 2002. Human Molecular Genetics (Second Edition), Prentice Hall.
6. Tom Strachan & Andrew P.Read, 1999. Human Molecular Genetics (Second Edition), John Wiley & Sons.
7. M.A.Jobling, M.E.Hurles & C. Tyler-Smith, 2004. Human Evolutionary Genetics-Origins, Peoples & Disease, Garland Science.
8. Jorge J.Yunis, 1977. Molecular Structure of Human Chromosomes, Academic Press.
9. Elaine Johansen Mange & Arthur P. Mange, 1995. Basic Human Genetics (Second Edition), Sinauer Associates, Inc.
10. Amita Sarkar, 2001. Human Genetics, Dominant publishers and Distributors.
11. Michael Baraitser & Robin Winter, 1983. A Colour Atlas of Clinical Genetics, Wolfe Medical Publications Ltd.

CODE: 508203 CLINICAL PATHOLOGY [4CREDITS]

Unit- I

Specimen collection and Processing: Collection of specimen , labeling , documentation , fixation - Grossing techniques and tissue processing - Cutting and staining of sections , use of special stains and immunocytochemistry , frozen sections - Cytological techniques including FNAC – preparation, staining and reporting, Autopsy techniques and grossing, Immunohistochemistry and immunofluorescence- Interpretation and reporting- Use and care of lab animals and bio products.

Unit- II

Haematology and blood banking: Haemoglobin estimation, blood counts .- Staining and reporting of smears - LE cells , ESR , Packed cell volume and absolute values- Special staining methods for blood cells - Investigations in haemolytic anemias and haemorrhaegic disorders -Blood bank serology , ABO grouping , Rh typing , special blood groups- Blood banking , selection of donors-, investigations in transfusion reactions.

Unit- III

Biochemical pathology: Preparation of buffers, molar solutions, normal solutions and determination of pH of buffers. Biochemical estimation of total protein, albumin, globulin, sugar, cholesterol urea, LFT, GTT, enzymes including preparation of their reagents,Physical and chemical examinations of urine including sugar, protein, acetone, bile salts, bile pigments, blood, urobilinogen, chyle and microscopic examination for crystals, cells and casts-Examination of body fluids (CSF, ascetic fluid, pleural fluid, synovial fluid etc.) including biochemical, microscopic-Semen analysis (count, motility, abnormal forms etc.)

Unit-IV

Clinical and chemical Pathology: Examination of urine , body fluids and stool - Collection of blood , anti coagulants , protein precipitants- Colorimetry , chromatography and electrophoresis- Estimation of blood sugar , urea, creatinine , proteins , bilirubin , cholesterol , uric acid , electrolytes , calcium and enzymes- Use of autoanalyzer techniques.

Unit- V Microbiology and serology: Sterilization and disinfection - Septic Specimen collection for microbial analysis -use of various culture media and identification of bacteria by specific procedures- Use of various microbiological stains- Antibiotic sensitivity tests- Identification of fungi in specimen and culture-- Diagnostic procedures in important viral infections- Serological techniques , Widal , Weil Felix , VDRL , HIV , HBV , CRP , RF , ASO and pregnancy tests - ELISA AND CLIA-

Reference:

1. Robbins Pathological Basis of disease – 8 th Edition –
2. General Pathology by J.R.Walter and Israel – 7 th edition –
3. Manual and Atlas of Fine Needle Aspiration Cytology – S R Orell-5 th Edn –
4. Practical Hematology – Dacie J V – 9 th Edn –
5. Medical Microbiology – Cruick Shank - Ananthnarayan & Paniker's Text book of Microbiology – 8 th Edn –
6. Short Text Book of Chemical Pathology – Baron
7. Andersons Pathology - LINDER – 10th Edition
8. Surgical Pathology – Ackermans – Jaun Rosai – 10th Edition
9. Diagnostic Surgical Pathology – S S Sternberg – 5 th Edition
10. Systemic Pathology . W St C Symmers - Soft Tissue Tumors - F M Enzinger , S W Weiss – 3 rd edition –
11. Theory and Practices of Histopathological techniques – Bancroft J D – 4 th Edn –
12. Diagnostic Cytology and its Histopathologic basis – H G Koss-5 th Edn –
13. Post Graduate Hematology – A V Hoffbrand-4 th Edn –
14. Wintrobe's Clinical Hematology – Lee G R-10th Edn –
15. Clinical Diagnosis and Management by Laboratory Methods – J B Henry-21st Ed –
16. Laboratory practice in tropical countries – Monica Cheesbrough (Part I , II) – Medical Microbiology by Greenwood Slack Pentherer –

III SEMESTER

CODE: 508301PHARMACEUTICAL CHEMISTRY [4CREDITS]

Unit -I

Introduction to pharmaceuticals –Pharmaceutical products from natural resources Extraction of active compounds – Identification of active compounds – Structural elucidation- Fractionation of active compounds by HPLC and GC – NMR techniques for structure determination – drug development for research on natural products.

Unit-II

Enzymes – Detection of abnormal isozymes – Enzymes employed on a clinical basis – Plasmin – Blood clotting disease – Genetic defect – Liver disease - Bilirubin metabolisms – Jaundice.

Unit-III

Amino acids – Amino end degradation – Carboxyl end degradation – Protein – Historic development of treatment for sickle cell disease – Hydroxyura treatment – Amyloid deposition in Alzheimer's disease.

