

D Y Patil University, Kolhapur

Pre- Ph.D. Course work

Choice based credit system (CBCS)

(Medical Sciences)

(Introduced from June, 2016 onwards)

The candidates registered for Ph. D degree are required to complete pre- Ph.D. course consisting of following three papers during the first year of registration. Paper I and Paper II are compulsory papers and candidate may select paper III from the paper III (A-J) as per his/her research topic/area. Total course work is of 12 credits.

Pre- Ph. D structure

**PAPER I: Research Methodology and Computer basics (4 credits)**

**PAPER II: Recent Topics in Medical Science (4 credits)**

The candidate may select one of the following papers as Paper III:

**Group of Paper III (Elective)**

PAPER III (A): Hospital Waste Disposal Management (4 credits)

PAPER III (B): Stem Cells and Regenerative (4 credits)

PAPER III (C): Advances in Physiology (4 credits)

PAPER III (D): Basic Environmental Studies (4 credits)

PAPER III (E): Advances in Microbiology (4 credits)

PAPER III (F): Topic in Biochemistry (4 credits)

PAPER III (G): Topic in DNA Nanobiosensor (4 credits)

PAPER III (H): Nanotechnology for Hospital Waste Treatment (4 credits)

PAPER III (I): Advances in Medical Science (4 credits)

PAPER III (J): Advance in Pharmacology (4 credits)

Paper III (K) Advances In Anatomy (4 credits)

**Following papers are to be introduced from 2018 onwards**

Paper III (B): Stem Cell and Regenerative Medicine (4 credits) (Revised)-

This Paper will replace Paper III (B)

Paper III (L): Pharmaceutical Sciences (Advance Pharmaceutics (4 credits)

Paper III (M): Advanced Topics in Radiation Therapy (4 credits)

Paper III (N): Deposition of Films and Their Applications (4 credits)

Paper III (O): Advances in Psychiatry (4 credits)

## **1.0 Course information**

- As per the University Grants Commission (Minimum Standards and Procedure for Award of M.Phil./Ph.D Degrees) Regulations, 2016, following are the Credit, Requirements, number, duration, syllabus, minimum standards for completion of the Course Work:
- The credit assigned to the Ph.D. course work shall be a minimum of 08 credits and a maximum of 16 credits.
- The course work shall be treated as prerequisite for Ph.D. preparation. A minimum of four credits shall be assigned to one or more courses on Research Methodology which could cover are; as such as quantitative methods, computer applications, research ethics and review of published research in the relevant field, training, field work, etc. Other courses shall be advanced level courses preparing the students for Ph.D. degree.
- All courses prescribed for Ph.D. course work shall be in conformity with the credit hour instructional requirement and shall specify content, instructional and assessment methods. They shall be duly approved by the authorized academic bodies.
- The Department where the scholar pursues his/her research shall prescribe the course(s) to him/her based on the recommendations of the Research Advisory Committee, the research scholar.
- All candidates admitted to the Ph.D. programs shall be required to complete the course work prescribed by the Department during the initial one or two semesters.
- Candidates already holding M. Phil. degree and admitted to the Ph.D. program, or those who have already completed the course work in M.Phil. and have been permitted to proceed to the Ph.D. in integrated course, may be exempted by the Department from the Ph.D. course work. All other candidates admitted to the Ph.D. program shall be required to complete the Ph.D. course work prescribed by the Department.
- Grades in the course work, including research methodology courses shall be finalized after a Combined assessment by the Research Advisory Committee and the Department and the final grades shall be communicated to the Institution/College.

## **2.0 Scheme of Examination and Passing:**

1. This course will have 100% external (University written examination of 3 hours duration for each course paper). All external examinations will be held at the end of course work and will be conducted by the University as per the existing norms.
2. Each question paper will be of 100 marks.
3. Each question paper will consists of six questions of 25 marks each and student should answer any four questions out of six questions.

### 3. 0 Standard point scale for grading:

Grade	Marks	Grade Points
O	70 & above	7
A	60-69.99	6
B	55-59.99	5
C	50-54.99	4
D	45-49.99	3
E	40-44.99	2
F(Fail)	39.99 & below	1

A Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the course work in order to be eligible to continue in the program and submit the dissertation/thesis.

## **Paper-I: Research Methodology and Computer Basics (4 Credits) (60h)**

### **Unit-I Research problem design (15h)**

Research problem and design: Meaning and objective of research, motivation in research, types of research, significance of research, research and scientific methodology, importance and criteria of good research, Formation of research problem, sources of research problem, meaning of research design, features of good design, important concepts of relating research design, different basic designs.

### **Unit-II Literature Searching and Report Writing: (15h)**

a) Literature Searching: On-line searching, different Database, Searching research articles, Citation Index, Impact Factor, H-index,

b) Writing scientific report: Structure and components of research report, revision and refining writing project proposal, Paper writing for International Journals, paper submission procedure, Conference oral and poster presentation, preparation of slides, pictures, graphs and citation styles.

c) Thesis writing: parts of thesis, the preliminary pages and the introduction, the literature review,

Methodology, data analysis, and conclusions

### **Unit III. Statistical analysis (15h)**

a) Data collection : Sources of Data: Primary Data, Secondary Data; Sampling Merits and Demerits of Experiments, Procedure and Control Observations, Sampling Errors - Type-I, Error - Type-II Error.

a) Statistical analysis and fitting of data : Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes, t-Test .

b) Standard deviation - Coefficient of variations. Correlation and Regression Analysis. Introduction to statistical packages, plotting of graphs.

### **Unit IV: Computer Basics and Applications (15h)**

a) Introduction to Computer and its generations, hardware, software-system soft ware and application software, computer networks and internet,

b) Data and Program representation: digital data representation, numerical data representation, binary coding system for text based data(ASCII and EBCDIC) , Computer hardware: coding system for other types of data (graphics, audio and video data),inside the system unit : motherboard, power supply and drive bays, CPU, Memory Cooling components, expansion slots, expansion cards and express cards, ports and connectors

c) Operating systems, application software-word processing concept, spread sheet concept, database concept, presentation graphic concepts, graphics and multimedia concepts

### **Reference Books**

1. Fundamentals of computers, Morley & Parkar, Cengage Learning Pvt. Ltd. New Delhi, 2009
2. Research Methodology – Methods and Techniques, C. R. Kothari, Wiley Easter Ltd, New Delhi 1985.
3. “How to write and Publish” by Robert A. Day and Barbara Gastel, (Cambridge University Press).2012
4. Survival skills for Scientists” by Federico Rosei and Tudor Johnson, (Imperial College Press).
5. “How to Research” by Loraine Blaxter, Christina Hughes and Malcolm Tight, (Viva Books).2001
6. “Probability and Statistics for Engineers and Scientists” by Sheldon Ross, (Elsevier Academic Press).2009
7. Computer Education by Prof. Lalini Varanasi, Prof. V. Sudhakar and Dr. T. Mrunalini, Neelkamal Publications PVT. LTD.
8. Basic Computing Principles by B. West, BPB Publications, New Delhi 1992

## **Paper II: Recent Topics in Medical Science (4 Credits)**

**(60h)**

### **Unit I: Modern Medical Instrumentations (15)**

Medical Instrumentations: principles, working and applications; X-ray diffraction machine, , Electrocardiogram(ECG) machine, Microscopes: optical, scanning electron and transmission electron., Computed tomography,(CT), Magnetic resonance imaging ( MRI), positron emission tomography ( PET),Tele cobalt brachytherapy, Cyclic voltammetry, Electrochemical Impedance spectroscopy ( EIS), Polymerase Chain reaction (PCR), fluorescence activated cell sorter ( FACS)

### **Unit II: Introduction to Intellectual Property Right (IPR) (15h)**

Origin and Genesis of IPR, The Ways and Means of Creation of IPR, Sources of IPR-Custom, Treaties, General Principles of Law, Resolutions of International Organizations, Patents – Basic aspects, Trade Marks – Basic principles, Copy Right – Basic Issues and Industrial Designs and Geographical Indications- Basic aspects

### **Unit III: Ethics in medical research (15h)**

General principles on ethical considerations involving human subjects, ethical review procedures, Institutional ethical committee, its organization and functions, general ethical issues, Specific principles for clinical evaluation of drugs/devices/diagnosis/vaccines/herbal remedies,, Specific principles in epidemiological studies, specific principles in human genetic research, specific principles for research in transplantation including fetal tissue implantation. Ethical guidelines for experimental animals for specific research, CPCSEA guidelines, In–vitro system to replace animals, legal provisions to experimentation of animals

### **Unit IV: Plagiarism (15h)**

Plagiarism: definitions and types of Plagiarism, causes of Plagiarism, importance of Plagiarism, ways to avoid Plagiarism, common knowledge, paraphrasing and citations and references, consequences of Plagiarism, Role of educator, Plagiarism checker software, cases of Plagiarism

