

# **Revised Regulations and CBME Curricula**

**For**

## **Post Graduate Degree in Pre-Clinical Medical Sciences**

**( M.D. ANATOMY, M.D. PHYSIOLOGY and M.D. BIOCHEMISTRY)**

**2020**



**Rajiv Gandhi University of Health Sciences, Karnataka**

**4<sup>th</sup> 'T' Block, Jayanagar, Bangalore - 560 041**

# Rajiv Gandhi University of Health Sciences, Karnataka, Bangalore

## The Emblem



The Emblem of the Rajiv Gandhi University of Health Sciences is a symbolic expression of the confluence of both Eastern and Western Health Sciences. A central wand with entwined snakes symbolises Greek and Roman Gods of Health called Hermis and Mercury is adapted as symbol of modern medical science. The pot above depicts Amrutha Kalasham of Dhanvanthri the father of all Health Sciences. The wings above it depicts Human Soul called Hamsa (Swan) in Indian philosophy. The rising Sun at the top symbolises knowledge and enlightenment. The two twigs of leaves in western philosophy symbolises Olive branches, which is an expression of Peace, Love and Harmony. In Hindu Philosophy it depicts the Vanaspathi (also called as Oushadi) held in the hands of Dhanvanthri, which are the source of all Medicines. The lamp depicts human energy (kundalini). The script “DevahithamYadayahu” inside the lamp is taken from Upanishath Shanthi Manthram (Bhadram Karnebhi Shrunuyanadev...), which says “**May we live the full span of our lives allotted by God in perfect health**” which is the motto of the Rajiv Gandhi University of Health Sciences.

## **Rajiv Gandhi University of Health Sciences, Karnataka, Bangalore**

### **Vision Statement**

The Rajiv Gandhi University of Health Sciences, Karnataka, aims at bringing about a confluence of both Eastern and Western Health Sciences to enable the humankind “Live the full span of our lives allotted by God in Perfect Health”

- It would strive for achievement of academic excellence by Educating and Training Health Professionals who,
  - ❖ Shall recognize health needs of community,
  - ❖ Carry out professional obligations Ethically and Equitably and in keeping with National Health Policy,
- It would promote development of scientific temper and Health Sciences Research.
- It would encourage inculcation of Social Accountability amongst students, teachers and institutions.
- It would Support Quality Assurance for all its educational programmes

### **Motto**

**Right for Rightful Health Sciences Education**



ರಾಜೀವ್ ಗಾಂಧಿ ಆರೋಗ್ಯ ವಿಜ್ಞಾನಗಳ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕರ್ನಾಟಕ, ಬೆಂಗಳೂರು

RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, KARNATAKA, BENGALURU  
4<sup>th</sup> T Block, Jayanagar, Bengaluru - 560 041

ACA/DCD/CBME-PG-Preclinical/410/2020-21

Date: 24/11/2020

**NOTIFICATION**

Sub: Revised Ordinance pertaining to Regulations and Curriculum of Pre-clinical Post Graduation subjects as per CBME guidelines.

Ref: 1) Minutes of BOS Pre-clinical PG held on 20/10/2020  
2) Proceedings of CAC meeting held on 02/11/2020  
3) Proceedings of 153<sup>rd</sup> Syndicate meeting held on 04/11/2020

In exercise of the powers vested under Section 35(2) of RGUHS Act, 1994, the Revised Ordinance pertaining to Regulation and Curriculum as per CBME guidelines for Pre-clinical Post Graduation subjects Anatomy, Physiology and Biochemistry is notified herewith as per Annexure.

The above Regulation shall be applicable to the students admitted to the said course from the academic year 2020-21 onwards.

By Order,

**REGISTRAR**

To

The Principals of all affiliated Medical colleges of RGUHS, Bangalore.

Copy to :

1. The Principal Secretary to Governor, Raj Bhavan, Bangalore - 560001
2. The Principal Secretary Medical Education, Health & Family Welfare Dept., M S Building, Dr.B.R. Ambedkar Veedhi, Bangalore - 01
3. PA to Vice - Chancellor/PA to Registrar/Registrar (Eva.)/Finance Officer, Rajiv Gandhi University Health Sciences, Bangalore
4. All Officers of the University Examination Branch/ Academic Section.
5. Guard File / Office copy.

# **Revised Regulations and CBME Curricula for Post Graduate Degree Courses in Pre-Clinical Sciences ( M.D. Anatomy, M.D. Physiology and M.D. Biochemistry)**

**(Annexure to University Notification No. ACA/DCD/CBME-PG-Pre Clinical/ 410/2020-21. Dated: 24/11/2020)**

## **Pre-Clinical Subjects**

### Contents

Chapter I	: Regulations	06-12
Chapter II	: Goals and objectives	13-14
Chapter III	: Course Description	
	MD Anatomy	15-41
	MD Biochemistry	42-70
	MD Physiology	71-94
Chapter IV	: Monitoring Learning Process	95-108
Chapter V	: Medical Ethics	109-110

**Chapter I**

**Revised Regulations and CBME Curricula for Post Graduate Degree in  
Pre-Clinical Medical Sciences**

**1. Branches of Study**

**1.1 Postgraduate Degree Courses**

The following courses of studies may be pursued

1. MD – Anatomy
2. MD – Physiology
3. MD - Biochemistry

**2. Eligibility for Admission**

*2.1 MD Degree:* A candidate affiliated to this university and who has passed final year MBBS examination after pursuing a study in a medical college recognised by the Medical Council of India / National medical Commission, from a recognised Medical College affiliated to any other University recognised as equivalent thereto, and has completed one year compulsory rotating internship in a teaching Institution or other Institution recognised by the Medical Council of India / National Medical Commission, and has obtained permanent registration of any State Medical Council shall be eligible for admission.

**3. Obtaining Eligibility Certificate by the University before making Admission**

No candidate shall be admitted for any postgraduate degree course unless the candidate has obtained and produced the eligibility certificate issued by the University. The candidate has to make an application to the University with the following documents along with the prescribed fee:

1. MBBS pass / degree certificate issued by the University.
2. Marks cards of all the university examinations passed MBBS course.
3. Attempt Certificate issued by the Principal.
4. Certificate regarding the recognition of the medical college by the Medical Council of India/ National medical Commission.
5. Completion of internship certificate.
6. In case internship was done in a non-teaching hospital, a certificate from the Medical Council of India / National medical Commission that the hospital has been recognised for internship.
7. Registration by any State Medical Council and
8. Proof of SC/ ST or Category I, as the case may be.

Candidates should obtain the Eligibility Certificate before the last date for admission as notified by the University. A candidate who has been admitted to postgraduate course should register his / her name in the University within a month of admission after paying the registration fee.

#### **4. Intake of students**

The intake of students to each course shall be in accordance with the ordinance in this behalf.

#### **5. Duration of Study**

##### *M.D Degree Courses*

The course of study shall be for a period of 3 years consisting of 6 academic terms.

#### **6. Method of training**

The training of postgraduate for degree shall be residency pattern with graded responsibilities in each academic year. The participation of the students in all facets of educational process is essential. Every candidate should take part in seminars, group discussions, journal review meetings, grand rounds, case demonstration, clinics, CPC and clinical meetings where relevant. Every candidate should be required to participate in the teaching and training programme of undergraduate students. Every candidate should be trained in basics of medical education technologies through research work and workshops at department or institutional level. Every candidate must undergo MCI/ NMC recommended Online Basic Research Methodology Course training during the first year of their course. Training should include involvement in laboratory and experimental work. Basic medical sciences students should be posted to allied and relevant clinical departments or institutions. Similarly, clinical subjects' students should be posted to basic medical sciences and allied speciality departments or institutions.

#### **7. Attendance, Progress and Conduct**

7.1 A candidate pursuing degree should work in the concerned department of the institution for the full period as a full-time student. No candidate is permitted to run a clinic/laboratory/nursing home while studying postgraduate course.

7.2 Each year shall be taken as a unit for the purpose of calculating attendance.

7.3 Every student shall attend symposia, seminars, conferences, journal review meetings, grand rounds, CPC, case presentation, clinics and lectures during each year as prescribed by the department and not absent himself / herself from work without valid reasons.

7.4 Every candidate is required to attend a minimum of 80% of the training during each academic term of the post graduate course. Provided further, leave of any kind shall not be counted as part of academic term without prejudice to minimum 80% attendance of training period every term.

7.5 Any student who fails to complete the course in the manner stated above shall not be permitted to appear for the University Examinations.

## **8. Monitoring Progress of Studies:**

8.1 *Work diary / Log Book* - Every candidate shall maintain a work diary and record of his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. (please see Chapter IV for model checklists). Work diary/ Logbook to be developed by the respective departments as per the local requirements. Special mention may be made of the presentations by the candidate as well as details of clinical or laboratory procedures, if any conducted by the candidate. The work diary/ logbook shall be scrutinised and certified by the Head of the Department and Head of the Institution, and presented in the university practical/clinical examination.

8.2 *Records*: Records and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University or MCI / NMC.

8.3 *Formative/ Internal assessment*: The concerned departments may conduct three internal assessments, two of them be annual tests, one at the end of first year and the other in the second year. The third test may be held three months before the final examination as per the University examination pattern – paper wise I - IV. The tests may include written papers, practical / clinicals and viva voce. Records and marks obtained in such tests will be maintained by the Head of the Department and sent to the University, when called for.

8.4 *Continuous formative assessment* should also be done based on participation in performance in the teaching and use of teaching aids, seminars, journal review, professionalism, and progress in dissertation work as enclosed. (see checklists - in chapter IV)

## **9. Basic Research Methodology Course**

It is mandatory to complete the MCI / NMC prescribed online Basic research methodology course during first academic year. This is to introduce the student to basic research methods and to facilitate the completion of dissertation work in partial fulfilment of the course requirements. A postgraduate student would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.

**Topics for the above presentation/ publication should be other than the dissertation work.**



## 10. Dissertation

10.1 Every candidate pursuing M.D degree course is required to carry out work on a selected research project under the guidance of a recognised post graduate teacher. The results of such a work shall be submitted in the form of a dissertation.

10.2 The dissertation is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, and comparison of results and drawing conclusions.

10.3 A **synopsis** containing particulars of proposed dissertation work **shall be uploaded to the designated portal** within six months from the date of commencement of the course on or before the dates notified by the University. The hard copy of the synopsis shall also be sent through the proper channel within the due date to the Registrar ( Academic), RGUHS.

***The duration between synopsis submission and dissertation submission shall be two years. Late submission of the synopsis will lead to refixation of examination term.***

10.4 Such synopsis will be reviewed only after receiving the hard copy and the dissertation topic will be registered by the University. No change in the dissertation topic or guide shall be made without prior approval of the University.

10.5 The dissertation should be written under the following headings:

- i. Introduction
- ii. Aims or Objectives of study
- iii. Review of Literature
- iv. Material and Methods
- v. Results
- vi. Discussion
- vii. Conclusion
- viii. Summary
- ix. References
- x. Tables
- xi. Annexures

10.6 The written text of dissertation shall be not less than 50 pages and shall not exceed 150 pages excluding references, tables, questionnaires and other annexures. It should be neatly typed in double line spacing on one side of paper (A4 size, 8.27" x 11.69") and bound properly. Spiral binding should be avoided. A declaration by the candidate that the work was done by him/her should be included. It should be endorsed and certified by the guide, head of the department and head of the institution.

**10.7 The soft copy of dissertation thus prepared shall be uploaded to the designated portal six months before final examination on or before the dates notified by the University.**

10.8 The dissertation shall be valued by examiners appointed by the University. Approval of dissertation work is an essential precondition for a candidate to appear in the University examination. Grades will be awarded to the dissertation as under:

A	:	Excellent > 70%
B	:	Good 60 - 70%
C	:	Satisfactory 50-60 %
D	:	Not Satisfactory <50%

**Could be accepted if** there is possibility to provide corrections within the next 2 months and submit. **If not accepted:** candidate to take up theory exam after 6 months with submission of thesis. To be informed to the candidate before the exam fees is paid. The thesis evaluation report of the students to be sent to the college from the university before student writes the university theory exam.

**10.9 Guide:** The academic qualification and teaching experience required for recognition by this University as a guide for dissertation work is as per Medical Council of India / National medical Commission Minimum Qualifications for Teachers in Medical Institutions Regulations, 1998. Teachers in a medical college/institution having basic MBBS degree and a total of eight years teaching experience out of which at least five years teaching experience as Assistant Professor gained after obtaining postgraduate degree shall be recognised as post graduate teachers.

A **Co-guide** may be included provided the work requires substantial contribution from a sister department or from another medical institution recognised for teaching/training by Rajiv Gandhi University of Health Sciences/Medical Council of India. The co-guide shall be a recognised postgraduate teacher of Rajiv Gandhi University of Health Sciences.

**10.10 Change of guide:** In the event of a registered guide leaving the college for any reason or in the event of death of guide, guide may be changed with prior permission from the university.

**10.11** Continuous evaluation of dissertation work (according to checklist 7 in chapter IV) must be done by guide and HOD

## 11. Schedule of Examination

The examination for MD courses shall be held at the end of three academic years (six academic terms). The university shall conduct two examinations in a year at an interval of four to six months between the two examinations. Not more than two examinations shall be conducted in an academic year.