Unit-IV

Alkaloids – Molecular structure and biological activity of alkaloids – Pyrrotidine alkaloids – Tropane alkaloids – Phenanthrene alkaloids – Role of alkaloids in pharmaceuticals – Terpenoids – Polynuclear Aromatic Hydrocarbons.

Unit –V

Nucleotide metabolisms – Chemotheraphy of breast cancer – Cyclophosphamide – Methotrexate – Fluorouracil – Hypothalamic neuropeptides – Hormones – Sex steroids – Infertile young woman and man – Sarcoidosis with Hypercalcemia – Medical need and pharmaceutical market.

Reference

1. Biopharmaceuticals drug and development – Susanna Wu-Pong, Youngut, Rojanasakul
2. Clinical Research in Pharmaceutical development – Barry Bleidt
3. Modern Drug Research – Yvonne Connoly Martin, Eberhard Kuter, Volkhard, Austil
4. Medical Biochemistry, 4th Edition - Chatterjee

CODE: 508302 PHARMACOLOGY AND TOXICOLOGY [4CREDITS]

Unit-I

Introduction to pharmacology, scope of pharmacology. Routes of administration of drugs, their advantages and disadvantages. Various processes of absorption of drugs and the factors affecting them; Adsoption, metabolism, distribution and excretion of drugs.
Pharmacodynamics: General mechanism of drug action and the factors, which modify drug action.

Unit-II

Pharmacological classification of drugs; the discussion of drugs should emphasize the following aspects: Drugs acting on the central nervous system: Anesthetics, pshychopharmacological agents. Drugs acting on the autonomic nervous system: Cholinergic drugs, anticholinergic drugs, anticholinesterase drugs, Adrenergic drugs and adrenergic receptor blockers, Neuron blockers and ganglion blockers, Neuromuscular blockers, drugs used in myasthenia gravis.

Unit-III

Hormones and hormone antagonists, Drugs acting on the respiratory system-bronchodilators, expectorants and antitussive agents, Drugs acting on the digestive system, Cardiovascular drugs, cardiotonics, antianginal agents, antihypertensive agents, peripheral vasodilators and drugs used in atherosclerosis, coaogulants and anticoaogulants.

Unit-IV

Synthetic organic compounds: Chemical additives in food, Chemicals in the work place, Solvents, Pesticides, Cosmetics, Drugs of abuse. Inorganic chemicals: Industrial and chemical environmental inorganic toxicants polluting air/ water/ food. Naturally occurring poisons: Mycotoxins, Bacterial toxins, Plant toxins and Animal toxins. Types of toxicity and its measurement: Acute, Sub-acute or Chronic and its manifestations. Acute toxicity: Mode of application/ administration/ exposure, in-vitro tests, Dose response relationship, Measurement of TD 50/ TC 50 and LD 50/ LC 50. Subacute and chronic toxicity. Special toxicity studies: Carcinogenecity, teratogenicity, in-vitro mutagenicity tests.

Unit-V

Pharmacokinetic aspects of toxicants- Absorption, Distribution, Metabolism and Excretion (ADME) of drugs and chemicals. A general study only. Site of metabolism, Metabolizing enzymes of liver, kidney, lung, GI tract, skin and their role in activation and detoxification of drugs and chemicals. Physiological (route of exposure, species, sex and age), Organ toxicities- HepatotoxicityNephrotoxicity: A brief description of morphological and functional aspects of kidney in relation of nephrotoxicity, Cardiovascular toxicity,

Neurotoxicity, Broncho-pulmonary (inhalation) toxicity. Gastro-intestinal toxicity. Skin toxicity/ photosensitivity.

References:

1 Goodman & Gilman's the pharmacological basis of therapeutics by Laurence Brunton and John Lazo and Keith Parker; Ed. 11th; McGraw-Hill Professional; 2005.

2 Pharmacology H. P. Rang and M.M. Dale and J.M. Ritter and P.K. Moore; Ed. 5th; Churchill Livingstone, 2003.

3 Integrated Pharmacology: With Student Consult Access by Clive P. Page and M.J. Curtis and M.C. Sutter and M.J. Walker and B.B. Hoffman; Ed. 3rd; Mosby; 2006.

4 Principles of toxicology by Karen E. Stine and Thomas M. Brown; Ed. 2nd; CRC Press; 2006.

5 Lu's basic toxicology: fundamentals, target organs and risk assessment by Frank C. Lu and Sam Kacew; Ed. 5th; Informa Healthcare; 2009.

6 Casarett and Dull's toxicology: the basic science of poisons by Curties D. Klaassen; Ed. 7th; McGraw Hill; New York; 2007.

7 Toxicology by Hans Marquradt and S.G. Schafer and R.D. McClellah and Academic Press; 1999.

8 Principles and practice of toxicology in public health by Ira R. Richards; Jones and Bartlett Publishers; 2007.

9 Handbook of human toxicology by E.J. Massaro; CRC Press; 1997.

CODE: 508303 BIOMATERIALS AND TISSUE ENGINEERING [4CREDITS]

Unit -I

Introduction of biomaterial, types of biomaterials, advantages and disadvantages, Bio ceramics for implant coating, calcium phosphates, hydroxy epilates Ti_6Al_4V and other biomedical alloys, implant and tissue interaction.