#### Reference books

1. Elements of X- ray diffraction By B. D. Cullity, (1956), Addison-Wesley Publishing company Inc., USA
- 2 Instrumental methods of analysis (Vth edition) by Willard, Merritt, Dean Settle
3. Microscopy of materials - D.K. Bowen & C.R. Hall (the MacMillan pressLtd. (London) 1975
4. Medical instrumentation: Applications and design, John G Webster, Wiley publishers 2009
- 5 Hand book of Biomedical instrumentation, IIRD Ed., R S Khandpur, Mac Graw Hill India 2014
6. Introduction to Biomedical Instrumentation, Barbara Christie, Cambridge university |press 2012
7. Intellectual Property rights, Narayan, 2007

8. Cases and Materials on Intellectual Property Law: Along With Objectives, Methodology, and Course Outline Bangalore Gopalakrishnan. N.S National Law School of India University, 1992
9. Ethical Guidelines for Biomedical research on human subjects, ICMR, New Delhi 2006.
10. Guidelines for care and use of animals in scientific research, Indian national Academy of Sciences,
11. Learning about Plagiarism, Clapper Nikki, Capstone press 2013
12. Critical conversation about Plagiarism: Ed: Michael Donnelly et al, Parler press 2012

## **Paper III (A): Hospital Waste Disposal Management (4 Credits) (60h)**

### **Unit-I : Hazardous of Bio-medical / Health Care Waste (15h)**

- i) Classification of Hazardous Wastes
- ii) Types of Hazardous (Infectious, Genotoxic, Cytotoxic, Chemical Toxicity, radioactive hazardous, physical injuries, public sensitivity.
- iii) Different streams of wastes production.
- iv) Handling of Hospital Wastes.

### **Unit-II : Segregation, Collection and Transportation of Hospital Wastes (15h)**

- i) Definition, strategy, handling, packaging and transportation of animal bio-medical waste, cytotoxic chemical wastes, human anatomical wastes, human blood and body fluid wastes, microbiology laboratory wastes, sharp wastes.
- ii) Special precautions for bio-medical wastes.

### **Unit-III : Safety Measures and Training in Biomedical Wastes (15h)**

- i) Personal protection of hospital staff.
- ii) Immunization of the staff.
- iii) Reporting accidents and spillages.
- iv) Safety Measures during Therapeutic and Diagnostic Procedures.
- v) Safety Measures in Handling bio-medical wastes, risk involved in handling bio-medical waste.
- vi) Training - Educational awareness of bio-medical waste (M and H) Rules 1998.
- vii) Safe Hospital Management Practices.

### **Unit-IV : Management and Administration for Bio-medical Wastes. (15h)**

- i) Formation of Hospital Waste Management Committee for making hospital specific action plan, for hospital management and its supervision, monitoring and implementation.
- ii) Legal aspects of bio-medical wastes - Legal Provisions, Environmental Acts, Role of Rag pickers, Criteria for selecting wastes processing and disposal technology, Social aspect in bio-medical waste management, Environmental Impact Assessment Report Preparation, Waste audit - Evaluating type and quantity of waste generated and for further planning.

#### **List of Books:**

- 1) Training Module on Hospital Waste Management by Dr. Neera Kewalramani, Dr. Alka Karande, Dr. Sneha Palnitkar, Brihan Mumbai Mahanagar Palika, Public Health Department.
- 2) Solid Waste Management in Class I Cities in India by Report of the Committee Constituted by the Hon. Supreme Court of India, March, 99.

- 3) Manual of Solid Waste Management, Published by All India Institute of Local Self-Government Mumbai, Dr.J.V.Modi.
- 4) Short Term Course on Municipal Solid Waste Management Published by Centre for Continuing Education, Indian Institute of Science, Bangalore.

## **Paper III (B): Stem Cells And Regenerative Medicine (4 Credits) (60h)**

### **Unit I: Establishment of Cell culture Laboratory and Cell culture Techniques:(15h)**

- Planning, Designee Layout, and construction.
- Equipments and there Specifications.
- Installation of HVAC and specifications.
- Principles of sterility techniques.
- Measurement of cell viability (Tripan Blue and 7AAD), colonigenic assay, MTT-based assay and cytotoxicity.
- History of animal cell culture;
- Types of balanced salt solutions and Cell culture media.
- Different tissue culture techniques
- Types of primary culture,Human skin fibroblast culture,Trypsinization; Cell separation, Suspension and adherantculture; Organ culture.
- Behavior of cells in culture conditions: Division, growth pattern, metabolism of estimation of cell number, Characterization and maintenance of cells, Cryopreservation; Common cell culture contaminants.
- Cell culture reactors, Scale-up in suspension, Scale and complexity, Mixing and aeration, Rotating chambers, Perfused suspension cultures, Fluidized bed reactors for suspension culture, Scale-up in monolayers,Multisurface propagators,MultisArray disks, spirals and tubes, Roller culture, Microcarriers, Perfused monolayer cultures, Membrane perfusion, Hollow fiber perfusion, Matrix perfusion, Microencapsulation.

### **Unit II; Stem Cells:**

**(15h)**

- Introduction to embryonic, fetal, and adult Cells,
- iPS Techniques and application of iPS technology to RegenerativeMedicine.
- Developmental hematopoiesis, Epigenetic regulation of stem cell fate, Nichebiology: regulation of hematopoiesis by the nice-mediated signalingmechanisms
- Cord blood banking and long-termstorage
- FACS and its application in stem cell characterization
- Mesenchymal stem cells and differentiation
- Bone and cartilage biology
- Immunomodulatory properties of mesenchymal stem cells
- Mechanisms of immunomodulation by MSCs.
- Plasticity, homing and Engraftment of stem cells
- Applications, current status and future prospectsof Stem Cell Therapy Role of MSCs in Graft vs. Host diseases, Stem cells for liver and kidney diseases, bone repair, diabetes. Stem cells for Neurodegenerative diseases, Stem cells for Cardiovascular diseases, Stem cells for autoimmune disorders, Stem cells for genetic diseases

- Basics of tissue engineering- Preparation of Biological and Synthetic Scaffold. Different Synthetic scaffolds and preparation methods. Tissue engineering of Skin, trachea, liver, kidney, bladder, veins, arteries, heart valves and heart. Clinical tissue engineered transplant.

**Unit III : Cancer Biology : (15h)**

- Cell cycle regulation, apoptosis, autophagy, senescence, Hallmarks of cancer.
- Genomic instability, angiogenesis and metastasis.
- Oncogenes and tumor suppressors.
- Gene Regulation and epigenetics.
- Cellular signaling in Cancer.
- Cancer stem cell; Molecular classification of cancer and cancer biomarkers; Cancer therapeutics; Cancer Immunotherapy; Animal model in cancer

**Unit IV: Advance and Applied Immunology: (15h)**

- Antibodies: Generation of monoclonal and polyclonal antibodies, recombinant approaches to generate monoclonal antibodies, Application of antibodies, abzymes (Catmab), immunotoxins, Single domain antibodies (Nanobody), bivalent and bi-specific antibodies.
- Autoimmunity and tolerance: General principle of autoimmune diseases, mechanism of peripheral and central tolerance, regulatory circuits in autoimmune processes, systemic autoimmune diseases, organ-specific autoimmune diseases (Central nervous system, gastrointestinal, Endocrine, Hepatic, cutaneous and rheumatoid arthritis).
- Transplantation immunology: History, principles and discovery of immunogenetics, donor antigens, mechanism of graft rejection, graft versus host diseases, physiological interaction that modulates graft rejection, manipulations to prevent graft rejection (strategies to induce central and peripheral tolerance). transplantation of specific organs (kidney, liver, heart, lung, pancreas), hematopoietic cell transplantation, xenogeneic transplantation, immunological issues in clinical transplantation.
- Tumor Immunology: Tumor recognition by immune cells, tumor antigens and its identification, Immunosuppression in tumor microenvironments, tumor escape mechanism. Influence of immune system on tumor development, immunoeediting, Cancer immunotherapies. NK cell and dendritic cell therapy.
- T-cell based vaccines, vaccine against parasitic diseases, adverse effects of vaccines. T cell and B-cell epitope mapping.
- Biologics and molecular medicine in immunology (cytokines, chemokines, cell-adhesion molecules, co-stimulatory molecules and surface receptor and ligands as therapeutic targets). Role of non-coding RNA in immunoregulation.
- Advance immunological techniques: Flow cytometry, Magnetic sorting, MHC tetramer technology, multiplex assays. Antibody purification and protein conjugations, spectratyping, surface plasmon resonance (SPR).

## Books/References:

1. The Cell Biology of Stem Cells. Edited by Eran Meshorer and Kathrin Plath. In *Advances in Experimental Medicine and Biology*, Volume 695. Year - 2010
2. *Molecular Cell Biology* (2013) Seventh Edition, by Lodish et al., Macmillan publishers
3. *Kuby Immunology*. 6th ed., W. H. Freeman & Company, 2007
4. Gordon JR. *A Practical Guide to cellular and Molecular Research Methods in Immunology*, Fifth edition, Saskatchewan 2004.
5. *Essentials of Mesenchymal Stem Cell Biology and Its Clinical Translation*. (Ed) Robert Chunhua Zhao. Publisher: Springer Science+Business Media. Year – 2013
6. *Stem Cell & Regenerative Medicine*(2016) by Herman Cheung, Bentham Publisher.
7. *Stem Cells Scientific Facts and Fiction* (Second Edition), Christine Mummery, 2014 Elsevier Publication.
8. Lobo, N.A., et al., The biology of cancer stem cells. *Annu Rev Cell Dev Biol*, 2007. 23: p. 675-99.