## 12. Scheme of University Examination (Summative Examination)

The examination for MD shall be held at the end of 3rd academic year. M.D Degree examinations in any subject shall consist of dissertation, written paper (Theory), Practical/ Clinical and Viva voce.

*12.1 Dissertation:* Every candidate shall carryout work and submit a dissertation as indicated in SI.NO.10. Acceptance of dissertation shall be a precondition for the candidate to appear for the final examination. Twenty marks (20 marks only) shall be earmarked for Dissertation discussion at the University Examination.

*12.2 Written Examination (Theory):* A written examination shall consist of four question papers, each of three hours duration. Each paper shall carry 100 marks.

- Questions on recent advances may be asked in any or all papers
- The topics assigned to the different papers are given under concerned speciality subject.
- A strict division of the subjects may not be possible. Some overlapping of topics is inevitable. Students should be prepared to answer the overlapping topics.
- Question Format:
  - Ten questions of Long essays carrying 10 marks each
  - Questions should be structured so that evaluation is better, unbiased, and uniform. Open ended questions shall be avoided.
  - 10% of each question paper should be based on clinical case/problem-based learning with relevant applied aspects.
  - At least 50% of the questions in each paper can be application based.

Model question papers (I-IV) (see annexure I under concerned subject speciality) according to blueprinting based on the above format may be prepared and sent to the paper-setter along with the syllabus.

*12.3 Practical / Clinical Examination:*

In case of practical examination, it should be aimed at assessing competence and skills of techniques and procedures as well as testing student's ability to make relevant and valid observations, interpretations and inference of laboratory or experimental work relating to his/her subject. The total marks for practical / clinical examination shall be 200.

*12.4 Viva Voce:* Viva Voce Examination shall aim at assessing depth of knowledge, logical reasoning, confidence and oral communication skills. The total marks shall be 100 and the distribution of marks shall be as under:

(i) For examination of all components of syllabus	60 Marks
(ii) For Pedagogy	20 Marks
(iii) For Dissertation discussion	20 Marks

A model checklist for the evaluation of the pedagogy session is provided – checklist III in chapter IV

*12.5 Criteria for pass:*

- The examinations shall be organised based on ‘Marking system’ to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training.
- Paper minimum 40% for each individual theory paper
- Minimum 50 % in theory aggregate
- Minimum 50 % in practical and viva voce

*12.6 Examiners:* There shall be at least four examiners in each subject. Out of them two shall be external examiners and two shall be internal examiners. The qualification and teaching experience for appointment as an examiner shall be as laid down by the Medical Council of India / NMC and as notified by RGUHS.

*12.7 Criteria for declaring as pass in University Examination\*:* A candidate shall secure not less than 50% marks in each head of passing which shall include (1) Theory, (2) Practical including clinical and viva voce examination.

A candidate securing less than 50% of marks as described above shall be declared to have failed in the examination. Failed candidate may appear in any subsequent examination upon payment of fresh fee to the Registrar (Evaluation).

*12.8 Declaration of distinction:* A successful candidate passing the University examination in first attempt will be declared to have passed the examination with distinction, if the grand total aggregate marks is 75 percent and above. Distinction will not be awarded for candidates passing the examination in more than one attempt.

*12.9 Number of Candidates per day.* The maximum number of candidates for practical/ clinical and viva-voce examination shall be a maximum of 6 per day.

## CHAPTER II

### Goal

#### Goals and General Objectives of Postgraduate Medical Education Program

The goal of postgraduate medical education shall be to produce competent specialist and /or Medical teacher:

- i. who shall recognise the health needs of the community, who would provide high quality health care, and carry out professional obligations ethically and in keeping with the objectives of the national health policy;
- ii. who shall have mastered most of the competencies pertaining to the specialty, that are required to be practiced at the secondary and the tertiary levels of the health care delivery system;
- iii. who shall be aware of the contemporary advances and developments in the discipline concerned;
- iv. who shall have acquired a spirit of scientific inquiry and is oriented to the principles of research methodology and epidemiology and advance the cause of science through research and training; and
- v. who shall have acquired the basic skills in teaching of the medical and paramedical professionals.

#### General Objectives

At the end of the postgraduate training in the discipline concerned the student shall be able to:

- i. Recognise the importance of the concerned speciality in the context of the health need of the community and the national priorities in the health sector.
- ii. Demonstrate mastery in understanding of the concerned basic science subject.
- iii. Develop honest work ethics and empathetic behaviour with students and colleagues.
- iv. Identify social, economic, environmental, biological and emotional determinants of health in a given case, and take them into account while planning therapeutic, rehabilitative, preventive and promotive measures/strategies.
- v. Diagnose and manage majority of the conditions in the speciality concerned on the basis of clinical assessment, and appropriately selected and conducted investigations.
- vi. Plan and advice measures for the prevention and rehabilitation of patients suffering from disease and disability related to the speciality.
- vii. Demonstrate skills in documentation of individual case relevant to the assigned situation.
- viii. Demonstrate upright attitude, professional and effective communication skills with students and colleagues from various fields.

- ix. Play the assigned role in the implementation of national health programmes, effectively and responsibly.
- x. Organise and supervise the assigned work and demonstrating adequate managerial skills in the department / laboratory.
- xi. Demonstrate qualities of a good teacher capable of innovating teaching methodology and developing skills of integrating relevant basic science subject with other disciplines as and when needed.
- xii. Develop skills as a self-directed learner, recognise continuing educational needs; select and use appropriate learning resources.
- xiii. Demonstrate competence in basic concepts of research methodology and epidemiology, and be able to critically analyse relevant published research literature.
- xiv. Develop skills in using educational methods and techniques as applicable to the teaching of medical/nursing students, general physicians and paramedical health workers.
- xv. Function as an effective leader of a team engaged in teaching/ training and research

### **Statement of the Competencies**

Keeping in view the general objectives of postgraduate training, each discipline shall aim at development of specific competencies, which shall be defined and spelt out in clear terms. Each department shall produce a statement and bring it to the notice of the trainees in the beginning of the programme so that he or she can direct the efforts towards the attainment of these competencies.

### **Components of the PG Curriculum**

The major components of the PG curriculum shall be:

- Theoretical knowledge
- Practical/clinical Skills
- Training in Research methodology and Dissertation writing
- Professionalism, Ethics and communication skills
- Training in basics of medical education technologies
- Training in District Hospital (District Residency Programme/ DRP)

Source: Medical Council of India / NMC, Regulations on postgraduate medical education, 2020.

Details regarding the DRP can be referred at : [https://medicaldialogues.in/pdf\\_upload/pdf\\_upload-134716.pdf](https://medicaldialogues.in/pdf_upload/pdf_upload-134716.pdf) (GAZETTE PGME 18-09-2020)

## CHAPTER III

### Subject wise Course Description

#### COMPETENCY-BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN ANATOMY

##### Preamble

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training. These guidelines would help to achieve a uniform level of training of MD Anatomy to post graduate students throughout the state. The student, after undergoing the training, should be able to deal effectively with the needs of the medical community and should be competent to handle all problems related to the specialty of Anatomy and recent advances in the subject. The post graduate student should also acquire skills in teaching anatomy to medical and para-medical students and be able to integrate teaching of Anatomy with other relevant subjects, while being aware of her/his limitations. The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

- I. **Goal:** The Goal of MD Anatomy is to train a doctor to become a competent teacher and researcher in Anatomy who is aware of contemporary advances and developments in the field of Anatomy. He /she should acquire the competencies pertaining to the subject of Anatomy that is required to be practiced at all levels of the health system. Must be oriented to the principles of research methodology. He must acquire skills in educating medical and paramedical professionals and effectively communicate with students and colleagues from various fields. He must acquire qualities of a good teacher capable of innovating teaching methodology and developing skills of integrating anatomy with other disciplines as and when needed. He should also develop adequate management skills to function as an effective leader of the team engaged in teaching and research.
- II. **Objectives:** After completing the three-year course in MD Anatomy, the student should have achieved the following:
  - **Knowledge of Anatomy:**
    - Acquire competencies in gross and surface anatomy, neuroanatomy, embryology, genetics, histology, radiological anatomy, applied aspects, and recent advances of the above-mentioned anatomy branches to clinical practice.
  - **Practical and Procedural skills:**
    - Acquire mastery in dissection skills, embalming, tissue preparation, staining, and museum preparation.

- **Training skill in Research Methodology:**
  - Acquire knowledge and skills in teaching, research methodology, epidemiology & basic information technology, and Biostatistics methodology.
  - Has the knowledge to plan the protocol of a thesis, carry out a literature review, execute research projects, and prepare reports.
  - Has the ability to use Microsoft Office (Microsoft word, excel, PowerPoint), Internet, Searching scientific databases (e.g., PubMed, Medline, Cochrane reviews).
  - Acquire skills in writing research papers, paper & poster preparation.
- **Professionalism, attitude, and communication skills:**
  - Develop honest work ethics and empathetic behaviour with students and colleagues.
  - Acquire capacity of not letting his/her personal beliefs, prejudices, and limitations come in the way of duty.
  - Acquire attitude and communication skills to interact with colleagues, teachers, students and body donors and their families.
- **Teaching Anatomy:**
  - Practicing different methods of teaching-learning
  - Making presentations of the subject topics (seminars and journal clubs) and research outputs
- **Problem Solving:**
  - Demonstrate the ability to identify applied implications of the knowledge of anatomy and discuss information relevant to the problem, using consultation, texts, archival literature, and electronic media.
  - Demonstrate the ability to correlate the clinical conditions to the anatomical/ embryological/hereditary factors.
  - Demonstrate the ability to evaluate scientific/clinical information and critically analyse conflicting data and hypotheses.

## **COURSE CONTENT - Knowledge and Skills**

### **Syllabus**

A postgraduate student, after three years of training in MD (Anatomy), should have acquired knowledge in the following aspects of anatomy:

#### **Section – 1: Gross anatomy**

- Gross Anatomy of the entire body including upper limb, lower limb, thorax, abdomen, pelvis, perineum, head and neck, brain, and spinal cord

#### **Section – 2: Developmental anatomy/embryology**

- General embryology: gametogenesis, fertilization, implantation, and placenta, early human embryonic development.
- Systemic embryology: development of organ systems and associated common congenital abnormalities with teratogenesis.
- Physiological correlations of congenital anomalies.



### **Section – 3: Histology and histochemistry**

- Cell Biology
  - Cytoplasm - cytoplasmic matrix, cell membrane, cell organelles, cytoskeleton, cell inclusions, cilia, and flagella.
  - Nucleus - nuclear envelope, nuclear matrix, DNA, and other components of chromatin, protein synthesis, nucleolus, nuclear changes indicating cell death.
  - Cell cycle - mitosis, meiosis, cell renewal.
  - Cellular differentiation and proliferation.
- The microscopic structure of the body:
  - Principles of light, transmission and scanning, electron, fluorescent, confocal, and virtual microscopy.
  - The systems/organs of body - Cellular organization, light, and electron microscopic features, structure - function correlations, and cellular organization.

### **Section – 4: Neuroanatomy**

- Brain and its environment, Development of the nervous system, Neuron and Neuroglia, Somatic sensory system, Olfactory and optic pathways, Cochleovestibular and gustatory pathways, Motor pathways, Central autonomic pathways, Hypothalamo-hypophyseal system, Limbic system,
- Basal ganglia, Reticular system, Cross-Sectional anatomy of the brain and spinal cord.
- Detailed structure of the central nervous system and its applied aspect.

### **Section – 5: Genetics**

- Human Chromosomes - Structure, number and classification, methods of chromosome preparation banding patterns.
- Chromosome abnormalities, Autosomal and Sex chromosomal abnormalities syndromes, Molecular and Cytogenetics.
- Single gene pattern inheritance: Autosomal and Sex chromosomal pattern of inheritance, Intermediate pattern and multiple alleles, Mutations, Non-Mendelian inheritance, Mitochondrial inheritance, Genome imprinting, parental disomy.
- Multifactorial pattern of inheritance: Criteria for multifactorial inheritance, Teratology, Structure gene, Molecular Screening, Cancer Genetics - Haematological malignancies, Pharmacogenetics.
- Reproduction Genetics - Male and Female Infertility, Abortuses, Assisted reproduction, Preimplantation genetics, Prenatal diagnosis, Genetic Counselling and Ethics of Genetics.
- Principles of Gene therapy and its applied knowledge.

### **Section – 6: Immunology**

- Immune system and the cell types involved in defence mechanisms of the body. Gross features, cytoarchitecture, functions, development and histogenesis of various primary and secondary lymphoid organs in the body.
- Biological and clinical significance of the major histocompatibility complex of man including its role in transplantation, disease susceptibility/resistance and

- genetic control of the immune response.
- Common techniques employed in cellular immunology and histocompatibility testing.
- Molecular hybridization and PCR technology in immunology research particularly mechanism of antigen presentation, structural and functional relevance of the T cell receptor, genetic control of the immune response.
- Molecular basis of susceptibility to disease.

### **Section – 7: Applied anatomy and recent advances**

- Clinical correlations of structure and functions of the human body. Anatomical basis and explanations for clinical problems.
- Applications of knowledge of development, structural (microscopy), neuroanatomy to comprehend deviations from normal.
- Recent advances in medical sciences which facilitate comprehension of structure function correlations and applications in clinical problem solving.
- Collection, maintenance, and application of stem cells, cryobanking and principles of organ donation from recently dead bodies.