Unit -II

Advantages of Nanomaterials use as implants, biological response of implanted materials, desirable and undesirable reactions of the body with implanted materials, Materials used for orthopaedic implants , bioceramics, modes of failure,

Unit -III

Materials used for dental, modes of dental implant failure, wear debris, materials used for cartilage and vascular, bladder, modes of cartilage implant, vascular implant, implant failure study, modes of bladder implant failure

Unit- IV

Protein interactions with implanted materials, cellular recognition of Proteins adsorbed on material surfaces, adhesion, migration, differentiation, Cellular Extra cellular Matrix deposition leading to tissue regeneration, foreign-body response, inflammatory response

Unit- V

Tissue engineering Introduction, Stem cells, Morphogenesis, Generation of tissue in the embryo, Tissue homeostasis, Cellular signaling, Extracellular matrix as a biologic scaffold for tissue engineering, Scaffold fabrication, bioactive scaffold, Natural polymers in tissue engineering applications, Degradable polymers for tissue engineering.

Reference:

1. William A. Goddard, Sergey Edward Lyshevski, Donald W. Brenner (Ed) Handbook of Nanoscience, Engineering and Technology CRC press 2003
2. Mark A. Ratner, Daniel Ratner (Ed) Nanotechnology; a gentle introduction to the next big idea; Prentice Hall PTR; 2003
3. Joachim Schummer, Davis Baird (Ed) Nanotechnology Challenges: implications for philosophy, Ethics and society ; World scientific ; 2006
4. Richard S. Silberglitt, Philip S. Anton, James Schneider (Ed.) . The global technology revolution: Bio/nano/materials trends and their synergies with information; Rand corporation;2001
5. William Sims Bainbridge, Mihail C. Roco (Ed) Societal implication of Nanosciences and Nanotechnology; Springer;2001
6. Jon J. Kellar (Ed) Functional fillers and nanoscale minerals; new markets/ new horizonsSME science; 2006

INTERDEPARTMENTAL COURSES

I - SEMESTER
CODE: 508701MOLECULAR CELL BIOLOGY [3CREDITS]

Unit-I

Biomembranes: Basic structure, lipid and protein composition and their basic functions Transport of molecules across membranes. Passive and active transport across membranes. Factors regulating them, ion chanells, ABC pumps of bacteria. Organelles of eukaryotic cells – Introduction basic structure and function of various organelles, ER, golgi bodies, chloroplasts, mitochondria endosomes, lysosomes etc. separation and visualization methods of various cell organelles. Muscle & Nerve Cells.

Unit-II

Nucleus and Chromosome Structure.Introduction- Prokaryotic and Eukaryotic genome and its organization, eukaryotic chromosome. Basic structure of DNA; hairpins and cruciform, Z-DNA, triple helix. DNA Supercoiling: Histones, nonhistone proteins, topoisomerases and telomerase and their functions in chromatin structure. Yeast artificial chromosome. The Cytoskeleton- Cytoskeleton proteins, Cell motility and shape, protein sorting, Transport of proteins. Microfilaments and actin filaments-ECM Proteins and Cell Adhesion
Cell-cell interaction, Cell junctions, Adhesion proteins, Cell matrix interaction, Integrins, Functional role of adhesion proteins.

Unit-III

Eukaryotic Cell Cycle-Cell cycle and its control: Loss of cell regulation by viral infection, checkpoints in cell cycle regulation.Cell to Cell Signaling- Cell surface receptors, G-protein mediated signaling, camp, receptors tyrosine kinases, second messengers. Cell death-Apoptosis, Necrosis, Proapoptotic and Antiapoptotic proteins and mechanism of action Autophagy, Senescence, Cell death mechanisms in health and diseases. Cell Differentiation-Cellular Stress Response- Stress response proteins and pathways, Post translational modifications in stress response, General responses to hyperthermia nutritional deprivation and other stressors.

Unit-IV

Regulation of gene expression in Prokaryotes- Coordinated control of clustered genes-operon model, with example of inducible systems like Lac– Operon. Arabinose operon and repressible systems like Trp operon. Role of cyclic AMP. Role of repressors and activators of transcription in regulation of phage-lytic and lysogeic pathways, lambda repressor.

Regulation of Gene expression in Eukaryotes- Introduction-Organization of genes in eukaryotic DNA; Repetitive DNA sequences, Activators, enhancers. Modular structure of transactivators, repressor complexes, mechanism of their function in gene regulation. Post transcriptional regulation of transcription regulators by methylation, acetylation, hormones and protein-protein interactions. Methods used to study protein-protein interactions (yeast two hybrid and co-Immunoprecipitation) and protein-DNA interactions (EMSA and DNA footprinting). Diseases linked with gene expression.

Unit-V

Recombinant DNA technology and Biotechnology- Types of Restriction endonucleases and how to make restriction maps. Other enzymes used in genetic engineering such as S1 nuclease, polynuceotide kinase, mung bean nuclease etc. Vectors - cloning and expression vectors, prokaryotic and eukaryotic cloning vectors, yeast vectors, shuttle vectors, YAC & BAC. Principles of selection of specific cloned DNA - blue white selection, insertional inactivation, antibiotic markers used in prokaryotic and eukaryotic cloning. Detection and identification of cloned DNA sequences, methods of sequencing of DNA. Application and principles of Polymerase Chain Reaction, RT-PCR, RFLP analysis, real time PCR. Mutagenesis – different methods used to generate mutants (deletion and point mutations). Application of recombinant DNA technology: DNA fingerprinting, gene therapy, diagnostics. Bio-safety and ethics for recombinant DNA technology.