**UNIT – I : Regulation and Assessment of Electrolytes**

Advanced concept of regulation of body electrolytes,

Functions & properties of the predominant cellular electrolytes, including recent method for its assessment.

Concept of Gibbs- Donnan equilibrium and its application in physiology,

Recent method to record the membrane potential

**UNIT- II : New Technique in Diabetes and Nerve Conductivity**

Concept / techniques:- used for CBS (coronary blood supply),

Changes occur during exercise – uses of special techniques to determine the changes.

Determine the insulin receptor significance & concept for type- II DM.

New technique used for Nerve Conduction & their Significance.

Advanced technique to focus / trace the clinical importance for cerebral circulation.

**UNIT- III (Applied) : Antioxidant and Hormonal Study**

Recent concept approval of anti oxidant in different conditions

New technique for Auditory, Visual and Evoke potential

Recent studies or advances in hormones acting on the kidney

**UNIT – IV: Microscopic Techniques**

Concept of microscope technique used for kidney functions

Advanced technique used for measure agents that modify renal hemodynamic

Advanced technique which is used to determine of GFR & RBF

Recent concept of insulin / counter regulatory balance with suitable technique applicable

Advanced technique to measure – Creatinine, Urea, Uric acid, Clearance test, Dialysis.

**Reference books:-**

- Concepts in medical physiology by Julian Seifter & Austin Ranter
- Environmental exercise physiology by Stephen S. Cheung
- Advanced exercise Physiology by ACSM'S
- Applied mathematical models in human physiology
- Cardiovascular physiology concept 2<sup>nd</sup> edition by Richard E. Klabunde
- Cell physiology by Nicholas Sperelakis

**Paper III (D): Basic Environmental Studies (4 Credits) (60h)**

**Unit –Limnology used in environmental science (15h)**

Pollutant, contaminant, receptor, sink, dissolved Oxygen (d.o), chemical oxygen demand (c.o.d), Biological oxygen demand (b.o.d) & threshold limit value (t.l.v)

**Unit –II: Environmental pollution & components in environment, deforestation (15h)**

I) different types of pollutants (ii) biotic components (iii) abiotic components

IV) reasons for environmental pollution , V) hospital waste management

**Unit –III: Water pollution & ecosystem (15h)**

Causes, effects and control methods of water pollution.

Ecosystem, structure and function of an ecosystem. Producers, consumers & decomposers.

**Unit –IV: Types of energy sources (15h)**

Renewable and non- renewable energy sources; types, present status,

Use of nanotechnology in pollution management

Definition of green chemistry. Role of green chemistry in reduction of

Pollution, role of phase transfer catalyst in green chemistry

**List of Reference Books:**

- ‘Research Methodology’ by C.H. Chaudhary, RBSA Publication.
- ‘Elements of Biostatistics in Health Science’ by W. Daniell.
- ‘Statistical Methods for Research’ by S.Singhet. al., Central Publishing, Ludhiana.
- ‘Instrumental Methods of Chemical Analysis’ by Willard H.H. & Merritt L.L., John Wiley.
- ‘Environmental Chemical Analysis’ by M.S. Cess& Mar, Amrical Publication.
- ‘Environmental Impact Assessments’ by Larry W. Canter, Mc-Graw Hill, NY.
- ‘Principles of Remote Sensing’ by A.N. Patel & S. Singh, Scientific Publishers, Jodhpur.
- ‘Green Chemistry- Theory & Practice’ by Paul T. Anastas& John C. Warner, Amazon.com
- ‘Handbook of Environmental Health and Safety’ by Herman Koren& Michel Biseri, Jaico Publishing House, Delhi.

## **Paper III (E): Advances In Microbiology (4 Credits) (60h)**

### **Unit 1: Gene Technology: (15h)**

Enzymes: DNA polymerase, restriction endonucleases, topoisomerase I and DNA ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNase H.

Vectors: plasmids;(Ti/Ri), Cosmids, bacteriophage, M13 vectors, BAC, YAC and synthetic plasmids.

DNA sequencing dideoxy chain termination and Sanger's +/- method.

cDNA library – screening by oligonucleotide probe, nick translation, site directed mutagenesis, linkage analysis.

Gene cloning- General strategy for gene cloning, transformation.

Application of gene technology, Gene Silencing, Geneknock out and gene therapy

### **Unit 2 :Immunology: (15h)**

Complement fixation, structure and classes of antibodies, genetic basis of antibody diversity.MHC I and II: structure and antigen presentation. T and B lymphocytes activation and role in humoral and cell mediated immunity. Vaccines live and attenuated, killed, multi-subunit and. Interleukins, Interferon and Lymphokine, Recent developments in Monoclonal antibody technology. In vitro synthesis of immunoglobulins, complement and other proteins

### **Unit 3:Bioremediation and biodegradation (15h)**

Bioremediation, *in situ* and *ex situ* bioremediation, constraints and priorities of bioremediation, Evaluating Bioremediation, Bioremediation of VOCs. Biodegradation. Factors affecting on process of biodegradation. Methods in determining biodegradability. Contaminant availability for biodegradation. Interleukins, Interferon and Lymphokines Recent developments in Monoclonal antibody technology In vitro synthesis of immunoglobulins, complement and other proteins

### **Unit 4:edicalmicobiology (15h)**

Rapid Detection of Food borne Pathogens, Recent advances in diagnosis of infectious diseases Microbial synthesis of nanoparticles, and its application in medical field Biosensors for detection of pathogens, Biofilm detection, and prevention of biofilm

### **Suggested reading**

1. Bergey's Manual of Systematic Bacteriology (2nd Ed.), Volumes 1 to 4 Springer
2. The Search for Bioactive Compounds from Microorganisms by S. Omura
3. Continuous Culture (Vol. 8) by A. C. R. Dean, D. C. Ellwood and C. G. T. Evans
4. Annual Reviews in Microbiology Volumes 46 & 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
5. Biotechnology: Current Progress Volume 1 by P. N. Cheremisinoff and L. M. Ferrante. Technomic Publishing Co. Inc
6. Advances in Applied Microbiology volumes 6, 10, 17 by D. Perlman and Umbreit (eds). Academic Press.
7. The Physiology and Biochemistry of Prokaryotes by D. White. Oxford University Press
8. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
9. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press,

Oxford, 1995

10. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995
11. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
12. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
13. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
14. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994
15. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
16. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998
17. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
18. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
19. Fundamentals of immunology 4th ed., Paul 1999, Lippencott Raven.

**Paper III (F) : Topics In Biochemistry (4 Credits) (60h)**

**I ] Instrumentation in Biochemistry : (15)**

Principles and methodology of Spectrophotometry, Fluorimetry, Atomic Emission and Absorption Ion Selective Electrodes, Oxygen and Carbon Dioxide Electrodes. Chromatography: Thin Layer Chromatography and Extraction Techniques, Gas Chromatography High Performance Liquid Chromatography, Electrophoresis Molecular Diagnostics, Immunological and Radioisotope Techniques, Coulometry, Osmometry and Refractometry

**II] Special Techniques in Biochemistry: (15)**

Molecular Diagnostics & Genetic Techniques – DNA hybridization techniques, Southern, Northern & Western blots, Restriction fragment length polymorphism, Polymerase chain reaction (PCR) Enzyme Linked Immunosorbent Assay (ELISA)

**III] Pathophysiology of Atherosclerosis & MI: (15)**

Cholesterol & Lipoprotein metabolism, Mechanism involved in atherogenesis & MI, Risk factors for atherosclerosis, Prevention of atherosclerosis

**IV] Cardiac Biomarkers (15)**

Biomarkers Definition, different types of biomarkers, cardiac biomarkers, historical concept, applications of measurement, clinical significance and correlation, types and limitations of: Cardiac troponins, myoglobin, troponin, creatine kinase (CK).

**Reference Books:**

1. Harper's Biochemistry by Murray, Granner, Mayes, Rodwell
2. Textbook of Biochemistry for Medical students, 8<sup>th</sup> edition  
D M Vasudevan, Sreekumari S, Kannan Vaidyanathan
3. Biochemistry, 4<sup>th</sup> edition U. Satyanarayana, U. Chakrapani
4. Medical Biochemistry by N V Bhagwan
5. Textbook of Biochemistry for Medical Students by Rafi
6. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 5<sup>th</sup> edition  
Burtis Carl A. & Ashwood Edward R.