### **Section – 8: Surface Marking and Radiology**

- Surface marking of all regions of the body.
- Interpretation of normal radiographs of the body including special contrast procedures including barium studies, cholecystography, pyelography, salpingography. Normal CT Scan, MRI and Ultrasound.

### **Section - 9: Anthropology**

- Different anthropological traits, identification and use of Anthropological instruments.

### **Section – 10: Forensic Medicine**

- Identification of human bones from their remains and determination of sex, age, and height for medico legal application of Anatomy.

### **Section – 11: Comparative anatomy**

- Outline of comparative anatomy of the whole body and basic human evolution

## **SUBJECT SPECIFIC COMPETENCIES**

At the end of the course, the student should have acquired the following competencies:

### **A. Cognitive domain**

1. Describe the gross anatomy of the entire body, including upper limb, lower limb, thorax, abdomen, pelvis, perineum, head and neck, brain and spinal cord.
2. Explain the normal disposition of gross structure and their interrelationship in the human body. She/He should be able to analyse the integrated functions of

- organ systems and locate the site of gross lesions according to deficits encountered.
3. Describe the process of gametogenesis, fertilization, implantation, and placenta formation in early human embryonic development along with its variation and applied anatomy.
  4. Demonstrate knowledge about the sequential development of organs and systems along with its clinical anatomy, recognize critical stages of development and effects of common teratogens, genetic mutations, and environmental hazards. She/He should be able to explain the developmental basis of variations and congenital anomalies.
  5. Explain the principles of light, transmission and scanning, compound, electron, fluorescent and virtual microscopy.
  6. Describe the microscopic structure of various tissues & organs and correlate structure with functions as a prerequisite for understanding the altered state in various disease processes.
  7. Demonstrate knowledge about cell and its components, cell cycle, cellular differentiation, and proliferation.
  8. Describe the structure, number, classification, abnormalities, and syndromes related to human chromosomes.
  9. Describe important procedures in cytogenetics and molecular genetics with its application.
  10. Demonstrate knowledge about single gene pattern inheritance, intermediate pattern and multiple alleles, mutations, non-mendelian inheritance, mitochondrial inheritance, genome imprinting, and parental disomy.
  11. Describe the multifactorial pattern of inheritance, teratology, structure gene, molecular screening, cancer genetics, and pharmacogenetics.
  12. Demonstrate knowledge about reproduction genetics, assisted reproduction, prenatal diagnosis, genetic counselling, and ethics in genetics.
  13. Explain principles of gene therapy and its applied knowledge.
  14. Describe immune system and cell types involved in defense mechanisms of the body. Also explain gross features, cytoarchitecture, functions, development and histogenesis of various primary and secondary lymphoid organs in the body.
  15. Demonstrate knowledge about common techniques employed in cellular immunology and histocompatibility testing.
  16. Demonstrate applications of knowledge of structure & development of tissue and organ system to comprehend deviations from normal.
  17. Demonstrate knowledge about recent advances in medical sciences, which facilitate comprehension of structure-function correlations and applications in clinical problem-solving.
  18. Explain the collection, maintenance, and application of stem cells, cryobanking and organ donation principles from recently dead bodies.
  19. Demonstrate knowledge about the surface marking of all regions of the body.
  20. Able to interpret various radiographs of the body, normal CT scan, ultrasound, and MRI.
  21. Demonstrate knowledge about different anthropological traits and the use of related instruments.
  22. Demonstrate knowledge about the outline of the comparative anatomy of the whole body and basic human evolution.
  23. Demonstrate knowledge about identification of human bones, determination of sex, age, and height for medico legal application of anatomy

## **B. Affective domain**

1. Demonstrate self-awareness and personal development in routine conduct. (Self-awareness)
2. Communicate effectively with peers, students, and teachers in various teaching-learning activities. (Communication)
3. Demonstrate

- a. Due respect in handling human body parts & cadavers during dissection. (Ethics & Professionalism)
  - b. Humane touch while demonstrating living surface marking in subject/patient. (Ethics & Professionalism)
4. Acquire capacity of not letting his/her personal beliefs, prejudices and limitations come in the way of duty.
  5. Appreciate the issues of equity and social accountability while exposing students to early clinical exposure. (Equity and social accountability)

### **C. Psychomotor domain**

1. Identify, locate and demonstrate surface marking of clinically important structures in the cadaver and correlate it with living anatomy.
2. Acquire mastery in dissection skills, embalming, tissue preparation, staining and museum preparation.
3. Locate and identify clinically relevant structures in dissected cadavers.
4. Locate and identify cells & tissues under the microscope.
5. Identify important structures visualized by imaging techniques, specifically radiographs, computerized tomography (CT) scans, MRI, and ultrasonography.
6. Demonstrate various movements at the important joints and actions of various groups of muscles in the human body.
7. Demonstrate the anatomical basis of common clinical procedures expected to be performed by a basic medical doctor.  
Demonstrate different methods of teaching-learning and make presentations of the subject topics and research outputs.

### **SPECIFIC PRACTICE-BASED COMPETENCIES**

At the end of the course, the student should have acquired following competencies:

#### **1. Gross anatomy**

- 1.1 Procurement, Embalming and Preservation of human cadavers
- 1.2 Preparation of tanks for preserving bodies
- 1.3 Dissection of cadaver
- 1.4 Window dissection of important regions
- 1.5 Preparation of specimens for museum with display
  - a) soft parts
  - b) models
  - c) charts
- 1.6 Preparation and preservation of human bones / skeleton as assigned by the faculty

#### **2. Histology**

- 2.1 Preparation of common fixatives embalming fluid 10% formalin, Bouin's fluid etc
- 2.2 Making paraffin blocks and section cutting and mounting
- 2.3 Preparation of staining set for H and E staining and staining paraffin sections with the stain

- 2.4 Making celloidin, araldite, gelatin blocks and their section cutting
- 2.5 Processing hard tissues, decalcification of bones, block making and sectioning, preparation of ground sections of calcified bones.
- 2.6 Frozen section cutting on freezing microtome and cryostat
- 2.7 Honing and Stropping of microtome knives, including sharpening by automatic knife sharpener
- 2.8 Histology file in which LM and EM pictures of all the organs and tissues of the body should be drawn, and a small description of salient features written

### **3. Histochemical Methods**

- 3.1 Practical classes for staining of glycogen, mucopolysaccharides, alkaline phosphatase acid phosphatase, and calcium

### **4. Cytogenetics**

- 4.1 Preparation of media, different solutions, stains etc.
- 4.2 Preparation of buccal smear for sex chromatin, Human chromosome preparation from peripheral blood and karyotyping.
- 4.3 Banding techniques (G and C)
- 4.4 Making of Pedigree charts for study of patterns of inheritance.
- 4.5 Chromosomal Analysis.

### **5. Neuroanatomy**

- 5.1 Dissection of brain and spinal cord for teaching and learning purpose
- 5.2 Preparation of brain and spinal cord macroscopic and microscopic sections and identification of different parts in them.
- 5.3 Discussions on clinical problems related to neurological disorders and anatomical explanation for the same.

### **6. Teaching – learning methods**

- 6.1 Participation in teaching undergraduate students – small group teachings, tutorials, lectures, problem based learning, case based discussion, e learning
- 6.2 Participation in integrated teaching of undergraduates by involving in joint teaching sessions and seminars with other departments
- 6.3 Training in basics of Medical education technologies through workshops at department or institutional level

### **7. Research methodology**

A postgraduate student should be able to,

- Present poster presentation
- Read a scientific paper at a national/state conference and
- Present research paper which should be published/accepted for publication

### **8. Rotational postings**

- Rotation postings is to full fill the learning objectives of the clinical relevance and applied anatomy.
- Post graduate students should be posted to allied and relevant clinical departments or institutions.
- Rotation postings of PG students shall be made in II and III years of the PG course as follows:

Sl no	Departments	Duration
1	<b>General Surgery</b>	1 week
	Learning objectives: Laparoscopic and Endoscopic visualization of viscera and clinical anatomy	
2	<b>Orthopaedics</b>	1 week
	Learning objectives: Arthroscopic visualization of structures, nerve injury cases, relevant applied anatomy of musculoskeletal system	
3	<b>Radio diagnosis</b>	2 weeks
	Learning objectives: Principles and recent advances in the following: CT, MRI, USG plain & contrast radiography	
4	<b>Paediatric surgery</b>	1 week
	Learning objectives: Congenital anomalies related to development of the system	
5	<b>Pathology</b>	2 weeks
	Learning objectives: <ul style="list-style-type: none"> <li>- Special staining techniques at least one hands on experience: Connective tissue, Nerve tissue, PAS- mucinogen</li> <li>- Principle of Frozen microtomy or Cryostat, Electron microscopy</li> <li>- (Where feasible – one day visit to an electron microscopy lab: eg. In medical colleges located within city limits or nearby)</li> </ul>	
6	<b>Forensic Medicine</b>	1 weeks
	Learning objectives: <ul style="list-style-type: none"> <li>- Anthropometry and age estimation</li> <li>- Identification of human bones from their remains and determination of sex, age, and height. for medico legal application of Anatomy.</li> <li>- If embalming if not available in Anatomy department, it should be learnt in Forensic Medicine</li> </ul>	
7	<b>Genetics / Paediatrics</b>	3 weeks
	Learning objectives: <ul style="list-style-type: none"> <li>- Syndromes and Karyotyping,</li> <li>- Preimplantation genetics, Prenatal diagnosis, Genetic Counselling and Ethics of Genetics.</li> <li>- Principles of Gene therapy and its applied knowledge</li> <li>- Stem cells and cryobanking</li> </ul>	

- If Genetics department is not available in parent institution, Postgraduate should be posted to recognized genetics labs.
- Postgraduate can be posted to super speciality departments wherever available and relevant. Example: Stem cell retrieval technology/ Cadaveric organ donation – kidney, skin, cornea.
- At the end of the posting, a certificate must be obtained from the concerned heads of the departments for satisfactory learning.

## Method of training

The training of postgraduates shall be residency pattern with graded responsibilities in each academic year.

### SUGGESTED GUIDELINES FOR THREE YEAR MD ANATOMY ACTIVITIES

	ACADEMICS/RESEARCH/PROFESSIONALISM
1 <sup>st</sup> year	<ul style="list-style-type: none"><li>• Orientation to the subject and departmental activities</li><li>• Understand the Competency, syllabus and assessment of the PG curriculum in Anatomy as per the RGUHS requirement</li><li>• Attend regular Undergraduate MBBS lectures and practical – Dissection and Histology. Mandatory to attend all lecture/practical class</li><li>• Start taking Undergraduate small group teaching /dissection/osteology/histology under supervision</li><li>• Gross anatomy: Dissection of one whole human body and study of gross anatomy</li><li>• Histology - Basic techniques in tissue processing, preparation of blocks, microtome sections and H &amp; E</li><li>• Acquisition of embalming skills.</li><li>• Start Journal clubs and seminars</li><li>• Attend the PG research methodology training programme and mandatory to complete MCI /NMC prescribed online research methodology course</li><li>• Attend the Post graduate Medical education training program (PG MET)</li><li>• Selection of topic for thesis – Synopsis</li><li>• Preparation and submission of the synopsis</li><li>• Maintain logbook entry of all activities</li><li>• Internal assessment I - theory, practical &amp; viva voce</li><li>• Begin review and data collection for thesis</li><li>• Attend CME/Conferences/training Workshops</li><li>• Preparation for Poster/Oral Presentation in State / National conference/International</li><li>• Submission of 1st year logbook to HOD for signature</li><li>• Feedback from guide and HOD</li></ul>

<b>2<sup>ND</sup> year</b>	<ul style="list-style-type: none"> <li>• Continue academic activities of teaching Undergraduate medical students</li> <li>• Plan for rotational postings</li> <li>• Continue Journal club and seminars</li> <li>• Complete record book</li> <li>• Plan and prepare for oral/poster presentation in State/ National conference/international conference</li> <li>• Submission of logbook entry to HOD signature with all entries of the teaching learning methods and training programmes</li> <li>• Internal assessment II – both theory, practical and viva voce</li> <li>• Review thesis preparation</li> <li>• Feedback from Guide and HOD</li> </ul>
<b>3<sup>rd</sup> year</b>	<ul style="list-style-type: none"> <li>• Continue academic activities of teaching Undergraduate medical students</li> <li>• Complete thesis</li> <li>• Presentation of thesis</li> <li>• Complete logbook entries</li> <li>• Practice pedagogy sessions</li> <li>• Preliminary examination (III IA– theory, practical and viva voce) three months prior to university examination</li> <li>• Feedback from Guide and HOD</li> </ul>

- The participation of the students in all facets of educational process is essential. Every candidate should take part in seminars, journal clubs, conducting practical / small group teachings.
- Every candidate should be required to participate in the teaching and training programme of undergraduate students.
- Training should include involvement in laboratory and experimental work, and research studies.

#### **Maintenance of record of work done**

- A logbook entry showing each day's work must be maintained by the candidate, which shall be submitted to the head of the department for scrutiny on the first working day of each month.
- Logbook with suggested template is given in tables 1,2,3,4 in chapter IV which can be suitably modified as per the individual needs of the department / institution.
- A practical record of work done in Histology has to be maintained by the candidate and duly scrutinized and certified by the head of the department and to be submitted to the external examiner during the final examination.
- A list of the seminars and journal clubs that have been attended and participated by the student must be maintained which should be scrutinized by the head of the department.