Reference:

1. Molecular biology of the cell by Bruce, Alberts and Alexander Johnson and Julian Lewis, and Martin Raff; Ed. 5th; Garland Science; 2008.
2. Molecular biology of the cell: the problem book by John Wilson and Tim Hunt; Ed. 5th; Garland Science; 2008.
3. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed. 6th; W H Freeman and Company; New York; 2008.
4. Cell: molecular approach by Geoffrey M. Cooper and Robert E. Hausman; Ed. 4th; ASM Press; 2007.
5. Cell biology by Thomas D. Pollard and William C. Earnshaw; Ed. 2nd; Saunders; 2008.
6. Gene VIII by Benjamin Lewin Ed.7th; Oxford; 2008.
7. Molecular cell biology by Harvey Lodish and Arnold Berk, Chris A. Kaiser, and Monty Krieger; Ed.6th; W H Freeman and Company; New York; 2008
8. Cell: a molecular approach by Geoffrey M. Cooper; Ed.3rd; ASM Press; 2004

III SEMESTER

CODE: 508703 INTRODUCTIONS TO BIOINFORMATICS [3CREDITS]

Unit-I

Basics of Bioinformatics: Introduction to Bioinformatics; Computers in Biology to understand Biological System; Basic commands of Windows, Unix and Linux operating systems; Concept of open resources in Bioinformatics.

Unit-II

Sequence Analysis: Biological background for sequence analysis; Sequence alignment: Global, Local, Pairwise and Multiple sequence analysis; Algorithm for alignments; Database Searching; Tools for Sequence alignment.

Unit-III

Biological database: Database concepts, Introduction to data types and source; Protein Sequence and Structural Databases; Nucleic acid databases; Genome databases; Specialized Databases; Carbohydrate Databases; Clinically relevant drug-drug interactions databases; Information retrieval from Biological databases: Entrez system, TCGA data bases, Bioporta

Unit-IV

Cheminformatics: Introduction; Cheminformatics tools; Chemical structure representation (SMILES and SMARTS); Chemical Databases: CSD, ACD, WDI, Chembank, PUBCHEM, Chemical Structure file formats; Structural Isomers; Structure visualization

Unit-V

Medical and Pharmacy Informatics: Introduction to pharmacy informatics, Medical Transcription, Role of informatics to enhance the services provided by pharmaceutical care givers. Health Information Systems Architecture, Health Data Management, Medical Coding, Telemedicine and Telehealth, Ethics in medical informatics, Pharmacy systems and automation, Informatics applications in pharmacy, survey and evaluation of on-line resources.

Reference:

1. Lesk, A.M. (2014) “Introduction to Bioinformatics”; Oxford University Press, UK, Fourth edition.
2. Gretchen Kenney, (2016) "Bioinformatics: Principles and Analysis"; Syrawood Publishing House USA.
3. Scott Markel (2003) “Sequence Analysis in a Nutshell – A Guide to Common Tools & Databases”; O’Reilly; 1 edition, ISBN-13: 978-0596004941.
4. David Mount, (2004), “Bioinformatics: Sequence and Genome Analysis”; Cold Spring harbor laboratory Press, US Revised Edition.
5. Ole Lund, Nielsen, M., Lundegaard, C. Kesmir, C. and Brnak, S. (2005) “Immunological Bioinformatics”; The MIT press.
6. Jean-Michel, Cand Notredame, C. (2006) “Bioinformatics for Dummies”; John Wiley& Sons, Second Edition.
7. Kindreas D Batevanis, (2006) “Bioinformatics: A Practical Guide to the Analysis of Gene and Protein”; Wiley Inter Science, Singapore, 3rd Edition.
8. Andrew R. Leach & Valerie J. Gillet, (2007) “An Introduction to Chemoinformatics”; Springer, Revised Edition.
9. David Edward, (2007) “Plant Bioinformatics”: Methods and Protocol, Humana Press.
10. Baxevanis, A.D. and Francis Ouellellette, B.F. (2011) “Bioinformatics –a practical guide to the analysis of Genes and Proteins”; John Wiley & Sons, UK, Third Edition.
11. Hossein G. Gilani, Katia G. Samper, Reza Khodaparast Haghi, (2012) “Chemoinformatics: Advanced Control and Computational Techniques”; Apple Academic Press, First edition.
12. Caroline St Clair, Jonathan E. Visick, (2013) “Exploring Bioinformatics”; Jones and Bartlett Publishers, Inc; 2nd Edition, ISBN-13: 978-1284034240.
13. Arthur Lesk, (2013) “Introduction to Bioinformatics”; OUP Oxford; 4 Edition, ISBN-13: 978-0199651566.
14. Kayvan Najarian, Siamak Najarian, Shahriar Gharibzadeh, (2017) “Systems Biology and Bioinformatics: A Computational Approach”; CRC Press; 1 Edition, ISBN-13: 978-1138118034.

ELECTIVE COURSES

I SEMESTER
CODE: 508501 FORENSIC SCIENCE [3CREDITS]

Unit - I

Definition and scope of Forensic Science, History and Development of Forensic Science, Development of Forensic Science in India. Scope and development of forensic science, Forensic science in India, Growth of Core laboratories, set up in country.