**Paper III (G) : Topics In DNA Nanobiosensor      4 Credits (60h)**

**I ] Instrumentation in Biochemistry : (15)**

Principles and methodology of Spectrophotometry, Fluorimetry, Atomic Emission and Absorption Ion Selective Electrodes, Oxygen and Carbon Dioxide Electrodes. Chromatography: Thin Layer Chromatography and Extraction Techniques, Gas Chromatography High Performance Liquid Chromatography, Electrophoresis, Immunological Techniques, Coulometry, Osmometry and Refractometry

**II] Nucleic acid chemistry and Metabolism (15)**

Introduction, historical prospects, definition, types of Nucleosides and Nucleotides: deoxyribonucleic acid, ribonucleic acid, ribosomal RNA transfer RNA messenger RNA heterogeneous nuclear RNA. Peptide Nucleic Acid and their delivery methods by using nanotechnology: Targeting microRNAs, Targeting mRNA, Targeting genomic DNA for gene editing, targeting genomic DNA for gene editing (

**III] Special Techniques in Biochemistry (15)**

Molecular Diagnostics & Genetic Techniques – DNA hybridization techniques, Southern, Northern & Western blots, Restriction fragment length polymorphism, polymerase chain reaction (PCR), RT-PCR, ELISA and RIA

**IV] Nanobiotechnology and Biosensors (15)**

Introduction to Biosensor and nanobiosensor basic concepts, characterization, perception, Enzyme– metal NP hybrids for biosensing and for the generation of nanostructures, Biomolecule– semiconductor NPs for biosensing, Different types of nanobiosensors; Nanobiosensors for medical diagnostics. Nanoprobes for analytical applications

**Reference Books:**

1. Harper's Biochemistry by Murray, Granner, Mayes, Rodwell
2. Textbook of Biochemistry for Medical students, 8<sup>th</sup> edition  
D M Vasudevan, Sreekumari S, Kannan Vaidyanathan
3. Biochemistry, 4<sup>th</sup> edition U. Satyanarayana, U. Chakrapani
4. Medical Biochemistry by N V Bhagwan
5. Textbook of Biochemistry for Medical Students by Rafi
6. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 5<sup>th</sup> edition  
Burtis Carl A. & Ashwood Edward R.

## **Paper III (H): Nanotechnology For Hospital Waste Treatment ( 4 Credits ) (60h)**

### **Unit-1 Hospital waste Treatment and Nanotechnology (15h)**

Types of hospital waste, Method of collection of hospital waste, Methods of hospital waste treatment Disposal of hospital waste.

Introduction of Nanotechnology, Introduction of Graphene, Use of Graphene composites in hospital Liquid management.

### **UNIT-2 Preparation and Fabrication of Graphene composites (15h)**

Selection of chemicals, reagents and dye, Method of synthesis of Graphite Oxide, Method of synthesis of Graphene composites.

### **UNIT-3 Method and Evaluation of Adsorption (15h)**

Adsorbent, Adsorption experiment in dark, Formula to find removed quantity of dye.

### **UNIT-4 Method of Photocatalytic Activity of Graphene composites (15h)**

Visible light irradiation, Photocatalytic activity measurements.

### **References**

1. P.K Mukherjee- Graphene a two dimensional molecular form of carbon ( Delhi 2009 )
2. Dharmendra K. Tiwari, J. Behari AND PrasanjitSen- Application of nanoparticles in waste water treatment.
3. Luo YB, Cheng JS, Ma Q, Feng YQ, Li JH: Graphene-polymer composite:
4. Extraction of polycyclic aromatic hydrocarbons from water samples by stir rod sorptive Extraction. Anal Methods 2011,3:92.
5. Chen JM, Zou J, Zeng JB, Song XH, Ji JJ, Wang YR, Ha J, Chen X: Preparation and evolution of graphene-coated solid-phase microextraction fiber. Anal Chim Acta 2010, 678:44.
6. Liu TH, Li YH, Du QJ, Sun JK, Jiao YQ, Yang GM, Wang ZH, Xia YZ, Zhang W, Wang KL, Zhu HW, Wu DH: Adsorption of methylene blue from aqueous solution by graphene. Colloids Surf B 2012, 90:197.
7. Gao Y, Li Y, Zhang L, Huang H, Hu J, Shah SM, Su X: adsorption and removal of tetracycline antibiotics from aqueous solution by graphene oxide. J Colloid Interface Sci 2012, 368:540.
8. Nanotechnology in Industrial Wastewater Treatment Author (s): Dr. Arup Roy and Professor Jayanta Bhattacharya, both at Indian Institute of Technology, Kharagpur, India.
9. Nanotechnology for Water and Wastewater Treatment by Piet Lens (Editor), Jurate Virkutyte (Editor), Veeriah Jegatheesan (Editor), Publisher: IWA Publishing.

**Paper III (I) - Advances In Medical Science ( 4 Credits) (60h)**

**UNIT 1: Three Dimensional Conformal Radiotherapy (15h)**

Introduction, Imaging, Treatment Planning Process, Plan Optimization and Evaluation, Dose-Volume Histogram.

**UNIT 2: Intensity Modulated Radiotherapy (IMRT) (15h)**

Introduction, Imaging, Types of IMRT Delivery – Static and Dynamic, MLC Characteristics, Planning Process, Patient Specific QAs,

**UNIT 3: Stereotactic Radiosurgery/ Radiotherapy (SRS/SRT) (15h)**

Introduction, Imaging, Fusion, SRS TECHNIQUES – X- Knife, Gamma Knife, Stereotactic Frames, Patient Specific QA

**Unit 4: HDR Brachytherapy and Proton Therapy (15h)**

Introduction, TG-43, Source characteristics, ICRU 38, Emergency Procedures, Treatment Techniques- ICRT, ILRT, Interstitial Implants. Calibration of HDR Source.

Introduction, Basic Physics, Bragg Peak, Proton Accelerators – Cyclotron, Synchrotron, Beam Delivery Systems- Passiv Beam Spreading, Pencil Beam Scanning, Dosimetry- Absorbed Dose Calibration, Formalism, Beam Quality Index, Quality Correction Factors, QA

**Reference books-** F.M.Khan books of radiation therapy

## **PAPER III(J): Advances in Pharmacology (4 CREDITS) (60HRS)**

### **Unit-I- Experimental pharmacology**

**15 h**

Preclinical studies and regulations

Detailed study of CPCSEA guidelines for maintenance, breeding techniques and experimentation using laboratory animals

Recent advances in Transgenic and Knockout animals.

Organization of screening: Pharmacological activity of new substances and safety assessment tests.

Toxicity studies: acute, sub acute (Repeated dose), and chronic toxicity.

Alternatives to animal experimentation: Animal cell lines and their uses, Stem cell research etc.

### **Unit-II–Clinical Pharmacology**

**15 h**

Clinical pharmacokinetics –Plasma half life, Steady state concentration, loading dose, volume of distribution, clearance.

Therapeutic drug monitoring and its need

Regulations and process of new drug development

Clinical trials and phases of clinical trials

Bioavailability and bioequivalence studies

Newer aspect of Good clinical practice (GCP Guidelines)

### **Unit-III Basic Pharmacology**

**15 h**

Mechanism of action of drug ,Receptor occupancy and cellular signaling such as G protein, phosphatidyl inositol.

Ion channel and their modulators: calcium, potassium, sodium and chloride channels.

Factors modifying drug response-drug factors, patient factors, pharmaceutical factors.

Overview of Novel medicine formulations

Types of ADRs and ADRs monitoring and Pharmacovigilance

Biostatistics , Bio- economics

### **Unit-IV –Recent advances in pharmacology**

**15 h**

Recent advances in drug delivery and targeting drug delivery system

Gene therapy- concept of gene therapy and recent development of use of gene therapy

Immuno-pharmacology-monoclonal antibodies and its applications

Endogenous bioactive molecules: endothelium derived vascular substances (NO, endothelins) and their modulators

Newer concept: Oxidative stress in different diseases and oxidants as biomarkers

Advances in drug treatment in HIV patient with ethical considerations in HIV patients

## References

- A Comprehensive Guide to toxicology in preclinical drug development by Ali S Faqi 2013.
- Guidelines for Animal welfare –Committee for the purpose of control and supervision of Experiment on Animals(CPCSEA), Minister of state environment and Forest of India New Delhi
- Transgenic and Knockout animals – International Research Journal of Pharmacy.
- Gene kicked mouse: Knock out mouse and its applications, Rajashekar B etal. Int Res J.Pharm,2013:4(7)
- Substitute of Animals in Drug Research:An Approach Towards Fulfilment of 4Rs, T Arora, A K Mehetaetal Indian J of Pharmaceutical science 2011 ,73(1):1-6
- Goodman and Gilman manual of Pharmacology and therapeutics Second Edition 2014
- Authors Lairence and Brunton
- The Drug Development Process U.S Food and Drug Administration
- GCP Guidelines by Central Drug Standard Control Organization (CDSCO), Ministry of Health and Family Welfare of India.
- Pharmacovigilance Programme of India(PVPI),Performance report 2015, Indian Pharmacopeia Commission ,Ministry of Health and Family Welfare Government of India
- Free Radicals, Antioxidants in Disease and Health, Lien Ai Pham-Huy, Hua He, and Chuong Pham-Huy ,Int J Biomed Sci. 2008 Jun; 4(2): 89–96.