### **Periodical assessment and progress report**

- The post graduate students have to be assessed periodically by conducting written, practical and viva voce examination at the end of every year.
- The assessment should be based also on participation in performance in the teaching and use of teaching aids, seminars, journal review, professionalism. (As enclosed in chapter IV: Seminar presentation evaluation- checklist VIII, Journal club review form -checklist I, PG appraisal form-checklist II, continuous evaluation of dissertation -checklist VII, teaching skill practice form- Checklist V)
- The assessment will be done by all the recognized PG teachers of the department and the progress record should be maintained by the head of the department.
- Minimum of three internal assessments (theory, practical and viva voce) are to be conducted during the postgraduate programme.
- Two of them will be annual conducted at the end of first and second academic year
- Third to be conducted three months before the university examination.
- Post graduate trainee must be appraised periodically and given feedback for improvement by the HOD and Guide and the record of the same need to be maintained in the department

### **Registration of dissertation topic**

- Every candidate shall submit a synopsis in the prescribed proforma for registration of dissertation topic by the University after it is scrutinized by the IEC cum Research Committee of the concerned institution.
- The synopsis shall be sent to University within the first 6 months from the commencement of the course or as notified by the University in the calendar of events, to the Registrar (Academic).
- The dissertation shall be submitted to the Registrar (Evaluation) of the University six months prior to the final examination or as notified in the calendar of events.
- Approval and acceptance of the dissertation by the panel of examiners is a prerequisite for a candidate to appear for the University examination.

### **Basic research methodology course**

It mandatory to complete the MCI / NMC prescribed online Basic research methodology course during first academic year. This is to introduce the student to basic research methods and to facilitate the completion of dissertation work in partial fulfilment of the course requirements. A postgraduate student would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/ accepted for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.

### **UNIVERSITY EXAMINATION (SUMMATIVE ASSESSMENT)**

- The examination for M.D / M.S courses shall be held at the end of three academic years (six academic terms).
- The university shall conduct two examinations in a year at an interval of four to six months between the two examinations. Not more than two examinations shall be conducted in an academic year.
- Examinations shall consist of dissertation, written paper (Theory), Practical and Viva voce.

- The examinations shall be organised based on ‘Marking system’ to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training.
- **Criteria for pass**
  - Paper minimum 40% for each individual theory paper
  - Minimum 50 % in theory aggregate
  - Minimum 50 % in practical and viva voce

(Model question papers and blueprinting are given in annexure I and annexure II respectively)

## **EXAMINATION-COMPONENTS, SUBJECTS AND DISTRIBUTION OF MARKS**

### **THEORY:**

- Total marks 400
- A written (Theory) examination shall consist of four question papers, with maximum of 100 marks each paper. Each paper will be of three hours duration.
- Each paper shall carry 100 marks.

<b>PAPER I</b>	Gross anatomy and applied anatomy
<b>PAPER II</b>	Embryology, genetics, and clinically oriented embryology
<b>PAPER III</b>	Microscopic anatomy, Principles of Microscopy, Organ donation, preservation of human body
<b>PAPER IV</b>	Neuroanatomy, radiological anatomy, cross sectional anatomy, recent advances in anatomical sciences

- Questions on recent advances may be asked in any or all papers
- The topics assigned to the different papers are given as general guidelines. A strict division of the subjects may not be possible. Some overlapping of topics is inevitable. Students should be prepared to answer the overlapping topics.

### **Question format:**

- Ten questions of Long essays carrying 10 marks each
- Questions should be structured so that evaluation is better, unbiased, and uniform
- 10% of each question paper should be based on problem-based learning with relevant applied Anatomy
- At least 50% of the questions in each paper can be application based.

Theory papers	TOPICS	Marks
<b>Paper I</b>	<p style="text-align: center;"><b>GROSS ANATOMY AND APPLIED ANATOMY</b></p> <p>a. Gross Anatomy of whole human body i.e. upper limb, lower limb thorax, abdomen, pelvis, head and neck</p> <p>b. Clinical and applied aspect of Anatomy</p>	<p style="text-align: center;"><b>100 marks</b></p>
<b>Paper II</b>	<p style="text-align: center;"><b>EMBRYOLOGY, GENETICS AND CLINICALLY ORIENTED EMBRYOLOGY</b></p> <p>a. General Embryology, Systemic Embryology, clinically oriented embryology, and teratology</p> <p>b. General Principles of genetics, Cytogenetic as applicable to medicine and different genetic disorders, gene therapy</p>	<p style="text-align: center;"><b>100 marks</b></p>
<b>Paper III</b>	<p style="text-align: center;"><b>MICROSCOPIC ANATOMY, PRINCIPLES OF MICROSCOPY, ORGAN DONATION, PRESERVATION OF HUMAN BODY</b></p> <p>a. Histology (including fine structure) of tissues and organs of the body with functional and clinical correlation</p> <p>b. Principles of light, transmission and scanning electron microscopy, confocal, virtual microscopy</p> <p>c. Basics of principles of organ donation</p> <p>d. Method of preservation of human body and its parts</p>	<p style="text-align: center;"><b>100 marks</b></p>
<b>Paper IV</b>	<p style="text-align: center;"><b>NEUROANATOMY, RECENT ADVANCES IN ANATOMICAL SCIENCES, RADIOLOGICAL ANATOMY, SECTIONAL ANATOMY</b></p> <p>a. Neuroanatomy - gross and applied aspects</p> <p>b. Recent advances in the application of knowledge of anatomy on human body</p> <p>c. Radiological anatomy, sectional anatomy</p> <p>d. Collection, maintenance and uses of stem cells</p> <p>e. Cryobanking</p>	<p style="text-align: center;"><b>100 marks</b></p>
	<b>TOTAL</b>	<p style="text-align: center;"><b>400 marks</b></p>

## ANNEXURE I

### Model question papers

**Rajiv Gandhi University of Health Sciences, Karnataka  
Post Graduate MD ANATOMY Examination - MMY**

**Anatomy Paper- I**

**Gross anatomy and applied anatomy**

**QP CODE: XXXX**

**Maximum marks: 100**

**Time: 3 hours**

#### **Instructions:**

- **Attempt all questions. Each question carries 10 marks**
- **Draw neat, labelled diagrams wherever necessary**

#### **Long essays:**

**10X 10=100 marks**

- 1 Explain the role of various factors helping the venous return of lower limbs. Explain the anatomical basis for Trendelenburg test in a person with varicosity of superficial veins. (6+4)
- 2 Discuss the features and clinical relevance of the layers of scalp. (5+5)
- 3 Discuss the laryngeal muscles under the following headings.  
a. Attachments  
b. Nerve supply  
c. Role in movement of vocal cords  
d. Effect of paralysis (3+1+3+3)
- 4 Describe a typical intercostal space under the following headings:  
a. Definition  
b. Boundaries and contents  
c. Course, branches and distribution of a typical intercostal nerve  
d. What is the ideal site to do a pleural tap. Explain the reason for the same (1+3+3+3)
- 5 A 54-year-old known patient of peptic ulcer develops perforation on the posterior surface of stomach. Where does the exudate collect? Describe the boundaries and communication of this space. Name the other peritoneal recesses. (1+4+2+ 3)
- 6 What is the common neurological complication occurring in the upper limb of a foetus following shoulder dystocia delivery? Explain the anatomical basis for this condition and add a note on the structures involved. (1+4+5).

- 7 Describe Coronary dominance. Correlate the effect of obstruction of posterior interventricular artery in a left dominant heart.  
(3+7)
- 8 Describe the ciliary ganglion under the following headings.  
a. Location  
b. Relations and connections  
c. Distribution (2+2+3+3)
- 9 Substantiate why the inguinal canal is a weak part of the anterior abdominal wall. Explain the various natural protective mechanisms which prevent the formation of hernia.  
(5+5)
- 10 Describe the prostate under the following headings.  
a. Location and coverings  
b. Anatomical and surgical lobes  
c. Features in the interior of the prostatic urethra  
d) Age changes in prostate (2+3+2+3)

**Rajiv Gandhi University of Health Sciences, Karnataka**  
**Post Graduate MD ANATOMY Examination - MMY**  
**Anatomy Paper- II**  
**Embryology, Genetics and Clinically oriented embryology**  
**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:**

- Attempt all questions. Each question carries 10 marks
- Draw neat, labelled diagrams wherever necessary

**Long essays:**

**10X 10=100 marks**

1. Discuss the stages of development of the metanephric kidney and the associated anomalies. (6+4)
2. A 28-year-old pregnant woman in the first trimester was subjected to ultrasound examination which revealed conjoined twins. Explain the embryological basis for various types of twinning and specify the number of placenta and foetal membranes in each. What are the hazards of twinning? (6+2+2)
3. Describe the principles of genetic transmission in
  - a. autosomal dominant inheritance
  - b. autosomal recessive inheritance. (5+5)
4. A 20-year-old delivered a full-term foetus with absence of skull cap. What is the congenital anomaly? Describe the physical features of the new born. Explain the reason for this congenital anomaly. (1+2+7)
5. The hysterosalpingography of a 35-year-old woman shows bilateral tubal blockage and her 38-year-old husband's sperm analysis shows no spermatozoa. What would be the ideal technique for this couple for conception. Explain the underlying principle of the technique. Name the steps involved with brief description of each step. (1+3+7)
6. Correlate the nerve supply of tongue with the development.
7. Describe the formation, subdivisions and fate of the somites. (2+2+6)
8. Describe the development of the interatrial septum. Explain the reason for the changes seen at birth. What is the embryological basis for Fallot's tetralogy? (4+3+3)
9. Describe the various factors responsible for the descent of testis. Add a note on the fate of the undescended testis. (7+3)
10. Explain the term non disjunction during cell division.

**Rajiv Gandhi University of Health Sciences, Karnataka**  
**Post Graduate MD ANATOMY Examination - MMY**  
**Anatomy Paper- III**

**Microscopic anatomy, Principles of Microscopy, Organ donation, preservation of human body**  
**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:**

- **Attempt all questions. Each question carries 10 marks**
- **Draw neat, labelled diagrams wherever necessary**

**Long essays:**

**10X 10=100 marks**

1. Describe the histology of testis. Explain the formation and functional significance of blood testis barrier. (5+5)
2. Discuss the microscopic cytoarchitecture of cerebellum and correlate its function. (5+5)
3. Describe the microscopic structure of serous salivary gland. Add a note on the role of the ducts in the secretion and release of saliva. (6+4)
4. Discuss the histology of liver and correlate the response of hepatocytes to toxins and bile duct occlusion in relation to the functional unit. (6+4)
5. Compare and contrast epidermis of thin and thick skin. Add a note on pigment donation.  
a. (6+4)
6. Discuss the principles of working of compound microscopy.
7. Explain the concept of open and closed circulation in relation to microscopy of the spleen.  
a. (5+5)
8. Describe the microscopy of various stages of development of a mature Graafian follicle. What is the fate of the follicular wall if the ovum is not fertilized? Correlate structure and function. (6+4)
9. Discuss the salient features of the Karnataka Anatomy act.
10. Describe the methods of embalming a term foetus.

**Rajiv Gandhi University of Health Sciences, Karnataka  
Post Graduate MD ANATOMY Examination - MMY**

**Anatomy Paper- IV**

**Neuroanatomy, radiological anatomy, cross sectional anatomy, recent advances in anatomical sciences**

**QP CODE: XXXX**

**Maximum marks: 100**

**Time: 3 hours**

**Instructions:**

- **Attempt all questions. Each question carries 10 marks**
- **Draw neat, labelled diagrams wherever necessary**

**Long essays:**

**10X 10=100 marks**

1. Describe the facial nerve under the following headings.
  - a. Functional components and nuclei
  - b. Course
  - c. Branches and distribution
  - d. Explain the effect of lesion of upper motor neuron palsy on the right side  
(2+2+3+3)
2. A woman complains that her 55-year-old husband's talk has become meaningless since morning although he seems to understand whatever is being said to him. Name the functional area affected. Describe the location, blood supply and connections of the affected functional area. Explain the reason for the patient's ability to understand the spoken words.  
(1+6+3)
3. Describe the lateral ventricle under the following headings.
  - a. Subdivisions
  - b. Relations
  - c. Applied anatomy  
(2+5+3)
4. Draw a neat labelled diagram of cross section of the medulla oblongata at the level of the sensory decussation. Enumerate the functions of the various structures seen at this level. (5+5)
5. Describe the oculomotor nerve under the following headings.
  - a. Functional components and nuclei
  - b. Course and relations
  - c. Distribution
  - d. Effects of lesion  
(1+3+3+3)
6. A patient presents with lesion of left half of spinal cord at the level of the eight cervical vertebra. Draw a neat labelled diagram of cross section of spinal cord at the cervical level. Correlate the clinical findings in this patient. (5+5).



7. Discuss the pros and cons of using virtual anatomy dissection.
8. Discuss the principles of CAT scan. Compare and contrast the advantages and disadvantages with MRI scan.  
(5+5)
9. Describe the cross section at the level of LI.
10. Describe the stem cells under the following headings
  - a. Sources
  - b. Types
  - c. Therapeutic uses.