Unit- II

Introduction to crime, Sociological aspect in society, Types of crimes, Crimes in India, Crime Scene Management, Crime Scene procedures, Protection of crime scene physical evidence-Scientific collection of physical evidence, Crime scene management in man made and natural disaster.

Unit -III

Duties of forensic scientist, Various divisions of crime investigation – Toxicology Biology Serology Chemistry Physics Ballistics Prohibition Document and other divisions.

Unit- IV

Specialised facilities offered by forensic science laboratory – DNA fingerprinting Polygraph Narco analysis, Brain electrical oscillation, signature proficiency (BEOSP)
Cyber forensic, Tape and video authentication,Speaker identification etc.

Unit - V

Concepts of psychology, History of psychology, modern perspectives, types of psychological professionals psychology, The science and research methods, professional and ethical issues in psychology.

References

1. Introduction to Forensic Science inCrime Investigation –Dr.Rukmani Krishnamurty, Selective and Scientific Books, 1stedition 2011
2. Criminalistics - An Introduction to Forensic Science- Richard Saferstein, Pearson Prentice Hall, 8thEdition
3. Introduction to Psychology, Morgan, King, Weiss and Schopler, VII edition, (1989) McGraw Hill, India.
4. Abnormal psychology & modern life,Carson RC & Butcher JN (10th Ed) Harper-Collins
5.The Counseling process Patterson, Lewis E.&Welfel, Elizabeth Reynold – [2000] Hilgard,

MEDICAL ONCOLOGY

Unit- I

Modulations of Cell- Cell cycle- ligands and receptors, cell- cell interactions, integrins, invasions by cancerous cells, angiogenesis, morphogens, mechanism of deregulation of cell cycle during cancer, Apoptosis

Unit - II

Types of tumor-Benign and malignant tumor, localized and metastasis disease, tumor classification-WHO classification, staging and grading, degree of malignancy, types of chromosomal translocations, Relationship between oncogene products and growth factors-Src, Wnt, GAP

Unit - III

Carcinogenesis-Oncogenic mutations in growth promoting proteins,Mutations causing loss of cell cycle control, evasion of growth inhibitory signals, cancer genes (oncogenes and tumor suppressor genes), necrosis.

Unit –IV

Cancer Diagnosis-Cancer Imaging Techniques, Drug targeting and anti cancer delivery system, Targeted delivery of anticancer agents using Nanoparticles, colloidal systems for the delivery of anticancer agents

Unit-V

Cancer therapy-Modulations of immunue response, immunotherapy, Conventional chemotherapy, photodynamic therapy of cancer, Critical analysis of cancer therapy, Cancer vaccines.

References:

1. Cell and Molecular Biology, 8th Edition, Eduardo D. P. De Robertis, E. M. F. De Robertis
   Lippincott Williams & Wilkins, 2010
2. The Cell: A Molecular Approach, 6th Edition Geoffrey M. Cooper ASM Press, 2013.
3. Cell and Molecular Biology: Concepts and Experiments, 6th Edition Gerald Karp John Wiley & Sons, Inc. 2010
4. Cancer: Principles and Practice of Oncology, 9th Edition Vincent T. DeVita, Jr., Theodore S. Lawrence, Steven A. Rosenberg Lippincott Williams and Wilkins, 2011

5. The Biology of Cancer Robert A. Weinberg Garland Science, 2012
6. Introduction to Cancer Biology, Robin Hesketh, Cambridge University Press, 2013
7. Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics, Lauren Pecorino, Oxford University Press, 2008

II SEMESTER

CODE: 508502 HOSPITAL MANAGEMENT AND BIOSAFETY [3CREDITS]

Unit- I

Introduction to Management, evolution of Management, Definition and importance of Management, Different bodies of Management thought- overall support and utility services management, Medical record maintenance and computer applications.

Unit- II

Epidemiological basis for healthcare management, Management development-towards development of professional management of Indian Hospitals, Management of Indian Hospitals, challenges ,strategies, Modern Techniques of hospital management, Operation concept- use of models, Health services research & formalized managerial methods.

Unit- III

Hospital Planning, Guiding principles in planning hospital facilities, services, Planning the hospital building, Finance, Need assessment survey of community, factors determining site, legal requirements, design consideration, Project management & implementation, Planning the operational units, engineering, lighting etc.

Unit- IV

Organization of the hospital, Management structure, Types of hospitals, Governing body, Hospital committee and hospital functionaries, Duties and responsibilities of various positions Hospital Operational management, Management of Quality Assured services of professional service units of hospital.

Unit -V

Waste disposal management, Hospital waste management, Biosafety- regulatory frame work for GMOs, bioethics and its socio economic impact,

References:

1. Management of Hospital (4 Vols), S.L Goel & R. Kumar, Deep & Deep Publications Pvt. Ltd.
2. Bioethics and Biosafety – M.K. Satheesh
3. Bioethics- Shaleesha and Stanley
4. Hospital Mgmt. In Tropics & Subtropics, James A. William, McMillan , London,1991
5. Hospital and Health Services Administration – Principals and Practice – Syed Amin Tabish – Oxford University Press.

6. Essential for Hospital Support Services and Physical Instructions – Sharma – Jaypaee Brothers – New Delhi.
7. Management in Health Care,Nelson Thrones,Health Care Provisions,2nd Ed,Nelson Thrones

BIOIMAGING TECHNOLOGY

Unit- I

Introduction of Microscope, principles and applications of optical microscope, confocal microscope, fluorescens microscope, Scanning electron microscope, Transmission electron microscope, Live and dead assay with dyes.