## **PAPER III (K) ADVANCES IN ANATOMY (4 CREDITS) (60HRS)**

### **UNIT 1: Embalming & Museum Techniques: (15h)**

Bombay Anatomy Act, Types of embalming, fluids for embalming, New techniques of embalming, Preservation of bodies and viscera, Museum Techniques - Plastination, Wax Embedding Techniques, Specimen Mounting Methods

### **UNIT 2: Histo Techniques: (15h)**

Marginating gross specimen, Fixation, Tissue processing, Sectioning, Mounting, Types of fixatives, H&E STAIN, Special Stains, Frozen sections, Decalcification, Histochemistry & Immuno Histochemistry – principle, applications, sample preparation, fixation, embedding, sectioning and mounting, Staining, counterstaining, labelling

### **UNIT 3: Anthropometry: (15h)**

Definition, Anthropometric parameters, Digital Anthropometry, Measures of Body Composition, Height/ Stature measurement technique, Mass/ Weight measurement technique, Body Mass Index, Waist: Hip circumference Ratio, Child Anthropometry, Regression Equation Formula, Anthropometric measurement usage in medical sciences.

### **UNIT 4: Genetics: (15h)**

Cell cycle and cell division, Gametogenesis, Infertility, DNA technologies - Cell culture, Karyotyping, Polymerase Chain Reaction (PCR), Fluorescent In Situ Hybridization (FISH), Southern Blotting – Principle, procedure and application, Northern Blotting – Principle, procedure and application, Gene and Genetic code, Prenatal diagnostic tests, Dermatoglyphics, Genetics and cancer, Population genetics, Mutation – types, factors affecting mutational load, Genetic Counselling

## **REFERENCE BOOKS**

1. Langman's medical embryology
2. The Developing Human, Clinically Oriented Embryology by Keith and Moore
3. Principles and Practice of Genetics – Emery: Volume I&II
4. Emery's elements of medical genetics – 13<sup>th</sup> edition: Peter Trunpenny
5. Essentials of Human Genetics – Bhatnagar, Kothari and Mehta
6. Tissues of Human Body – Le Gros Clerk
7. Theory and Practice of Histology Techniques – John Bancroft
8. Medical Laboratory Technology – Dr. Ramnik Sood
9. Genetics A Molecular Approach – Peter J. Russel
10. Molecular Cell Biology – Harvey Lodish, Arnold Berk
11. Histology Stains – Richard Horobin
12. Embalming – T. Jayavelu
13. Embalming – M.L.Ajmani
14. An Introduction to Anthropology- M.F.Ashley Montagu
15. History of Anatomy and Embalming Techniques –Dr. Pratibha Athavia
16. Histology Microscopy and Photomicrography – D.R.SINGH
17. Handbook of Immunohistochemistry and In Situ Hybridization of Human Carcinomas – Vol. I, II, III – Hayat M.A.

## **Syllabus of the papers (III) to be introduced from 2018 onwards**

### **Paper III (B): Stem cell and Regenerative Medicine (Revised) (4credits)**

#### **Unit 1: Introduction and basic biology of stem cells (15h)**

Stem cell evolution, Historical perspective - with model systems, Definition, Type of stem cells: Embryonic and adult stem cells, Embryonic germ cells and carcinoma cells: Teratomas and Teratocarcinoma, Stem cell markers, Stem cell niches, Growth Factors and Paracrine mechanism and action of stem cells, Cell stage to blastocyst formation, Implantation, gastrulation, properties and characterization of embryonic stem cells, Types of adult stem cells: Bone marrow, adipose tissue, cord blood, placenta, endometrium and other post-natal adult stem cells.

#### **Unit 2: Cell culture techniques and Molecular mechanism of Stem cells**

**(15h)**

Cell culture basics, Cell culture media and culture methods, primary and secondary cultures, cell counting and viability techniques, cryopreservation of stem cells, stem cell cycle and their regulators: embryonic vs adult cells, symmetric and asymmetric division Isolation and maintenance of embryonic stem cells and adult stem cells, Serum and feeder free culture of embryonic stem cells, characterization of embryonic stem cells, Extracellular and intracellular signaling involved in embryonic vs adult stem cells, Genetic regulation of stem cell fate, Telomerase and its regulation, iPS Techniques and application of iPS technology to Regenerative Medicine, Molecular mechanism of stem cells: Signal transduction pathways- Wnt pathway, BMP pathway, Notch pathway, Hedgehog signaling, JAK-STAT pathway, VEGF Pathway, PI3 kinase, ERK pathway and TGF beta pathway.

#### **Unit 3: Hematopoietic and Mesenchymal stem cell: Self renewal and differentiation**

**(15h)**

Bone marrow microenvironment, Hematopoietic stem cell mobilization, mesenchymal stem cells and their properties, Hematopoietic Vs mesenchymal stem cells, Isolation of Hematopoietic and mesenchymal stem cells, Ex vivo expansion, Characterization of Hematopoietic and mesenchymal stem cells using Fluorescent activated cell sorter and other methods of characterization, Transcriptional regulation of Hematopoietic and mesenchymal stem cells, Side population phenotypes, endothelial progenitor cells, Multipotent adult progenitor cells, Differentiation of stem cells in-vivo and ex-vivo, Differentiation in to osteoblast, adipocyte, chondrocyte lineages, Trans differentiation of

mesenchymal stem cell into various ectodermal and endodermal lineages, perivascular cells, differentiation into endothelial cells and stem cell mediated angiogenesis.

**Unit 4: Cancer biology and application of stem cells: (15h)**

Introduction to cancer, Oncogenes, Tumor suppressive gene, metastasis, Stem cell origin of cancer, Cancer stem cells, Pathways involved in cancer stem cells and their tumor progression, cancer stem cells, pericytes and tumor angiogenesis, cancer therapeutics, animal models in cancer, sources of cancer stem cells from solid tumors: Breast, cervix, endometrium, brain and so on.

Application of stem cells: Application of stem cells in treating various neurodegenerative diseases, role of stem cells in acute myocardial infarction and dilated cardiomyopathy, stem cell therapy for treating macro and microvascular complications, stem cell therapy for treating diabetes mellitus, application of stem cells in genetic diseases, bone marrow stem cell transplantation for malignancies- lymphoma, leukemia and myeloma.

**Text/Reference Books**

- “Stem cell basics and application” Ed. by K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
- “Stem cell therapy for organ failure”, Ed by, Indumathi Somasundaram, Springer Verlag, UK, 2015.
- Handbook of stem cells, Ed by Robert Lanza. Elsevier Academic Press, 2011.
- Human embryonic stem cells, Ed by Arlene Y. Chiu, Mahendra Rao. Human Press.
- Essentials of mesenchymal stem cells and their clinical translation, Ed by, Robert Chunhua Zhao. Springer Science+ business media, 2013.
- Stem cells and Regenerative Medicine, Ed by Herman Cheung, Bentham publisher, 2016.

**Paper III (L): Pharmaceutical Sciences (Advance Pharmaceutics)**  
**(4credits)**

**Unit 1: Basics of Controlled Drug Delivery and Drug Targeting (15h)**

Controlled Drug Delivery Systems: i. Concepts and Rationale ii. Classification of controlled release systems iii. Carriers for CDDS iv. Design and evaluation v. Release KineticsMolecular basis of targeted drug delivery.

**Unit 2: Transdermal Drug Delivery and Implants (15h)**

Transdermal Drug Delivery System (TDDS) i General considerations, Basic Components, ii Different approaches iii Methods of enhancements of percutaneous absorption iv Evaluations and applications of TDDS.

Implants and Inserts i General considerations, Mechanism of drug release ii various approaches and Devices iii Applications Osmotically Regulated Systems i General considerations ii Classifications and development of Osmotic Pumps iii Applications

**Unit 3: Novel Drug Delivery System (15h)**

General Considerations, Methods of Preparation, Characterization and Applications of following drug Delivery Systems: i. Liposomes ii. Niosomes iii. Resealed Erythrocytes iv. Nnparticles v. Solid Lipid Nanoparticles vi. Dendrimers vii. Multiple emulsions viii. Submicron emulsion

**Unit 4:Recent Advancements in Novel Drug Delivery Systems (15h)**

An overview and Applications of following Drug Delivery Systems: i. Aquasomes ii. Pharmacosomes iii. Transfersomes iv. Liquid Crystals v. Magnetically modulated drug delivery vi. Peptide and Protein drug DeliveryColon – Specific drug delivery i. General considerations, ii. Various approaches and applications

**Books and References**

1. Jain, N. K., “Controlled & Novel drug delivery”, CBS Publishers & distributors, New Delhi.
2. Jain, N. K., “Advances in Controlled & Novel drug delivery”, CBS Publishers & distributors, New Delhi
3. Vyas, S. P. and Khar, R. K. “Controlled drug delivery – Concepts & Advances”, Vallabh Prakashna, Delhi

4. Vyas, S. P. and Khar, R. K, "Targeted & Controlled drug delivery Novel Carrier Systems", CBS Publishers, New Delhi.
5. Mathiowitz, E., "Encyclopaedia of Controlled drug delivery" Vol - 1 & II, John Wiley & Sons, Canada
6. Swarbick, J. and Boyln, J., "Encyclopaedia of pharmaceutical technology" Vol. 1- III, Marcel Dekker, Inc., New York.
7. Jones, D. A., "Transdermal& related drug delivery system", Marcel Dekker, Inc., NY.
8. Robinson, J. R. and Lee,. H., "Controlled drug delivery fundamentals & applications" Marcel Dekker, Inc., New York. 15
9. Chein, Y. W., "Transdermal controlled systemic medications" Marcel Dekker, Inc., New York.
10. Hillery, A. and Llyod, A. W., "Drug delivery & Targeting", Taylor & Francis, London.