(3+3+4)

**ANNEXURE II**  
**BLUEPRINT FOR THE MD ANATOMY THEORY EXAMINATION**  
**PAPER 1**

**Gross anatomy and Applied Anatomy**

<b>TOPIC</b>	<b>Arteries</b>	<b>Veins</b>	<b>Lymphatics</b>	<b>Nerves</b>	<b>Muscles</b>	<b>Spaces</b>	<b>Bones</b>	<b>Joints</b>	<b>Connective tissue</b>	<b>Organ</b>	<b>Others</b>	<b>Marks</b>
<b>Upper limb</b>												<b>10</b>
<b>Lower limb</b>												<b>10</b>
<b>Thorax (including diaphragm)</b>												<b>20</b>
<b>Abdomen</b>												<b>20</b>
<b>Pelvis</b>												<b>10</b>
<b>Head and neck</b>												<b>30</b>
<b>TOTAL</b>												<b>100</b>

- All ten questions must be structured
- **10% Problem-based learning** with **Applied Anatomy**
- At least **50% of the questions** Application based questions

**PAPER 2**

**Embryology, Genetics and relevant clinical oriented embryology**

<b>TOPICS</b>										<b>Marks</b>
<b>General embryology</b>	Gametogenesis	First week of development ovulation to implantation	Second week of development Bilaminar germ disc	Third week of development Trilaminar germ disc	Third to eighth week Embryonic period	Body cavities	Foetal membranes and placenta	Prenatal diagnosis	Others	<b>20</b>
<b>Systemic embryology</b>	Axial skeleton	Muscular system Limbs	Respiratory system	Cardiovascular system	Digestive system	Urogenital system	Head and neck	Central nervous system	Special sensory	<b>30</b>
<b>Clinically oriented embryology</b>										<b>10</b>
<b>Teratology</b>										<b>10</b>
<b>Principles of Genetics and applied genetics</b>										<b>10</b>
<b>Genetic disorders</b>										<b>20</b>
<b>TOTAL</b>										<b>100</b>

- All ten questions must be structured
- **10% Problem-based learning** with **Applied Anatomy**
- At least **50% of the questions** Application based questions

### PAPER 3

#### Microscopic anatomy, Principles of Microscopy, Organ donation, preservation of human body

TOPIC										Marks
<b>General histology</b>	Epithelial tissue	Connective tissue	Epithelial glands	Cartilage and Bone	Muscle tissue	Circulatory system	Lymphatic tissue	Nervous tissue	Skin and appendages	<b>20</b>
<b>Systemic histology</b>	Respiratory system	Digestive system	Excretory system	Reproductive system: Male	Reproductive system: Female	Endocrine system	Special sensory			<b>40</b>
<b>Principles of light, transmission and scanning electron microscopy, confocal, virtual microscopy</b>										<b>10</b>
<b>Basics of principles of organ donation</b>										<b>10</b>
<b>Embalming principles/Method of preservation of human body and its parts</b>										<b>20</b>
<b>TOTAL</b>										<b>100</b>

- All ten questions must be structured
- **10% Problem-based learning** with **Applied Anatomy**
- At least **50% of the questions** Application based questions

## PAPER 4

### Neuroanatomy, radiological anatomy, cross sectional anatomy, recent advances in anatomical sciences

TOPIC											Marks
<b>Neuroanatomy</b>	Cranial nerves	Forebrain & midbrain	Hindbrain	Spinal cord	Somatic sensory system and Motor pathways	Olfactory Optic Cochleovestibular gustatory	Central autonomic pathways	Hypothalamo-hypophyseal system	Reticular system	Basal ganglia	<b>60</b>
<b>Radiological anatomy</b>											<b>10</b>
<b>Sectional anatomy</b>											<b>10</b>
<b>Recent advances in the application of knowledge of anatomy on human body</b>											<b>10</b>
<b>Collection, maintenance and uses of stem cells and cryobanking</b>											<b>10</b>
<b>TOTAL</b>											<b>100</b>

- All ten questions must be structured
- **10% Problem-based learning** with **Applied Anatomy**
- At least **50% of the questions** Application based questions

**PRACTICAL & VIVA VOCE:**

- Spread over a minimum of 2 days
- 200 marks (Gross Anatomy – 100 marks, Histology – 100 marks).
- Viva voce with dissertation discussion and Pedagogy – 100 marks [60 +20+20]

<b>Day 1</b>	<b>GROSS ANATOMY</b>	
	1. 3 hours Window <b>dissection</b> of the allotted gross anatomy topic on human cadaver	40 Marks
	2. Display and discussion of the allotted dissection exercise on a human cadaver	50 Marks
	3. Surface anatomy	10 marks
	<b>TOTAL</b>	100 Marks
	<b>HISTOLOGY</b>	
	1. Identification and discussion 10 stained sections which includes Neuroanatomy, Embryology and Human Genetics	40 Marks [4 marks per slide X 10 number]
	2. Tissue preparation and staining	10 Marks
	i. Preparation of a paraffin block	10 Marks
	ii. Taking serial sections from blocks provided	10 Marks
iii. Staining of given section with H & E and discussion	20 Marks	
iv. Discussion on histological techniques	10 Marks	
<b>TOTAL</b>	100 Marks	
<b>Day 2</b>	<b>VIVA VOCE</b>	
	<ul style="list-style-type: none"> <li>• All the components of the syllabus along with specimens,</li> <li>• Embryology models, teratology,</li> <li>• Skeletal system including short bones</li> <li>• Embalming techniques,</li> <li>• Radiographs, MRI, CT &amp; ultrasonographs</li> </ul>	60 Marks
	<b>DISCUSSION ON DISSERTATION TOPIC</b> submitted for the examination	20 Marks
<b>PEDAGOGY:</b> Demonstration of teaching skill / techniques	20 Marks	
<b>TOTAL</b>	100 Marks	

**RECOMMENDED BOOKS, REFERENCE BOOKS (preferably latest editions of the following authors) AND JOURNALS**

**Gross Anatomy**

1. Susan Stranding: Gray's Anatomy: The anatomical basis of clinical practice, Churchill Livingstone Elsevier.
2. Dutta A.K. Human Anatomy vol. I-III Current Publisher.
3. Dutta A.K. Principle of General Anatomy. Current Publisher.
4. Romanes. Cunningham's Manual of Practical Anatomy vol. I-III, Oxford.
5. Keith and Moore Clinical Oriented Anatomy. Lippincott Williams and Wilkins's.
6. R.S Snell. Clinical Anatomy by regions. Lippincott Williams and Wilkins.
7. J.V. Basmajian. Grant's Method of Anatomy. Williams and Wilkins.
8. R.J. Last. Anatomy Regional and Applied. Churchill Livingston.
9. Lee McGregor. Surgical Anatomy. K.M. Varghese.
10. A.G. R Deckeg, D.J du Pless Lee. Mc Gregor's Synopsis of Surgical Anatomy. Varghese Publishing House.
11. Snell. Clinical anatomy by regions. Lippincott's, Williams and Wilkins.
12. S. Chummy Sinnatamby. Last's Anatomy Regional and Applied. ChurchillLivingston.
13. Hollinshed W Henry. Anatomy for surgeons. Vol. I-III Lippincott's, William sand Wilkins.
14. Vishram Singh. Clinical and Surgical Anatomy. Elsevier.
15. Vishram Singh. Textbook of general anatomy. Elsevier.
16. Frank H. Netter. Atlas of Human Anatomy. Saunders Elsevier

**Histology and histological techniques**

1. Young B. and Heath J. Wheater's Functional Histology. Churchill Livingstone.
2. M.H. E Ross. Histology: A textbook and atlas. Williams and Wilkins.
3. V. Bharihoke. Textbook of human histology. Delhi AITBS.
4. Difiore's. Atlas of histology with functional co-relation.
5. Bloom and Fawcett. Textbook of histology.
6. Carlton's. Histology Technique.
7. E.C. Clayden. Practical of section cutting and staining.
8. D W Cormack. Ham's Histology. Lippincott's, Williams and Wilikins.
9. Bloom and Fawcett. Textbook of Histology.

**Genetics**

1. J.S Thompson and Thompson. Genetics in medicine. W.B. Saunders and Co. Philadelphia, London.
2. George Fraser and Oliver Mayo. Textbook of Human Genetics. BlackwellScientific Publications London, Oxford Edinburg, Melbourne.
3. Hann Sellwerger and Jame Simpson. Chromosomes of Man. Sparsher'sInternational Medical Publications.

### **Embryology**

1. Hamilton, Boyd. and Mossman. Human Embryology.
2. TW Sadler. Langman's Medical Embryology. Lippincott's, Williams and Wilkins.
3. Keith L Moore and T.V.N. Persaud. The Developing Human. Saunders.
4. Rani Kumar. Textbook of embryology. I.K. International New Delhi Neuroanatomy
5. Richard S. Snell. Clinical Neuroanatomy for Medical Students. Williams and Wilkins.
6. Parent. Carpenter's Human neuroanatomy. Williams and Wilkins.
7. Vishram Singh. Clinical Neuroanatomy. Elsevier.
8. A K. Dutta. Essentials of Neuroanatomy. Current books international.
9. John A. Kiernan. Barr's the human nervous system, Lippincott, Williams and Wilkins.

### **Embalming techniques**

1. Tompsett RH Anatomical Techniques.

### **Physical antropology**

1. Harrision, Human Biology an introduction to Human Evolution and Growth-2<sup>Nd</sup> Edition, 1970.
2. Poirie, Fossil Man, 1973.

### **Statistics**

1. David E. Matthews and Vernon T. Farewell. Using and Understanding Medical Statistics. Karger.

### **Radiology**

1. T.B. Moeller et.al. Sectional Anatomy CT and MRI Vol. I, II, III New York. Theme Stuttgart.
2. J.B. Walter et.al. Basic Atlas of Sectional Anatomy with correlated imaging. Saunders Elsevier.

### **Surface anatomy**

1. SP John, Lumley editors. Surface Anatomy, The Anatomical basis of clinical examination. London: Churchill Livingstone.
2. A. Halim. and A.C. Das. Surface Anatomy Lucknow. ASI, KGMC.

### **Journals**

1. Journal of Anatomical Society of India
2. Journal of anatomy
3. American Journal of anatomy
4. American Journal of Physical Anthropology
5. Journal of Morphology, Embryology
6. Anatomical Record
7. American Journal of Medical Genetics
8. Annual Review of Genetics



## **Comparative anatomy**

1. Banks Histology and Comparative Organology – A text & Atlas –Edition 1974
2. Wolstnhome, Taste & Smell in Vertebrates –Edition 1970.
3. Embryogenesis in Mammals CIBA foundation –Edition 1976.
4. George C.Kent , Comparative Anatomy of the Vertebrates -3rd Edition , 1983  
MC.Graw  
HillBook Company.
5. Romer, Vertebrate body-5<sup>th</sup> edition, 1978, V.B. Saunders Company.

## **Additional reading**

1. Compendium of recommendations of various committees on Health and Development (1943-1975). DGHS, 1985 central bureau of health intelligence Directorate General of Health Services, Ministry of Health and Family Welfare, Govt Of India, Nirman Bhawan, New Delhi.
2. National health Policy, Ministry of Health and Family Welfare, Govt Of India, Nirman Bhawa , New Delhi.
3. Santosh Kumar, the elements of research, writing and editing 1994, dept of urology, JIPMER, Pondicherry.
4. Srinivasa D.K. et al, Medical Education Principles and Practice, 1995, National Teacher Training centre, JIPMER Pondicherry
5. Indian Council of Medical Research, “Policy statement of Ethical Consideration involved in research on Human Subjects”, 1982, ICMR., New Delhi.
6. Code of medical ethics framed under section 33 of the Indian Medical Council Act 1956. Medical Council of India, Kotla Road, New Delhi.
7. Francis C.M medical Ethics, JP Publications 2nd edition 2004.
8. Indian National Science Academy, Guidelines for care and use of animals in Scientific research, New Delhi, 1994.
9. International Committee of Medical Journal Editors, Uniform requirements for manuscripts submitted to biomedical Journals, N Engl J Med 1991.
10. Kirkwood B.R, Essentials of Medical Statistics, 1st Ed., Oxford: Blackwell Scientific Publications 1988.
11. Mahajan B K. Method in Biostatistics for medical students, 5th Ed. New Delhi, Jaypee Brothers Medical Publishers , 1989.
12. Raveendran, B Gitanjali, A Practical approach to PG Dissertation, New Delhi JP Publications 1998.

# COMPETENCY BASED POST GRADUATE TRAINING PROGRAMME FOR

## MD IN BIOCHEMISTRY

### PREAMBLE

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training. The student who has obtained MD degree in Biochemistry shall be well-versed in basic concepts and recent advances in the subject and shall have acquired skills and expertise in various laboratory techniques applicable to metabolic and molecular aspects of medicine and in research methodology. Training during the course will equip the student with skills to become an effective teacher, able to plan and implement teaching programmes for students in medical and allied health science courses, set up/manage a diagnostic laboratory, generate, evaluate and interpret diagnostic laboratory data, interact with clinicians to contribute to more effective patient care and carry out a research project and publish its results. The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

### MD BIOCHEMISTRY

**Goals of the program:** The goal is to have uniform standards in the teaching of Biochemistry at Postgraduate level throughout the country. The guidelines will help achieving such standards which will in ensure availability of competent Biochemists equipped with required knowledge and skills for teaching and applied research.