Unit- II

Ultrasound imaging, Physics of ultrasound- Principles of image formation, capture and display- Principles of A, B M Mode, scan converters- Doppler ultrasound- pulsed and continuous

Unit- III

Principles and production of X-rays-soft and hard, Radiographic and fluoroscopic images in X-Ray systems, Screen-film and image intensifier systems, computed and digital radiography, flat panel detectors

Unit- IV

Introduction to emission tomography, mammography, Transverse tomography, Optical coherence tomography (OCT)- medical applications, CT Angiography basic physics of radioisotope imaging, Nuclear imaging, PET scanner principles, SPECT, Computer techniques in fast acquisition.

Unit- V

Image acquisition in magnetic resonance imaging MRI-T1 MRI-T2 proton density weighted images spin-echo technique and spin relaxation technique- Various types of pulse sequences for fast acquisition of imaging, NMR spectroscopy

Reference:

1. Khandpur R.S, “Hand-book of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition, 2003.
2. William R. hendee, E, Russell Ritenour “Medical imaging physics”, Fourth edition, 2002
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Prentice-Hall of India, 2 nd Edition, 1997.
4. Wolfgang Drexler James G.Fijimoto “Optical coherence tomography technology and applications”, Springer, First edition, 2008

III SEMESTER

CODE: 508503 MOLECULAR ADVANCED DIAGNOSTICS [3CREDITS]

Unit -1

Introduction and History of diagnostics, Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Philosophy and general approach to clinical specimens, Sample collection- method of collection, transport and processing of samples, Interpretation of results, Normal microbial flora of the human body, Host - Parasite relationships.

Unit - II

Cytogenetics Karyotype analysis, blood , bone marrow, amniotic fluid, chorionic villus samples, productsiof conception Fluorescent in situ hybridization, Cytogenetic studies using microarrays or bacs-on-beads. Molecular DNA isolation and quantification, Probe and primer designing, PCR -standard and various modifications, Real time PCR, MLPA analysis, SNP, SSCP,

Unit - III.

Southern blotting, isotopic and nonisotopic methods, Western blotting, DNA Sequencing, including massively parallel sequencing. Use of microarrays, Bioinformatics as applied to sequencing and microarrays

Unit- IV.

Applications of PCR- PCR based microbial typing: Eubacterial identification based on 16S rRNA sequences- Amplified Ribosomal DNA Restriction analysis (ARDRA)-Culture independent analysis of bacteria- DGGE and TRFLP. Molecular diagnosis of fungal pathogens based on 18SrRNA sequences- Detection of viral pathogens through PCR. RAPD for animal and plants. PCR in forensic science- AmpFLP, STR, Multiplex PCR- Determination of Paternity- Human identification and sex determination.

Unit - V

Proteomics- Clinical Proteomics- Overview of immune system , Antigens and antibodies , Antigen-antibody interactions, Major Histocompatibility Complex (MHC), HLA typing , Immunotherapy and immunodiagnostics. Immunodiagnostics - Introduction, antigen-antibody binding interactions and assays; antibodies- polyclonal and monoclonal antibodies, Immunoassays – types [RIA, ELISA, Chemiluminescent IA, FIA] and specific applications; Immunohistochemistry – principle and techniques. Good Laboratory Practices. Different Levels of Biosafety, Containment

Books

1.Medical Microbiology (1997), Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.
2.Parasitology (1997), Chatterjee K.D, Chatterjee Medical Publishers.
3.Bailey & Scott's Diagnostic Microbiology (2002), Betty A. Forbes , Daniel F. Sahm, Alice S.Weissfeld , Ernest A. Trevino, Published by C.V. Mosby
4.Jawetz, Melnick, & Adelberg's Medical Microbiology (2004), Geo F. Brooks, Stephen A. Morse,Janet S. Butel.
5.Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A.Burtis. Saunders Group.
6.Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws.
7.Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A.Burtis. Saunders Group.
8.Expert Review of Proteomics and Molecular Diagnostics (Journals) Basic Concepts of Molecular Pathology Series: Molecular Pathology Library, Vol. 2; Cagle, Philip T. Allen, Timothy C. (Eds.);Springer 2009, Softcover
9.Molecular Pathology: The Molecular Basis of Human Disease; William B. Coleman, Gregory J.Tsongalis (Eds.); Academic Press; 1 edition 2009
10 .Genomics and Personalized Medicine (2 volumes); Huntington F. Willard, Geoffry S.Ginsburg;Elsevier 2009

ARTIFICIAL ORGANS

Unit - I

Design of artificial organs-substitutive medicine, Biomaterial Concentration, Outlook for Organ Replacement, Design Consideration, Evaluation of Artificial Organs.

Unit - II

Artificial heart and circulatory assist devices-Design of Artificial heart, History of Artificial Heart, Types of Valve Prostheses, Thrombus Deposition, Durability, Mechanical Circulatory Assistance, Two Main Categories, Intra- Aortic Balloon Pump, Percutaneous Cardio-Pulmonary Bypass,

Unit - III

Artificial lungs and blood gas exchange devices-Artificial lung ventillation, Gas Exchange Systems, Cardio Pulmonary Bypass, ECMO,Comparison of Artificial Lungs and Natural Lungs,Oxygen Transport, Carbon-di-oxide Transport.