## **Paper III (M): Advanced Topics in Radiation Therapy (4 credits)**

### **Unit 1: Basics Of Radiation Physics (15h)**

Radioactivity-general properties of alpha,beta and gamma rays- laws of radioactivity- laws of successive transformations-natural radioactive series-radioactive equilibrium-alpha ray spectra, beta ray spectra-theory of beta decay-gamma emission-electron capture-internal conversion-nuclear isomerism- artificial radioactivity-Particle accelerators for medical and research applications: Van De Graff Generator-Cyclotron-linear accelerator-Interaction of electromagnetic radiation with matter-exponential attenuation-Thomson scattering-photoelectric and Compton process and energy absorption-pair production-attenuation and mass energy absorption coefficients-interaction of charged particles with matter-Principles of radiation detection and measurement-gas filled detectors-ionisation chambers-scintillation detectors-semiconductor detectors-radiographic and radiochromic films-Thermoluminescent dosimeters (TLD)-optically stimulated luminescence dosimeters (OSLD).

### **Unit 2: Intensity Modulation Radiation Therapy and Stereotactic Technics (15h)**

Introduction to IMRT – Physical optimization – Biological models for evaluation and optimization of IMRT – Target and critical structure definitions for IMRT – Static MLC IMRT, Dynamic MLC IMRT, patient specific quality assurance in IMRT – IMRT delivery system quality assurance –Introduction to SRS and SRT – SRS with Co-60 sources; the gamma knife – stereo tactic multiple –arc radiotherapy with a Linac – Dynamic SRS – Dynamic collimation for SRS with multiple arc. Mechanics of breathing – Methods to manage respiratory motion in radiation treatment – X-ray imaging techniques for guidance in the Radiation therapy

### **Unit 3: Physics of Nuclear Medicine (15h)**

Introduction to nuclear medicine-unsealed sources-production of radionuclide used in nuclear medicine-Variou usages of radiopharmaceuticals. In-vivo non-imaging procedures; thyroid uptake measurements, renogram, blood volume studies- The rectilinear scanner and its operational principle-two dimensional imaging techniques-three dimensional imaging techniques - focal plane tomography-single photon emission computed tomography-positron emission tomography.

#### **Unit 4: Basics of Brachytherapy**

**(15h)**

Definition and classification of brachytherapy techniques, Dose rate considerations and classification of brachytherapy techniques - low dose rate (LDR), high dose rate (HDR) and pulsed dose rate (PDR). Source specification - source calibration using in air set up, well-type chambers and solid phantoms- self absorption and attenuation in sources - TG43 dosimetry formalism -Monte Carlo based source dosimetry- manual dosimetric calculations -Manchester, Quimby and Paris systems - ICRU - 38 and 58- optimization methods- Quality Assurance - integrated brachytherapy unit- brachytherapy treatment planning, CT based brachytherapy planning

#### **Books for Study and Reference:**

1. H. E. Johns and Cunningham. The Physics of Radiology (4<sup>th</sup> edition), Thomas, Springfield, Ill, USA, 1983
2. Faiz M. Khan, The Physics of Radiation Therapy (3<sup>rd</sup> edition), Lippincott Williams & Wilkins, Philadelphia, 2003.
3. Faiz M. Khan, Roger A. Potish, Treatment Planning in Radiation Oncology, Williams & Wilkins, Baltimore, 1998.
4. W. H. Blahd, Nuclear Medicine, McGraw Hill Co., New Delhi, 2002.
5. The physics of modern brachytherapy for oncology, D Baltas, Taylor and Francis.2007.

## **Paper III (N): Deposition of Films and Their Applications (4 credits)**

### **Unit 1: Deposition of films using Physical method**

**(15h)**

Thermal evaporation: - Vacuum systems, Evaporation methods- Resistive heating, Laser evaporation, electron beam bombardment heating.

Cathodic Sputtering: - Sputtering process, Glow discharge, Sputtering Variants, low pressure sputtering, Reactive sputtering, Magnetron sputtering, RFsputtering

### **Unit 2: Deposition of films using Chemical method**

**(15h)**

Chemical vapour deposition: Deposition mechanism, Laser CVD, Photothermal CVD, Plasma enhanced CVD, MOCVD.

Solution deposition: - Ionic and solubility products, deposition parameters and process, Chemical deposition, SILAR, Spray pyrolysis and Spin coating.

Electrodeposition: - Faradays laws, mechanisms and deposition parameter, binary and ternary alloy deposition.

Epitaxial growth of films:-Influence of substrate and deposition condition, Theories of epitaxy.

### **Unit 3: Solar energy devices**

**(15h)**

Solid state junction solar cells: - principle of solar cells, Fabrication of CdS/ Cu<sub>2</sub>S and CdS / CuInSe<sub>2</sub> solar cells, performance testing, stability and efficiency consideration.

Organic solar cells.

Photoelectrochemical Solar Cells: -Basic principle, fabrication of CdSe/Polysulphide/Pt cell, band diagram, Stability of PEC cells.

Dye sensitized solar cells (DSSC):- Working principle, Fabrication of DSSCs based on TiO<sub>2</sub> and ZnO, stability and performance of dyes.

Solar selective Surface: -Method of obtaining selective surface, Application of selective surface in photo thermal conversion.

### **Unit 4: Other devices**

**(15h)**

Microelectronics: - MOS transistors, different steps in CMOS technology, thick film hybrid microcircuits.

Supercapacitor: - Materials for supercapacitors, Types of supercapacitors, thin film based supercapacitors on carbon, polymers, metal oxides.

Thin film gas sensor:- Basic parameters and mechanism of gas sensing, electrical

resistivity and heterojunction based sensors.

### **Reference book**

- 1) Thin film phenomena- K. L. Chopra, Mc Graw Hill, N.Y(1969)
- 2) Preparation of thin films- Joy George, Marcel & Dekker(1992)
- 3) Physics of thin film –L. Eckertova. Plenum press, N.Y(1986)
- 4) The theory and practice of microelectronics-S. K. Gandhi, John. Wiley & sons, N.Y(1968)
- 5) Gas sensors, V Demarne and R Sanjincs, Dordrecht,(1992)
- 6) Electrochemical Supercapacitors, B E Conway. Kluwar- plenum, NY1999

### **Paper III (O):- (Advances in Psychiatry) (4 Credits)**

#### **Unit 1: Advances in Clinical Psychiatry (15h)**

Newer pharmacotherapeutic molecules, newer brain stimulation techniques, newer neuroimaging modalities.

#### **Unit 2: Advances in Social Psychiatry (15h)**

Advances in suicide research, social influences on suicide, Farmers' suicide. Community mental health and Child Sexual abuse

#### **Unit 3: Media, social media and mental health (15h)**

Developments in mental health aspects of media and social media usage, media influence on behavior on Children and Adults.

#### **Unit 4: Advances in legal-aspects of mental health (15h)**

Mental Healthcare Act 2017 – Structure, Developments, Critique and future suggestions.

#### **Books & References:**

- Ed; Benjamin J. Sadock, Virginia A. Sadock. (2000). Kaplan & Sadock's comprehensive textbook of psychiatry. Philadelphia :Lippincott Williams & Wilkins.
- Ed; Vyas JN, Ghimire SR. Textbook of postgraduate psychiatry. Jaypee Brothers Publishers. New Delhi.
- Ministry of Health and Family Welfare. The Mental Healthcare Act 2017.