#### **Objectives of the program**

A post graduate student upon successfully qualifying in the MD (BIOCHEMISTRY) examination will be able to:

**1.Acquisition of knowledge:** The student will be able to explain clearly concepts and principles of biochemistry and cell biology, including correlations of these with cellular and molecular processes involved in health and disease.

**2.Teaching and training:** The student will be able to effectively teach undergraduate students in medicine and allied health science courses so they become competent health care professionals and able to contribute to training of post graduate students.

**3.Diagnostic services:** The student will be able to set up/supervise/manage a diagnostic laboratory in Biochemistry in a hospital, ensuring quality control, and providing a reliable support service. The student will be able to provide clinicians with consultation services for diagnostic tests in biochemistry and in interpretation of laboratory results.

**4.Research:** The student will be able to carry out a research project from planning to publication and be able to pursue academic interests and continue life-long learning to become more experienced in all the above areas and to eventually be able to guide postgraduates in their thesis work.

### **COURSE CONTENT – KNOWLEDGE AND SKILLS**

At the end of post-graduation, the student must acquire the following subject specific competencies

#### **A. Cognitive domain**

1. Describe and apply biochemical principles to explain the normal state, abnormal disease conditions and mechanism of action used in the perception, diagnosis and treatment of diseases.
2. Explain energy transactions in a living system, and describe importance of biomolecules in sustaining the life process.
3. Describe pathways of the intermediary metabolism along with their individual and integrated regulation and apply that in understanding the functioning of the body.
4. Describe and apply the concept of nutrition in health and disease, micro- and macronutrition and essential nutrients, and interlinks of nutrients with metabolism and functions of a living system
5. Apply and integrate knowledge of molecular and metabolic conditions in normal and disease states for clinical problem solving and research
6. Acquire knowledge on application of various aspects of genetic engineering in medicine
7. Acquire knowledge and apply the principle of statistics, biostatistics and epidemiology to the evaluation and interpretation of molecular and metabolic disease states.
8. Evaluate, analyze and monitor disease states by applying relevant biochemical investigations and interpreting the clinical and laboratory data.
9. Able to integrate principles of immunology in biochemistry.
10. Demonstrate knowledge of basics of research methodology, develop a research protocol, analyse data using currently available statistical software, interpret results and disseminate these results and to have the potential ability to pursue further specializations and eventually be competent to guide students.

11. Describe the principles of teaching - learning technology towards application and take interactive classroom lectures, prepare modules for PBL, organize and conduct PBLs, case discussions, small group discussions, Seminars, Journal club and research presentations
12. Demonstrate knowledge of principles of Instrumentation.
13. Demonstrate knowledge about recent advances and trends in research in the field of clinical biochemistry.

## **B. Affective domain**

1. Effectively explain to patients from a variety of backgrounds, the molecular and metabolic basis of disease states and lifestyle modifications.
2. Communicate biochemical reasoning effectively with peers, staff and faculty, and other members of the health care team.
3. Demonstrate empathy and respect towards patients regardless of the biochemical nature of their disease.
4. Demonstrate respect in interactions with patients, families, peers, and other healthcare professionals
5. Demonstrate ethical behavior and integrity in one's work.
6. Demonstrate effective use of nutrition, lifestyle and genetic counseling.
7. Be aware of the cost of diagnostic tests and economic status of patients.
8. Acquire skills for self-directed learning to keep up with developments in the field and to continuously build to improve on skills and expertise

## **C. Psychomotor domain:**

1. Able to select, justify, and interpret the results of clinical tests in biochemistry.
2. Develop differential diagnoses for molecular and metabolic causes of diseases.
3. Suggest preventive, curative, and/or palliative strategies for the management of disease.
4. Predict effectiveness and adverse effects associated with disease intervention.
5. Demonstrate skills for clinical diagnosis, testing, understanding of biochemical conditions and diagnostic service.
6. Perform important biochemical, immunological and molecular biology techniques.
7. Observed working of important advanced techniques.
8. Demonstrate standard operating procedures of various methods and techniques used in clinical biochemistry.
9. Determination of enzyme activity and study of enzyme kinetics ideally it will be accompanied by purification (partial) of the enzyme from a crude homogenate to emphasise the concepts of specific activity, yield and fold purification
10. Demonstrate and report routine investigations in hematology and microbiology
11. Demonstrate presentation skills at academic meetings and publications.

## SYLLABUS

### Outline of course contents

#### Theory

#### PAPER I-

**Biomolecules, cell biology, Analytical techniques and instrumentation in Biochemistry, biostatistics and research methodology, basics of medical education in teaching and assessment of Biochemistry**

#### **Biomolecules:**

- *Properties of water*
- *Concept of an acid, a base, pH, pK, buffer and buffering capacity*
- *Classification, structure and functions of amino acids and peptides*
- *Structural organization of proteins and relationship with their functions.*

Primary, secondary, tertiary and quaternary structure of proteins

Protein folding and denaturation

- *Structure-function relationship of proteins*

Structure and functions of hemoglobin and myoglobin

Structure and function of collagen

Structure and function of immunoglobulins

- *Classification, functions, properties and reactions of carbohydrates*

Structure & functions of monosaccharides, disaccharides & polysaccharides

Reducing property and other reactions of carbohydrates

- *Classification, properties and importance of lipids*

Fatty acids - nomenclature, classification, properties, reactions

Mono, di- and triacylglycerols

Trans fats

Cholesterol - structure, properties and functions

Phospholipids - definition, types, properties, s and importance

Glycolipids - definition, types, functions, examples.

Lipoproteins - definition, structure, types, functions, role of apoproteins, importance in health and disease.

Biological membranes - structure, function, properties and importance

Micelles and liposomes

- *Nucleotides and nucleic acids*

Purine and pyrimidine bases in DNA and RNA

Nucleosides and nucleotides

Physiologically important nucleotides

Synthetic analogues of purine/pyrimidine bases and nucleosides used as therapeutic agents (anti-cancer drugs, anti-viral drugs)

Watson and Crick model of DNA structure

Structure and functions of different types of RNA.

### **Cell biology :**

- Structure of the cell and different subcellular organelles
- Structure and functions of cell membrane, solute transport across biological membranes
- Intracellular traffic and sorting of proteins
- Intracellular signaling pathways, membrane receptors and second messengers,
- Extracellular matrix composition, importance and biomedical importance, cellular adhesion molecules and intercellular communication
- Cytoskeleton, muscle contraction and cell motility
- Cell cycle, mitosis, meiosis and mechanisms of cell death
- Red and white blood cells

### **Analytical techniques and instrumentation in Biochemistry**

- Principles of basic techniques used in a clinical biochemistry laboratory  
Spectrophotometry (UV and visible spectrophotometry)
- Atomic absorption spectrophotometry
- Flame photometry
- Fluorometry
- Turbidimetry and nephelometry
- Gravimetry
- Electrochemistry (pH electrodes, ion-selective electrodes, gas-sensing electrodes)
- Chemiluminescence
- Water testing
- Electrophoresis (principle, types, applications; isoelectric focusing capillary electrophoresis; 2-D electrophoresis)
- Chromatography (principle, types [including high performance liquid chromatography and gas chromatography, UPLC])
- Techniques in molecular biology: Blotting techniques, polymerase chain reaction (PCR), DNA and protein sequencing, Microarrays and DNA chip technology, cloning techniques, genomics, proteomics, and metabolomics
- Ultracentrifugation
- Cell fractionation
- Osmometry, mass spectrometry, immunochemical techniques, automation, point of care testing,) automation
- Flow cytometry
- Microscopy- electron and fluorescent

## **Nanotechnology and microfabrication**

**Techniques to study in vivo metabolism –NMR, SPECT, PET scans etc**

## **Radioisotope – based techniques and its applications**

### **Biostatistics and research methodology**

- Basic concepts of biostatistics as applied to health science
- Statistical tests: t-test, analysis of variance, chi-square test, non-parametric tests, correlation and regression
- Statistical methods of validation of diagnostic tests
- Basics of epidemiological study designs and sampling methodologies
- Meta-analysis and systematic reviews

### **Basics of Medical Education in teaching and assessment of Biochemistry**

Principles of adult learning, taxonomy of learning, educational objectives, principles of assessment and question papers settings, methods of assessing knowledge, appropriate use of media, microteaching, small group teaching.

## **PAPER II**

**Enzymes, bioenergetics, biological oxidation, Metabolism of carbohydrates, Lipids, Proteins, Nucleotides and Heme and its associated disorders, intermediary metabolism and regulation, Metabolism of xenobiotics, Free radicals and antioxidant defence systems in the body and associations with disease process**

### **Enzymes:**

Properties, classification, mechanism of action, coenzymes and cofactors, kinetics of enzyme activity, Enzyme inhibition regulation of enzyme activity, isoenzymes, diagnostic and therapeutic enzymes, principles of assays of enzymes, enzymes as therapeutic targets of drugs.

### **Biological oxidation**

- Basic concepts of thermodynamics and its laws, as applied to living systems,
- Exergonic and endergonic reactions and coupled reactions, redox potential
- High energy compounds
- Classification and role of oxidoreductases
- Cytochromes; cytochrome P450 system

### *Respiratory chain and oxidative phosphorylation*

Components, complexes and functioning of the respiratory chain

Process of oxidative phosphorylation: Mechanisms of ATP synthesis and regulation  
Mitochondrial transport systems and shuttles, Inhibitors, uncouplers and ionophores

OXPPOS diseases

## Overview of metabolism and intermediary metabolism

### *Metabolism of carbohydrates*

- Digestion and absorption,
- Glycolysis and TCA cycle, including regulation
- Glycogen metabolism and its regulation
- Cori cycle, gluconeogenesis and control of blood glucose
- Metabolism of fructose and galactose
- Pentose phosphate and uronic acid pathways and their significance
- Polyol pathway
- Regulation of blood glucose levels
- Diabetes mellitus (including gestational diabetes mellitus) – classification, pathogenesis, metabolic abnormalities, diagnostic criteria, principles of treatment, pathogenesis of complications, laboratory tests
- Metabolism of ethanol

[

### *Metabolism of lipids*

- Digestion and absorption, including role of bile salts
- Biosynthesis and oxidation of fatty acids o Ketone bodies – formation, utilisation and regulation Metabolism of unsaturated fatty acids and eicosanoids
- Metabolism of triacylglycerol; storage and mobilisation of fats
- Metabolism of cholesterol
- Metabolism of lipoproteins
- Metabolism in adipose tissue
- Role of liver in lipid metabolism o Role of lipids in atherogenesis
- Metabolism of phospholipids and associated disorders

### *Metabolism of amino acids and proteins*

- Digestion and absorption
- Pathways of amino acid degradation - transamination, oxidative deamination
- Transport and metabolism of ammonia
- Metabolism of individual amino acids.
- Plasma proteins

### *Metabolism of nucleotides*

- De novo synthesis of purine nucleotides
- Salvage pathway for purines
- Degradation of purines
- De novo synthesis of pyrimidine nucleotides
- Degradation of pyrimidine



### ***Metabolism of haem***

- Biosynthesis of heme and associated disorders
- Degradation of heme and associated disorders

### ***Metabolism in Individual tissue and in the fed and fasting states***

- Liver, adipose tissue, brain, RBC's, skeletal muscle and cardiac muscle

### **Composition of lens, Biochemical Changes during cataractogenesis**

### **Metabolism of xenobiotics**

### **Free radicals and antioxidant defence systems in the body and associations with disease process**

## **PAPER III**

### **Molecular biology, molecular and genetic aspects of cancer, immunology, Nutrition in health and disease, Vitamins, Minerals Environmental Biochemistry- Toxic elements & effects of environmental pollutants on the body, health and population,**

### ***Structure and organization of chromosomes and chromatin re-modelling***

#### ***DNA replication***

- DNA replication in prokaryotes and eukaryotes (including important differences between the two):
- Roles of DNA polymerase, helicase, primase, topoisomerase and DNA ligase
- Replication fork
- Okazaki fragments and its importance in replication.
- Overview of role of major DNA repair mechanisms – mismatch repair, base excision repair, nucleotide excision repair and double strand break repair.
- Diseases associated with abnormalities of DNA repair systems
- DNA recombination

#### ***Transcription***

- Structure of a gene - exons and introns, promoter, enhancers/repressors and response elements.
- Process of transcription in prokaryotes and eukaryotes – initiation, elongation and termination (including important differences).
- Post-transcriptional processing – capping, tailing and splicing.