UNIT - IV

Artificial kidney and artificial pancreas-Artificial Kidney: Renal Transplantation, Mass Transfer in Dialysis, Membranes, Hemofiltration, Peritoneal Dialysis Equipment. Artificial pancreas: Insulin Therapy,Therapeutic options in Diabetes, Insulin Administration System,Insulin Production System.

UNIT - V

Artificial blood and artificial liver- Artificial Blood: Plasmapheresis, Blood Substitutes, Hemodilution, Classification, Characterisation of substitutes. Artificial Liver, Liver Support Systems, Global Liver Function Replacement, Hybrid Liver Function Replacement.

Reference:

1. 'Tissue Engineering and Artificial Organs' By Joseph D.Bronzino
2. 'Cardiogenic Shock' by Steven M. HollenBerg.
3. 'Biomaterials, Artificial Organs and Tissue Engineering' by Larry L.Hench and Julian R.Jones.
4. "Artificial Organs" by Gerald E.Miller Morgan & Claypool Publisher

PRACTICAL-I- CODE: 508104 BIOCHEMISTRY AND MICROBIOLOGY [3CREDITS]

Microbiology

1. Laboratory organization.
2. Reception of specimen, dispatch of reports, records keeping, coding of cases.
3. Laboratory safety guidelines.
4. SI units and conventional units in hospital laboratory.
5. Compound microscope and its application in microbiology.
6. Demonstration of sterilization equipments: hot air oven, autoclave, bacterial filters. Demonstration of commonly used culture media, nutrient broth, nutrient agar, blood agar, chocolate agar, Mac conkey medium, L J media, Robertson cooked meat media, MacConkey agar with LF & NLF, Nutrient agar with staph colonies. Anaerobic culture, Methods and Antibiotic susceptibility test.
7. Demonstration of common serological tests: Widal, VDRL, ASLO, CRP, RF, Rapid tests for HIV, Hbsag and HCV.
8. Grams staining.
9. Acid fast staining.
10. Principles and practice of Biomedical waste management.
11. Stool Microscopy.

Biochemistry

1. Salting in and salting out of proteins.
2. Desalting of proteins by dialysis and Sephadex G-25.
3. Protein estimation by Loorys & Bradford methods.
4. Ion-exchange chromatography.
5. Affinity chromatography for protein purification.
6. To check purity of protein & subunit structure by SDS page & silver staining.
7. Western blot analysis to check special proteins.
8. Isolation of genomic & plasmid DNA.
9. Protein & Nucleic Acid blasts, Clustal W and sequence alignment etc.

PRACTICAL-II- CODE 508105 BIO INSTRUMENTATION AND ANALYTICAL CHEMISTRY [3CREDITS]

1. To verify Lambert Beer's law .
2. To study interaction of intercalating agents like ethidium bromide and porphyrin with DNA using:
    a. UV –visible spectroscopy.
    b. Fluorescence spectroscopy.
3. Studying the Conformation change of Biomolecule using CD spectroscopy.
4. Biomolecular Interaction studies using Yeast 2 Hybrid System. DNA protein interactions by EMSA.
5. Infra red Spectroscopy.
    Recording and interpretation of IR of a biological fluid.
6. HPLC: Analysis of 5-hydroxy tryptamine from blood, HPLC analysis of Nucleobases from Calf thymus DNA.
7. Gas Chromatography.
    Analysis of opium alkaloids from opium, Analysis of Cortisol from blood.
8. Mass Spectroscopy: Identification of a biopolymer using MALDI/ LC-MS.
9. NMR: 1H and 31P spectroscopy of muscle physiology during exercise and calculation of pH change from spectra.
10. Spectral Identification of a simple organic compound/metabolite/drug.

PRACTICAL- III – CODE:508204 ANATOMY, PHYSIOLOGY & MEDICAL GENETICS [3CREDITS]

Anatomy & Physiology:

1. Measurement of Blood pressure- By Sphygmomanometer.
2. Demonstration of bones identification and side determination upper limb-clavicle, scapula, humerus, radius, ulna, lower limb-femur, Hip bone, Tibia, Fibula, Vertebral Column, Ribs, Sternum, Sacrum
3. Demonstration of heart.
4. Demonstration of different parts of respiratory system and normal X-rays- lungs.
5. Demonstration of the part of digestive system and normal X-rays- stomach, small intestine, large intestine, liver.
6. Demonstration of major vessels of the body-Aorta, subclavian, carotid, brachial, radial, ulnar, femoral, renal.
7. Demonstration of bones & joints of the limb in normal X-ray.
8. Demonstration of major muscles of the body-limbs, head & neck.
9. Demonstration of other organs—spleen, testis, uterus.

Medical Genetics

1. Studies of inversion polymorphism in Chironomous/mosquito polytene chromosomes.
2. Construction of Pedigree chart for family history.
3. Preparation of normal human karyotype and chromosomal diseases(Klinefelter syndrome, Down syndrome, Turner syndrome, etc).
4. Feulgen staining of DNA in Protozoa (Paramecium)
5. Chromosome staining and banding technique.
6. Structure and molecular organization of Chromosomes - Demo
7. Culture techniques Banding techniques Sex Chromatin bodies
8. Diagnosis of biochemical disorders (Phenylketonuria, Alkaptonuria, Survey of mucopolysaccharide disorders).