**MINISTRY OF HUMAN RESOURCE DEVELOPMENT**  
**UNIVERSITY GRANTS COMMISSION**  
**NOTIFICATION**

New Delhi, the 5th May, 2016

**University Grants Commission (Minimum Standards and Procedure for Award of M.PHIL./Ph.D Degrees) Regulations, 2016**

**{In supersession of the UGC (Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009, notified in The Gazette of India [No. 28, Part III-Section 4] for the week July 11-July 17, 2009}**

**No. F. 1-2/2009(EC/PS)V(I) Vol. II** - In exercise of the powers conferred by clauses (f) and (g) of sub-section (1) of Section 26 of the University Grants Commission Act, 1956 (3 of 1956), and in supersession of the UGC (Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009, notified in The Gazette of India [No.28, Part III-Section 4] for the following Regulations, namely:-

**1. Short title, Application and Commencement:**

- 1.1 These Regulations may be called University Grants Commission (Minimum Standards and Procedure for Award of M.Phil./Ph.D. Degrees) Regulations, 2016.
- 1.2 They shall apply to every University established or incorporated by or under a Central Act, a Provincial Act, or a State Act, every affiliated college, and every Institution Deemed to be a University under Section 3 of UGC Act, 1956.
- 1.3 They shall come into force from the date of their publication in the Gazette of India.

**2. Eligibility criteria for admission to the M.Phil. programme:**

2.1 Candidates for admission to the M.Phil. programme shall have a Master's degree or a professional degree declared equivalent to the Master's degree by the corresponding statutory regulatory body, with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) or an equivalent degree from a foreign educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions.

2.2 A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC(non-creamy layer)/Differently-Abled and other categories of candidates as per the decision of the Commission from time to time, or for those who had obtained their Master's degree prior to 19th September, 1991. The eligibility marks of 55% (or an equivalent grade in a point scale wherever grading system is followed) and the relaxation of 5% to the categories mentioned above are permissible based only on the qualifying marks without including the grace mark procedures.

**3. Eligibility criteria for admission to Ph.D. programme:**

Subject to the conditions stipulated in these Regulations, the following persons are eligible to seek admission to the Ph.D. programme:

3.1 Master's Degree holders satisfying the criteria stipulated under Clause 2 above.

3.2 Candidates who have cleared the M.Phil. course work with at least 55% marks in aggregate or its equivalent grade 'B' in the UGC 7-point scale (or an equivalent grade in a point scale wherever grading system is followed) and successfully completing the M.Phil. Degree shall be

eligible to proceed to do research work leading to the Ph. D. Degree in the same Institution in an integrated programme. A relaxation of 5% of marks, from 55% to 50%, or an equivalent relaxation of grade, may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/differently-abled and other categories of candidates as per the decision of the Commission from time to time.

3.3 A person who's M.Phil. Dissertation has been evaluated and the viva voce is pending may be admitted to the Ph.D. programme of the same Institution;

3.4 Candidates possessing a Degree considered equivalent to M.Phil. Degree of an Indian Institution, from a Foreign Educational Institution accredited by an Assessment and Accreditation Agency which is approved, recognized or authorized by an authority, established or incorporated under a law in its home country or any other statutory authority in that country for the purpose of assessing, accrediting or assuring quality and standards of educational institutions, shall be eligible for admission to Ph.D. programme.

#### **4. Duration of the Programme:**

4.1 M.Phil. programme shall be for a minimum duration of two (2) consecutive semesters / one year and a maximum of four (4) consecutive semesters / two years.

4.2 Ph.D. programme shall be for a minimum duration of three years, including course work and a maximum of six years.

4.3 Extension beyond the above limits will be governed by the relevant clauses as stipulated in the Statute/Ordinance of the individual Institution concerned.

4.4 The women candidates and Persons with Disability (more than 40% disability) may be allowed a relaxation of one year for M.Phil and two years for Ph.D. in the maximum duration. In addition, the women candidates may be provided Maternity Leave/Child Care Leave once in the entire duration of M.Phil/Ph.D. for up to 240 days.

#### **5. Procedure for admission:**

5.1 All Universities and Institutions Deemed to be Universities shall admit M.Phil/Ph.D. students through an Entrance Test conducted at the level of Individual University/Institution Deemed to be a University. The University/Institution Deemed to be a University may decide separate terms and conditions for Ph.D. Entrance Test for those students who qualify UGC-NET (Including JRF)/UGC-CSIR NET (including JRF)/SLET/GATE/teacher fellowship holder or have passed M.Phil programme. Similar approach may be adopted in respect of Entrance Test for M.Phil programme.

5.2 Higher Educational Institutions (HEIs) referred to in sub-clause 1.2 above and Colleges under them which are allowed to conduct M.Phil. and/or Ph.D. programmes, shall:

5.2.1 decide on an annual basis through their academic bodies a predetermined and manageable number of M.Phil. and/or Ph.D. scholars to be admitted depending on the number of available Research Supervisors and other academic and physical facilities available, keeping in mind the norms regarding the scholar- teacher ratio (as indicated in Para 6.5), laboratory, library and such other facilities;

5.2.2 notify well in advance in the institutional website and through advertisement in at least two (2) national newspapers, of which at least one (1) shall be in the regional language, the number of seats for admission, subject/discipline-wise distribution of available seats, criteria for admission, procedure for admission, examination centre(s) where entrance test(s) shall be conducted and all other relevant information for the benefit of the candidates;

5.2.3 adhere to the National/State-level reservation policy, as applicable.

5.3 The admission shall be based on the criteria notified by the Institution, keeping in view the guidelines/norms in this regard issued by the UGC and other statutory bodies concerned, and taking into account the reservation policy of the Central/State Government from time to time.

5.4 HEIs as mentioned in Clause 1.2 shall admit candidates by a two stage process through:

5.4.1 An Entrance Test shall be qualifying with qualifying marks as 50%. The syllabus of the Entrance Test shall consist of 50% of research methodology and 50% shall be subject specific. The Entrance Test shall be conducted at the Centre(s) notified in advance (changes of Centres, if any, also to be notified well in advance) at the level of the individual HEI as mentioned in clause 1.2; and

5.4.2 An interview/*viva-voce* to be organized by the HEI as mentioned in clause 1.2 when the candidates are required to discuss their research interest/area through a presentation before a duly constituted Department Research Committee.

5.5 The interview/*viva voce* shall also consider the following aspects, viz. whether:

5.5.1 the candidate possesses the competence for the proposed research;

5.5.2 the research work can be suitably undertaken at the Institution/College;

5.5.3 the proposed area of research can contribute to new/additional knowledge.

5.6 The University shall maintain the list of all the M.Phil. / Ph.D. registered students on its website on year-wise basis. The list shall include the name of the registered candidate, topic of his/her research, name of his/her supervisor/co-supervisor, date of enrolment/registration.

**6. Allocation of Research Supervisor:** Eligibility criteria to be a Research Supervisor, Co-Supervisor, Number of M.Phil./Ph.D. scholars permissible per Supervisor, etc.

6.1 Any regular Professor of the University/Institution Deemed to be a University/College with at least five research publications in refereed journals and any regular Associate/Assistant Professor of the university/institution deemed to be a university/college with a Ph.D. degree and at least two research publications in refereed journals may be recognized as Research Supervisor. Provided that in areas/disciplines where there is no or only a limited number of refereed journals, the Institution may relax the above condition for recognition of a person as Research Supervisor with reasons recorded in writing.

6.2 Only a full time regular teacher of the concerned University/Institution Deemed to be a University/College can act as a supervisor. The external supervisors are not allowed. However, Co-Supervisor can be allowed in inter-disciplinary areas from other departments of the same institute or from other related institutions with the approval of the Research Advisory Committee.

6.3 The allocation of Research Supervisor for a selected research scholar shall be decided by the Department concerned depending on the number of scholars per Research Supervisor, the available specialization among the Supervisors and research interests of the scholars as indicated by them at the time of interview/*viva voce*.

6.4 In case of topics which are of inter-disciplinary nature where the Department concerned feels that the expertise in the Department has to be supplemented from outside, the Department may appoint a Research Supervisor from the Department itself, who shall be known as the Research Supervisor, and a Co-Supervisor from outside the Department/ Faculty/College/Institution on such terms and conditions as may be specified and agreed upon by the consenting Institutions/Colleges.

6.5 A Research Supervisor/Co-supervisor who is a Professor, at any given point of time, cannot guide more than three (3) M.Phil. and Eight (8) Ph.D. scholars. An Associate Professor as Research Supervisor can guide up to a maximum of two (2) M.Phil. and six (6) Ph.D. scholars and an Assistant Professor as Research Supervisor can guide up to a maximum of one (1) M.Phil. and four (4) Ph.D. scholars.

6.6 In case of relocation of an M.Phil./Ph.D. woman scholar due to marriage or otherwise, the research data shall be allowed to be transferred to the University to which the scholar intends to relocate provided all the other conditions in these regulations are followed in letter and spirit and the research work does not pertain to the project secured by the parent institution/ supervisor from any funding agency. The scholar will however give due credit to the parent guide and the institution for the part of research already done.

**7. Course Work:** Credit Requirements, number, duration, syllabus, minimum standards for completion, etc.

7.1 The credit assigned to the M.Phil. or Ph.D. course work shall be a minimum of 08 credits and a maximum of 16 credits.

7.2 The course work shall be treated as prerequisite for M.Phil./Ph.D. preparation. A minimum of four credits shall be assigned to one or more courses on Research Methodology which could cover areas such as quantitative methods, computer applications, research ethics and review of published research in the relevant field, training, field work, etc. Other courses shall be advanced level courses preparing the students for M.Phil./Ph.D. degree.