### ***Genetic code and mutations***

- Characteristics of the genetic code
- Molecular basis of degeneracy of the genetic code (Wobble hypothesis)
- Mutagens- examples of physical, chemical and biological mutagens.
- Types of mutations – point mutations and chromosomal mutations
- Relationship of mutations with specific diseases

### ***Translation***

- Basic structure of prokaryotic and eukaryotic ribosomes.
- Structure of tRNA (diagram of clover leaf model of tRNA structure) and its function in protein synthesis.
- Function of aminoacyl tRNA synthase.
- Process of protein synthesis (translation) – initiation, elongation and termination (including important differences between prokaryotic and eukaryotic translation).
- Inhibition of prokaryotic translation by antibiotics.
- Post-translational modifications

### ***Regulation of gene expression in prokaryotes and eukaryotes***

- The operon concept in prokaryotes
- Role of general and gene specific transcription factors
- Small interference RNA (siRNA) and micro RNA (miRNA).
- Other modes of regulation of gene expression: alternative splicing, alternative promoter usage, DNA methylation, Histone acetylation / deacetylation, RNA editing, alterations of RNA stability

### ***Recombinant DNA technology and its applications in modern medicine***

- Concepts of recombinant DNA, genetic engineering, biotechnology and cloning.
- Restriction endonucleases.
- Vectors for cloning – plasmids, cosmids and phages
- Genomic and cDNA libraries
- Applications of recombinant DNA technology in medicine
- Gene therapy
- Diagnosis of genetic diseases and genetic counselling
- DNA fingerprinting
- DNA sequencing
- Microarrays
- Fluorescent in situ hybridization (FISH)
- DNA vaccines
- Transgenic animals
- Application of molecular techniques in forensic investigation and medico legal cases

## ***Overview of Human Genome Project***

### ***Basics of bioinformatics***

#### ***Principles of human genetics***

- Alleles, genotypes and phenotypes
- Patterns of inheritance: monogenic and polygenic inheritance
- Population genetics
- Genetic factors in causation of diseases
- Types of genetic diseases: Chromosomal, monogenic and polygenic disorders, mitochondrial disorders, nucleotide repeat expansion disorders, imprinting disorders
- Screening for genetic diseases and prenatal testing
- Ethical and legal issues related to medical genetics

#### **Stem cells in clinical medicine**

- Basic concepts regarding stem cells
- Types of stem cells: embryonic and induced pluripotent stem cells (IPSC)
- Potential applications in the clinical medicine
- Ethical and legal issues related to use of stem cells in medicine

#### **Cancer**

- Carcinogens: physical, chemical and biological
- Clonal origin of cancers
- Genetic basis of carcinogenesis
- Role of oncogenes and tumour suppressor genes
- Familial cancer syndromes
- Cancer stem cells
- Epigenetic regulation in cancer
- Gene expression profiling in cancer
- Cancer cell biology: cell cycle abnormalities, telomerase activity, proliferative capacity and decreased apoptosis
- Metastasis
- Tumour markers
- Biochemical basis of cancer chemotherapy and drug resistance
- New methods of anti-cancer therapy: targeted cancer therapy, cancer immunotherapy.

#### **Immunology**

- Innate and acquired immunity
- Humoral and cell-mediated immunity
- Cells and organs of the immune system - T and B cells, macrophages, dendritic cells, NK cells, granulocytes
- Antigens, epitopes and haptens
- Immunoglobulin classes, isotypes, allotypes, idiotypes, monoclonal antibodies, organization and expression of immunoglobulin genes, immunoglobulin gene rearrangement, class switching

- Antigen-antibody interaction - immunochemical techniques
- Major histocompatibility complex, antigen processing and presentation,
- T cell and B cell receptor, toll like receptors
- T cell maturation/activation/differentiation
- B cell generation/activation/differentiation
- Cytokines
- Complement system, cell
- Immune response to infections
- Hypersensitivity reactions
- Vaccines
- Immuno-deficiency syndromes
- Autoimmunity
- Transplantation immunology
- Cancer and immune system,
- Immunodiagnostics
- Immunotherapy

### **Nutrition in health and disease**

- Principles of food components
- General nutritional requirements
- Energy requirements – calculation of calorie requirements in healthy individuals and diseased states
- Biological value of proteins
- Thermogenic effect of food
- Balanced diet, diet formulations in health and disease, mixed diet
- Nutritional supplements
- Food Toxins & additives
- Disorders of nutrition, obesity, protein and protein energy malnutrition, dietary fibers, undernutrition, laboratory diagnosis of nutritional disorders
- National Nutrition Program

### **Vitamins**

- Classification, chemistry, absorption and transport, biochemical role, sources, RDA and deficiency state of each vitamin (including diagnostic tests for deficiency and treatment, hypervitaminosis)

### **Minerals**

- Classification, biochemical role, sources, requirement and deficiency state of each mineral (including diagnostic tests for deficiency and treatment and toxic manifestation of minerals)

## **Environmental Biochemistry: Toxic elements and effects of environmental pollutants on the body, health and population**

### **PAPER IV**

#### **Basic principles and practice of clinical biochemistry along with Total quality management and Quality Control, Clinical correlates and analytical procedures including diagnostic assessment of body systems and organ functions, endocrinology and recent advances in Biochemistry, Biomedical waste management**

##### **Basic principles and practice of clinical biochemistry**

Units of measure, reagents, clinical laboratory supplies, basic separation techniques, laboratory calculations, specimen collection and processing, safety in the laboratory, clinical utility of laboratory tests (including sensitivity, specificity, ROC curves, etc), analysis in the laboratory, selection and evaluation of methods (including statistical techniques), evidence based laboratory medicine, establishment and use of reference values, pre-analytical variables and biological variations, Total quality management and Quality Control, clinical laboratory informatics

##### **Clinical correlates and analytical procedures**

- Amino acids, peptides and proteins; non-protein nitrogenous compounds
- Enzymes
- Carbohydrates
- Lipids, lipoproteins and apolipoproteins and other cardiovascular risk factors
- Regulation of fluid and electrolyte balance and its associated disorders
- Blood gases, pH, buffers, H-H Equation and Regulation of acid-base balance and associated disorders
- Hormones and associated disorders
- Catecholamines and serotonin
- Haemoglobin and bilirubin
- Porphyrins and associated disorders
- Bone and mineral metabolism
- Tumour markers
- Assessment of organ functions (hypothalamus and pituitary, adrenal glands, gonads, thyroid, parathyroid, liver, kidney, heart, stomach, pancreas, intestine, etc) and associated disorders
- Pregnancy and maternal and fetal health
- Reproduction related disorders – infertility
- New-born screening for Inborn errors of metabolism
- Haemostasis
- Therapeutic drug monitoring Clinical toxicology
- Body fluid analyses

### **Biochemistry of Endocrine system**

- Classification and general mechanism of action of hormones
- Biosynthesis, secretion, regulation, transport and mode of action of hypothalamic peptides, adenohipophyseal and neurohypophyseal hormones, thyroid and parathyroid hormones, calcitonin, pancreatic hormones, adrenocortical and medullary hormones, gonadal hormones, gastrointestinal hormones, opioid peptides, parahormones.
- Biochemistry of conception, reproduction and contraception
- Endocrine interrelationship and their involvement in metabolic regulation
- Neuro-modulators and their mechanism of action and physiological significance
- Biochemical aspects of diagnosis and treatment of endocrinal disorders:

### **Hematopoietic disorders**

- Iron deficiency and other hypoproliferative anaemias - iron metabolism, laboratory tests of iron status, iron therapy
- Anaemia of chronic disease, anaemia of renal disease
- Hemoglobinopathies - sickle cell anaemia, methaemoglobinemias, thalassemia syndromes, Megaloblastic anaemia
- RBC membrane and metabolism
- Haemolytic anaemia - inherited defects in RBC membrane and enzymes (G6PD deficiency), immunologic causes of haemolysis
- ABO blood group system - biochemical basis, transfusion biology.
- Plasma cell disorders - multiple myeloma.

### **Haemostasis and thrombosis**

- Biochemical mechanisms, related laboratory tests, antiplatelet/anticoagulant/fibrinolytic therapy

### **Cardiovascular system**

- Atherosclerosis - pathogenesis, risk factors, prevention and treatment

Cardiac failure, acute coronary syndrome, cardiac biomarkers

### **Respiratory system**

- Gaseous exchange in lungs - physiological features and disturbances, arterial blood gases  
Pathogenesis of cystic emphysema, alpha-1 anti-trypsin deficiency

### **Nervous system:**

- Neurotransmitters and their receptors
- Ion channels and channelopathies
- Neurotrophic factors
- Protein aggregation and neurodegeneration
- Alzheimer's disease, Parkinson's disease, Huntington's disease, multiple sclerosis

- Prions and prion diseases
- Guillain-Barre syndrome – immunopathogenesis
- Myasthenia gravis – pathophysiology
- Hereditary myopathies - Duchenne muscular dystrophy
- Inherited disorders of muscle energy metabolism
- Mitochondrial myopathies
- Pathophysiology of psychiatric disorders such as anxiety, depression and schizophrenia

## **Kidney**

Kidney function tests; pathophysiology, biochemistry, laboratory findings and management in acute kidney injury and chronic kidney disease; estimation of GFR; glomerular diseases - pathogenesis and mechanisms of glomerular injury, nephrotic syndrome, diabetic nephropathy; tubular disorders - renal tubular acidosis, proteinuria, nephrolithiasis, kidney transplant; biochemical aspects of renal stones.

## **Gastrointestinal system**

- Gastric physiology
- Pathophysiology of peptic ulcer disease, including role of H. pylori; gastric function tests; Zollinger-Ellison syndrome
- Digestion and absorption of nutrients; evaluation of malabsorption (steatorrhea, lactose intolerance)
- Celiac disease
- Inflammatory bowel disease
- Protein losing enteropathy
- Regulatory peptides in the gut
- Neuroendocrine tumours

## **Liver**

- Liver function tests
- Hyperbilirubinemias
- Viral hepatitis
- Serologic/virologic markers
- Alcoholic liver disease, fatty liver, chronic liver disease, cirrhosis and its complications  
Pathogenesis of ascites
- Hepatic encephalopathy
- Metabolic diseases affecting liver
- Reye's syndrome
- Diseases of gall bladder/bile ducts - pathogenesis of gallstones
- Pancreas - acute and chronic pancreatitis, cystic fibrosis, pancreatic function tests.

## **Bone and mineral metabolism**

- Bone structure and metabolism; metabolism of calcium, phosphate and magnesium; regulation and abnormalities of bone metabolism; vitamin D; parathyroid hormone; calcitonin; parathyroid hormone-related (PTHrP); osteoporosis – pathophysiology; markers of bone turnover

## **Biomedical waste management**

### **Practical**

#### **Subject specific practical based competencies to be acquired by the post graduate student at the end of the course**

##### **I General Biochemistry**

1. Performance of reactions of carbohydrates, amino acids and proteins, and lipids
2. Experiments to demonstrate normal and abnormal constituents of urine
3. Paper chromatography, TLC, Two-dimensional paper chromatography for separation of amino acids
4. Determination of enzyme activity and study of enzyme kinetics using any two suitable enzymes (E.g.: Catalase from rat liver and acid phosphatase from potatoes)
5. Preparation of Buffers
6. Electrophoresis of serum proteins, lipoprotein,  
Electrophoresis Hemoglobin (Optional)  
Electrophoretic separation of LDH isozymes or any other isoenzymes (Optional)

##### **II Clinical Biochemistry: Estimation of clinical analytes as detailed below:**

- Blood glucose, glycated haemoglobin; performance of glucose tolerance test
- Electrolytes, arterial blood gas analysis
- Cholesterol, triglycerides, phospholipids, Lp (a), urea, creatinine, uric acid, ammonia, microalbuminuria
- Liver function tests (bilirubin, hepato-biliary enzymes such as AST, ALT, ALP, GGT, serum proteins/albumin, 5'NT and prothrombin time)
- Calcium, magnesium, copper (and ceruloplasmin), serum iron, TIBC and ferritin
- Estimation of phosphorus by Fiske Subbarao method
- Estimation of proteins by Folin's method and dye binding method
- Markers of myocardial Infarction (CK, CK MB, troponins, LDH)
- Other enzymes of diagnostic relevance (e.g. phosphatases, amylase etc)
- Vitamins D and B12, and folate
- Clearance tests
- CSF analysis
- Thyroid function tests and other hormone assays by ELISA/RIA/ECLIA
- Tumour markers – PSA,  $\beta$ - hCG by chemiluminescence



### **III. Clinical Laboratory**

- Taking any one parameter, students will prepare a Levy Jennings chart and plot inter-assay and intra-assay variation for the laboratory.
- Implementation of Westgard rules.
- Determination of reference values for any one parameter for the clinical laboratory
- Method validation

### **IV. In addition, all efforts will be made to ensure that students atleast see a demonstration of the following experiments and techniques.**

- Experiments to demonstrate constituents of milk
- Determination of iodine number and saponification number of fats
- Estimation of ammonia and amino acids by Sorenson formal titration
- Estimation of nitrogen estimation in a given amino acid solution by micro Kjeldahl method
- Estimation of ascorbic acid in lime
- Preparation and estimation of starch, glycogen, casein (phosphorus in casein) and haemoglobin from biological samples.
- Estimation of free fatty acids
- Separation of peripheral blood lymphocytes using Ficoll Hypaque
- Subcellular fractionation/marker enzymes for organelles to demonstrate fractionation
- Ultracentrifugation, Isolation of high molecular weight DNA from tissues/blood
- Isolation of RNA; synthesis of cDNA by reverse transcription; PCR (both conventional and real-time)
- Isolation of plasmids and agarose gel electrophoresis for nucleic acids
- Basic techniques in cell culture
- High performance liquid chromatography (HPLC)/ UPLC
- Flow cytometry

## **TEACHING AND LEARNING METHODS**

### **Teaching methodology**

Active and interactive learning should be the mainstay of the program. The following methods are to be used to facilitate learning by training of MD students.