PRACTICAL IV – CODE: 508205 CLINICAL PATHOLOGY [3CREDITS]

1. Examination of Urine, Stool, Sputum - Semen examination - Routine and Special tests
2. Examination of CSF - Routine and Special tests
3. White Blood Cell count
4. Red Blood Cell count
5. Determination of Blood Groups
6. Leishman's staining and Differential WBC count
7. Determination of packed cell Volume
8. Erythrocyte sedimentation rate [ESR]
9. Calculation of Blood indices
10. Determination of Clotting Time, Bleeding Time
11. Various culture media and identification of bacteria by specific procedures-
12. Use of various microbiological stains-
13. Antibiotic sensitivity tests-
14. Identification of fungi in specimen and culture-- Diagnostic procedures important viral infections- Serological techniques , Widal , Weil Felix , VDRL , HIV , HBV , CRP , RF , ASO and pregnancy tests - ELISA AND CLIA.

PRACTICAL-V- CODE: 508304 PHARMACOLOGY AND TOXICOLOGY [3CREDITS]

1. Animal handling and precautions, and study the routes of administration
2. Topical application of Atropine and Pilocarpine on rabbit eye
3. Analgesic effect of diclofenac on mice/rat
4. Study the effects of acetylcholine (Ach) and plot the dose-response curve.
5. Study the effect of general anaesthesia with ketamine
6. To determine the effect of promethazine on phenobarbitone induced sleeping time in mice.
7. To determine the acute toxicity of a given drug and calculate the LD50 value.
8. Detection of organophosphorous pesticides in biological sample.
9. To test the presence of paracetamol in the given biological sample.
10. To study the effect of organophosphate Malathion on the specific activity of the enzyme acetylcholinestrase in rat brain homogenate.

PRACTICAL-VI- CODE: 508305 BIOMATERIALS AND TISSUE ENGINEERING [3CREDITS]

1. Basic study of Culturing/ growth of cell line- E.g MCF 7, Vero
2. Cytotoxicity assay-MTT assay
3. DPPH radical scavenging assay
4. LDH (Lactate dehydrogenase assay)
5. Microscopic analysis of cell culture - DAPI Staining
6. Live and Dead cell assay
7. DNA fragmentation assay

CODE: COM 001 EMPLOYABILITY ENHANCEMENT PRACTICES [2CREDITS]

Unit - I

Education>Employability>Employment: Conceptual Understanding- Education- Manifest: Enabling Cumulative Fund of Curriculum and Common Parlance Knowledge and Skill- Numeric Sense and Quickness- Attitude towards and Aptitude for enhanced Ingenuity- Employability: Kinetic Use of Knowledge- Book-work to Cook-work- Thrust to Listen>Learn>Link>Leverage>Leap> Lead > Legend in an Employment context- Usefulness of Self Motivation, Self Esteem and Self Actualization – Employment: Life's Goals Linked to Employment and Career- Continuous Learning Contours in Career - Inspiration from Enviable Colleagues and Legendary Leaders- Appreciation for Team Colleagues.

Unit - II

Literary Skills>Employability>Employment: Literary Reflections from School Days inspired by Great Authors, Great Works, Quotable Quotes, Important Verses and Even Nursery Rhymes- Let your Ears Hear Sounds, Screeches, Sentences, Speeches and Songs - Let the substances be Learnt- Vocabulary Variety, Velocity, Vistas and Vanity- Be Fluent, Fresh, Flash and Fanfare- Tense Sense and Sense in Sentences- Reading Passages from Dailies and Literary Pieces- Expansion and Contraction of Passages- Preparing for Presentations Long and Short- Write PQRS: Poem>Quote>Story>Report.

Unit -III

Quantitative Skills>Employability>Employment: Love, Learn and Leverage Numbers, Dimensions, Proportions, Equations and Derivations- Measurement Matters in Many Ways in Life- Understanding the Metrics and Non-metrics- Transcending the Mental Mathematics- 'Quest Quizy Quantics'- Lit you with the Light of Algebra, Geometry, Calculus and 'Big Data'- Be a Statistician: Descriptive and Inferential Statistics.

Unit-IV

Expressivity>Employability>Employment: Inward-Outward Personality Expressiveness- Inner-side of Expressiveness in Thought, Word and Action- Communicate Your Emotions>Fantasy>Glam>Hits> Imagination- Contours of Communication-'7Cs': Content>Context>Clarity>Completeness>Construct> Consonance>Confidence- Watch and Notch Your Grammar> Your Honour> Your Illuminator> Your Job-guarantor- Outer-Personality Expressiveness: Groomed Ladies and Gentlemen: Your Physics and Chemistry Accessories from Top>Tip>Toe- Write Your Resume expressing your credentials.

Unit -V

Exposure>Employability>Employment: Expose to Novelties>Nature>Niches> Nuances>Niceties – Get you exposed substantially and superbly in Local-National-Global Political, Economic, Social, Technological, Legal and Environmental (PESTLE) issues and also in Info-tech, Familial, Financial, Commercial and Cultural, (IFFCC)- Face Your Interview: Prepare Well> Mock-interviews > You tube Yourself> Attire for Context Convenience > Listen to Instructions and Settings > Answer/Converse to the Point > Interview etiquette- Group Discussion: Listening> Ice breaking>Participation>Norming>Forming> Performing>Storming>Reforming>Conforming.

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