7.3 All courses prescribed for M.Phil. and Ph.D. course work shall be in conformity with the credit hour instructional requirement and shall specify content, instructional and assessment methods. They shall be duly approved by the authorized academic bodies.

7.4 The Department where the scholar pursues his/her research shall prescribe the course(s) to him/her based on the recommendations of the Research Advisory Committee, as stipulated under sub-Clause 8.1 below, of the research scholar.

7.5 All candidates admitted to the M.Phil. and Ph.D. programmes shall be required to complete the course work prescribed by the Department during the initial one or two semesters.

7.6 Candidates already holding M. Phil. degree and admitted to the Ph.D. programme, or those who have already completed the course work in M.Phil. and have been permitted to proceed to the Ph.D. in integrated course, may be exempted by the Department from the Ph.D. course work. All other candidates admitted to the Ph.D. programme shall be required to complete the Ph.D. course work prescribed by the Department.

7.7 Grades in the course work, including research methodology courses shall be finalized after a combined assessment by the Research Advisory Committee and the Department and the final grades shall be communicated to the Institution/College.

7.8 A M.Phil./Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the course work in order to be eligible to continue in the programme and submit the dissertation/thesis.

**8. Research Advisory Committee and its functions:**

8.1 There shall be a Research Advisory Committee, or an equivalent body for similar purpose as defined in the Statutes/Ordinances of the Institution concerned, for each M.Phil. and Ph.D.

scholar. The Research Supervisor of the scholar shall be the Convener of this Committee.

This Committee shall have the following responsibilities:

- 8.1.1 To review the research proposal and finalize the topic of research;
- 8.1.2 To guide the research scholar to develop the study design and methodology of research and identify the course(s) that he/she may have to do.
- 8.1.3 To periodically review and assist in the progress of the research work of the research scholar.

8.2 A research scholar shall appear before the Research Advisory Committee once in six months to make a presentation of the progress of his/her work for evaluation and further guidance. The six monthly progress reports shall be submitted by the Research Advisory Committee to the Institution/College with a copy to the research scholar.

8.3 In case the progress of the research scholar is unsatisfactory, the Research Advisory Committee shall record the reasons for the same and suggest corrective measures. If the research scholar fails to implement these corrective measures, the Research Advisory Committee may recommend to the Institution/College with specific reasons for cancellation of the registration of the research scholar.

## **9. Evaluation and Assessment Methods, minimum standards/credits for award of the degree, etc.:**

9.1 The overall minimum credit requirement, including credit for the course work, for the award of M.Phil. degree shall not be less than 24 credits.

9.2 Upon satisfactory completion of course work, and obtaining the marks/grade prescribed in sub-clauses 7.8 above, as the case may be, the M.Phil./Ph.D. scholar shall be required to undertake research work and produce a draft dissertation/thesis within a reasonable time, as stipulated by the Institution concerned based on these Regulations.

9.3 Prior to the submission of the dissertation/thesis, the scholar shall make a presentation in the Department before the Research Advisory Committee of the Institution concerned which shall also be open to all faculty members and other research scholars. The feedback and comments obtained from them may be suitably incorporated into the draft dissertation/thesis in consultation with the Research Advisory Committee.

9.4 M.Phil scholars shall present at least one (1) research paper in a conference/seminar and Ph.D. scholars must publish at least one (1) research paper in refereed journal and make two paper presentations in conferences/seminars before the submission of the dissertation/thesis for adjudication, and produce evidence for the same in the form of presentation certificates and/or reprints.

9.5 The Academic Council (or its equivalent body) of the Institution shall evolve a mechanism using well developed software and gadgets to detect plagiarism and other forms of academic dishonesty. While submitting for evaluation, the dissertation/thesis shall have an undertaking from the research scholar and a certificate from the Research Supervisor attesting to the originality of the work, vouching that there is no plagiarism and that the work has not been submitted for the award of any other degree/diploma of the same Institution where the work was carried out, or to any other Institution.

9.6 The M.Phil. dissertation submitted by a research scholar shall be evaluated by his/her Research Supervisor and at least one external examiner who is not in the employment of the Institution/College. The *viva-voce* examination, based among other things, on the critiques given in the evaluation report, shall be conducted by both of them together, and shall be open to be

attended by Members of the Research Advisory Committee, all faculty members of the Department, other research scholars and other interested experts/ researchers.

9.7 The Ph.D. thesis submitted by a research scholar shall be evaluated by his/her Research Supervisor and at least two external examiners, who are not in employment of the Institution/College, of whom one examiner may be from outside the country. The *viva-voce* examination, based among other things, on the critiques given in the evaluation report, shall be conducted by the Research Supervisor and at least one of the two external examiners, and shall be open to be attended by Members of the Research Advisory Committee, all faculty members of the Department, other research scholars and other interested experts/researchers.

9.8 The public *viva-voce* of the research scholar to defend the dissertation/thesis shall be conducted only if the evaluation report(s) of the external examiner(s) on the dissertation/thesis is/are satisfactory and include a specific recommendation for conducting the *viva-voce* examination. If the evaluation report of the external examiner in case of M.Phil. Dissertation, or one of the evaluation reports of the external examiner in case of Ph.D. thesis, is unsatisfactory and does not recommend *viva-voce*, the Institution shall send the dissertation/ thesis to another external examiner out of the approved panel of examiners and the *viva-voce* examination shall be held only if the report of the latest examiner is satisfactory. If the report of the latest examiner is also unsatisfactory, the dissertation/ thesis shall be rejected and the research scholar shall be declared ineligible for the award of the degree.

9.9 The Institutions shall develop appropriate methods so as to complete the entire process of evaluation of M.Phil. Dissertation/ Ph.D. thesis within a period of six months from the date of submission of the dissertation/thesis.

## **10. Academic, administrative and infrastructure requirement to be fulfilled by Colleges for getting recognition for offering M.Phil./Ph.D. programmes:**

10.1 Colleges may be considered eligible to offer M.Phil./Ph .D programmes only if they satisfy the availability of eligible Research Supervisors, required infrastructure and supporting administrative and research promotion facilities as per these Regulations.

10.2 Post-graduate Departments of Colleges, Research laboratories of Government of India/State Government with at least two Ph.D. qualified teachers/scientists/other academic staff in the Department concerned along with required infrastructure, supporting administrative and research promotion facilities as per these Regulations, stipulated under sub-clause 10.3, shall be considered eligible to offer M.Phil./Ph.D. programmes. Colleges should additionally have the necessary recognition by the Institution under which they operate to offer M.Phil/Ph.D. programme.

10.3 Colleges with adequate facilities for research as mentioned below alone shall offer M.Phil./Ph. D.programmes:

- 10.3.1 In case of science and technology disciplines, exclusive research laboratories with sophisticated equipment as specified by the Institution concerned with provision for adequate space per research scholar along with computer facilities and essential software, and uninterrupted power and water supply;
- 10.3.2 Earmarked library resources including latest books, Indian and International journals, e-journals, extended working hours for all disciplines, adequate space for research scholars in the Department/ library for reading, writing and storing study and research materials;
- 10.3.3 Colleges may also access the required facilities of the neighbouring Institutions/Colleges, or of those Institutions/Colleges/R&D laboratories/Organizations which have the required facilities.

### **11. Treatment of Ph.D / M.Phil. through Distance Mode/Part-time:**

11.1 Notwithstanding anything contained in these Regulations or any other Rule or Regulation, for the time being in force, no University; Institution, Deemed to be a University and College shall conduct M.Phil. and Ph.D. Programmes through distance education mode.

11.2 Part-time Ph.D will be allowed provided all the conditions mentioned in the extant Ph.D Regulations are met.

### **12. Award of M.Phil./Ph.D. degrees prior to Notification of these Regulations, or degrees awarded by foreign Universities:**

12.1 Award of degrees to candidates registered for the M.Phil./Ph.D. programme on or after July 11, 2009 till the date of Notification of these Regulations shall be governed by the provisions of the UGC (Minimum Standards and procedure for Awards of M.Phil/Ph.D Degree) Regulation, 2009.

12.2 If the M.Phil./Ph.D. degree is awarded by a Foreign University, the Indian Institution considering such a degree shall refer the issue to a Standing Committee constituted by the concerned institution for the purpose of determining the equivalence of the degree awarded by the foreign University.

### **13. Depository with INFLIBNET:**

13.1 Following the successful completion of the evaluation process and before the announcement of the award of the M.Phil./Ph.D. degree(s), the Institution concerned shall submit an electronic copy of the M.Phil. dissertation /Ph. D. thesis to the INFLIBNET, for hosting the same so as to make it accessible to all Institutions/Colleges.

13.2 Prior to the actual award of the degree, the degree-awarding Institution shall issue a provisional Certificate to the effect that the Degree has been awarded in accordance with the provisions of these UGC Regulations, 2016.

Prof. JASPAL S. SANDHU, Secy.

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