### **I. Seminars and Journal clubs.**

Students of Biochemistry should be actively involved in departmental seminars and journal clubs. A record should be maintained for each student and the list of seminars and papers presented in journal club by each student should be presented at the time of university examination. Minimum of two seminars & two journal clubs per term per student should be held

The post graduate trainees shall familiarize themselves with the recent advances in the Medical biochemistry, which are covered under various review articles appearing in scientific journals

In addition, students should participate in an Interactive lectures, tutorials, problem-based learning, case discussions, guest lectures & E-learning of undergraduate teaching programme.

Clinical case presentations should be routinely conducted once in a month from 2<sup>nd</sup> year onwards.

They should also participate in undergraduate practicals. These are to be assessed by the faculty as per the RGUHS curriculum assessment form.

## **II. Dissertation**

### **Registration of dissertation topic**

- Every student should submit dissertation on a selected research problem involving laboratory investigations.
- Every candidate should submit a synopsis in the prescribed proforma for registration of dissertation topic by the University after it is scrutinized by the PG training cum Research Committee of the concerned institution.
- The synopsis should be sent to the University within the first 6 months from the commencement of the course or as notified by the University in the calendar of events, to the Registrar (Academic).
- The dissertation should be submitted to the Registrar (Evaluation) of the University six months prior to the final examination or as notified in the calendar of events.
- Approval and acceptance of the dissertation by the panel of examiners is a prerequisite for a candidate to appear for the University examination.

### **III. Presentation of work done on thesis to peers**

A post graduate student of a postgraduate degree course in Biochemistry would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.

### **IV. Horizontal and vertical integration of teaching of Biochemistry with other preclinical, para-clinical and clinical departments**

The post graduate students should take part in integrated teaching of undergraduates by participation in joint teaching sessions and seminars with different departments, participation in clinical rounds for discussing cases of interest and by small group discussions of case-based problems.

### **V. Training in the basics of medical education and technology**

The post graduate students may be provided with training in the basics of medical education and technology through workshops at the departmental and/or institutional level.

### **VI. Development of communication skills**

The post graduate students should develop effective communication skills by making presentations at seminars and journal club sessions and by teaching undergraduates.

## VII. Training in clinical Biochemistry:

The post graduate students should receive hands-on training in a diagnostic laboratory in Biochemistry; such training should be extensive and rigorous enough for each post graduate student to acquire adequate skills and expertise to manage and supervise such a laboratory. The post graduate students should be posted in all sections of the laboratory in the institution, starting from sample collection and processing. They should become proficient in working with the autoanalysers in the laboratory, in quality control methods, setting up of a clinical biochemistry laboratory, specialized assays and statistical analysis of data. It would also be desirable for them to acquire experience in running a 24-hours diagnostic laboratory.

## VIII. Rotational postings

Term	Sl no	Postings	Duration
1 <sup>st</sup> term	1	Orientation Research methodology and Biostatistics	15 days
	2	Teaching learning methods Basic MET including AETCOM	15 days
	3	Biochemistry laboratory Postings (QC, calibrators, Normal values, Analytical methods, reference range, Phlebotomy)	3 months
2 <sup>nd</sup> term	1	General medicine	1 month
	2	Paediatrics	10 days
	3	Nephrology	10 days
	4	Haematology	1 month
	5	Routine microbiology	1 month
	6	Molecular genetics and cytogenetics	10 days

**Clinical postings:** Clinical postings in the forenoon to be attended and return to the department to do the experimental work in the afternoon.

During the training programme, patient safety is of paramount importance, therefore skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently; for this purpose, provision of skills laboratories in medical colleges is mandatory. Students may be posted to institution where these facilities are available for molecular genetics and Cytogenetics (Govt. or Private).

At the end of the posting, a certificate must be obtained from the concerned heads of the departments for satisfactory learning and also present one each case scenario with Biochemical basis from the above clinical postings.

### Skills to be acquired during the clinical postings

During posting in medical and other related departments, the student should acquire relevant knowledge and skills. These generally include:

1. Clinical examination of a patient.

2. Investigations to be carried and their relevance
3. Drawing of blood, collection of urine and other specimens for investigations and their storage.
4. Biopsy techniques and handling of biopsy material to be sent for relevant tests/ investigations.
5. Interpretation of laboratory data, X ray and biopsy results.
6. Clinical pathology postings:  
(Haematology, transfusion serology, coagulation and cellular immunology)
  - a. Determination of ESR, Hb, Haematocrit, cell count, MCV, MCH, MCHC. b. Preparation and staining of blood smears
  - c. Morphological investigation of bone marrow Smears, different staining procedures.
  - d. Coagulation tests.
  - e. Determination of coagulation factors.
  - f. Investigation of fibrinolysis.
  - g. Blood group-typing, Cross matching for transfusion. h. Investigation of transfusion reactions.
  - i. Preparation and application of blood components. j. Immunohistochemistry
7. Microbiology  
(Covering bacteriology, virology, parasitology and mycology)
  - a. Specimen collection.
  - b. Specimen processing: smears, staining, culture and sensitivity. c. Serology tests
  - d. Techniques for parasite and fungus identification.
  - e. Immunological and molecular diagnosis (PCR) – HIV, Tuberculosis et

## **IX. Log book and practical record**

All post graduate students should maintain a log book that documents all the work that they have done during their years of training. This log book should be checked and assessed periodically by the faculty members involved in the training programme. Student should maintain practical record for general and clinical biochemistry separately of all practicals done during the course and submit at the time of university examination after duly certified by the Head of the Department.

## **ASSESSMENT**

### **Formative assessment during the training**

Internal Assessment should be frequent, cover all domains of learning and provide feedback to the student to improve learning; it should also cover professionalism and communication skills. The Internal Assessment should be conducted in theory and practical examination.

### **Quarterly assessment during the MD training should be based on:**

1. Journal based / recent advances learning
2. Patient based /Laboratory or Skill based learning
3. Self-directed learning and teaching
4. Departmental and interdepartmental learning activity
5. External and Outreach Activities / CMEs

### **The student to be assessed periodically as per checklists in chapter IV**

Minimum of three formative assessment (theory, practical and viva voce) are to be conducted during the postgraduate programme. –

Two of them will be annual conducted at the end of first and second academic year –

Third assessment will be conducted three months before the university examination. (assessment should be conducted paper wise)

The assessment will be done by all the recognized P.G. teachers of the department and the progress record should be maintained by the head of the department.

### **UNIVERSITY EXAMINATION (Summative assessment)**

- The examination for M.D courses shall be held at the end of three academic years (six academic terms).
- The university shall conduct two examinations in a year at an interval of four to six months between the two examinations. Not more than two examinations shall be conducted in an academic year.
- Examinations shall consist of dissertation, written paper (Theory), Practical and Viva voce.

#### **Criteria for pass**

- The examinations shall be based on ‘Marking system’ to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training.
- Obtaining a paper minimum of 40% marks in each paper and Aggregate of 50% marks in ‘Theory’ as well as ‘Practical’ separately shall be mandatory for passing examination.

### **Scheme of Examination**

#### **A. THEORY**

There shall be four papers of 100 marks each. Each paper shall be of 3 hours duration. Each paper shall have 10 questions of 10 marks **EACH** (10x10=100).

The distribution of topics /chapters for the Question papers will be as \* under

**Paper-I-** Biomolecules, cell biology, Analytical techniques and instrumentation in Biochemistry, Biostatistics and research methodology, basics of medical education in teaching and assessment of Biochemistry

**Paper-II** - Enzymes, bioenergetics, biological oxidation, Metabolism of carbohydrates, Lipids, Proteins, Nucleotides and Heme and its associated disorders, intermediary metabolism and regulation, Metabolism of xenobiotics, Free radicals and antioxidant defence systems in the body and associations with disease process

**Paper-III** - Molecular biology, molecular and genetic aspects of cancer, immunology, Nutrition in health and disease, : Vitamins, Minerals Environmental Biochemistry- Toxic elements & effects of environmental pollutants on the body, health and population .

**Paper- IV** - Basic principles and practice of clinical biochemistry along with Total quality management and Quality Control, Clinical correlates and analytical procedures including diagnostic assessment of body systems and organ functions, endocrinology and recent advances in Biochemistry, Biomedical waste management

- Paper I shall include 1 question from basic medical education principles, research methodology carrying 10 marks each
- Recent advances may be asked in any or all the four papers.
- Reasoning type of questions shall be included in all or any of the question papers.
- Each question paper shall include one case based question
- The questions shall be structured. Open ended questions shall be avoided.

\*The topics assigned to the different papers are given as general guidelines. A strict division of subjects may not be possible. Some overlapping of topics is inevitable. Students should be prepared to answer the overlapping topics.

## **B. PRACTICAL EXAMINATION: 200 marks**

The practical examinations will be held over 2 days; one day will be mainly for the practical exercises and the second day for the oral/ viva voce. The practical examinations will have the following components.

- A. A clinical case examination and discussion to be done, as per the facilities available in each institution running the course. The clinical features of the patient and relevant laboratory investigation of biochemical abnormalities present will be discussed
  - B. Identification the carbohydrate/amino acid provided and confirm of its identity by paper chromatography, Urine analysis.
  - C. Performance of an electrophoresis for serum proteins and discussion of electrophoretic pattern.
  - D. Quality Control, its interpretation and Method validation,
- Clinical lab data Interpretation (5 cases with lab data, each carrying 4 marks). Interpretation of clinical data from cases on liver function, renal function, thyroid function, cardiac diseases, endocrine diseases, electrolyte and acid base disorders, analysis of body fluids, lipid profile, vitamin deficiencies, mineral metabolism, nutritional disorders etc

**Viva-voce Examination:** (60 marks)

E. Grand Viva Voce examination will be conducted conjointly by all the examiners to test comprehension, analytical approach, expression and interpretation of facts.

F. Thesis presentation (of about 15 mins duration)

G. Pedagogy (20 mins duration plus 10 mins for questions)

		PRACTICALS				Total 200	VIVA-VOCE (E, F, G)						Total 100
		PART A	PART B	PART C	PART D		Ex 1 (15 )	Ex 2 (15 )	Ex 3 (15 )	Ex 4 (15 )	Dissert ation (20)	Pedagogy (20)	
Sl. No.	RE G. No.	CASE PRESENTATI ON DISCUSSION (25) & Standardizatio n & 2 analyte Estimation (75)	Body fluid Analysis & Chromatogra phy (30)	Case scenario followed by electrophor esis technique (30)	Quality control, its interpretat ion and method validation (20) & Clinical lab data interpretat ion (20)								
1													

Maximum marks	Theory	Practical	Viva-Voce	Total
	400	200	100	700

**Recommended Books(preferably the latest editions of the following authors) and Journals**

**THIS ENTIRE LIST MUST BE INCLUDED**

1. Murray RK, Grannar DK, Mayes PA, Rodwell VW, Harper's Illustrated Biochemistry, McGraw – Hill
2. Champe PC, Harvey RA, Ferrier DR, Lippincott's Illustrated reviews: Biochemistry, Wolter Kluwer (India) Pvt Ltd, New Delhi
3. Devlin TM, Textbook of Biochemistry with Clinical Correlations – Wiley-Liss, NewYork
4. Berg JM, Tymoczko JL, Stryer L. Biochemistry – WH Freeman and Company, New

York

5. Lehninger AL, Nelson DL, and Cox MM. Lehninger's Principles of Biochemistry, WH Freeman and company, New York
6. Voet D and Voet J, Biochemistry – John Wiley and Sons, New York
7. Voet D and Voet J, Principles of Biochemistry, John Wiley and Sons, New York
8. Marshall WJ, and Bangert SK, Clinical Chemistry: Metabolic and Clinical aspects, Mosby Elsevier, New York
9. Baynes JW and Dominiczak MH, Medical Biochemistry, Mosby Elsevier, New York
10. Bhagavan NV and Ha Chung-Eun, Essentials of Medical Biochemistry with clinical cases, Elsevier, New York
11. Smith CM, Marks AD, Lieberman M. Marks Basic Medical Biochemistry: A clinical Approach, Lippincotts Williams and Wilkins, Philadelphia
12. Henry et al, Clinical chemistry
13. Chhabra Namrata, A case- oriented approach towards Biochemistry, Jaypee Brothers Medical Publishers (P) Ltd. New Delhi
14. Montgomery R, Biochemistry: A case oriented approach, Mosby Harcourt Health Sciences Company, Sydney
15. Bruce Alberts. Molecular Biology of the Cell, Taylor and Fracis, New York
16. Bondy PK and Rosenberg LE, Duncan's Diseases of Metabolism, W B Saunders company, Philadelphia
17. Scriver CR., et al. Metabolic and Molecular basis of Inherited diseases, McGraw Hill International edition, New York.
18. Rose BD, Clinical Physiology of acid-base and electrolyte disorders- McGraw Hill International edition, New York
19. Burtis CA and Ashwood ER, Tietz Fundamentals of Clinical Chemistry, Harcourt (India) Ltd.
20. Burtis CA, Ashwood ER, Burns DE. Tietz textbook of Clinical Chemistry and Molecular Diagnostics, Elsevier, Philadelphia
21. Kaplan LA and Pesee AG, Clinical Chemistry: Theory, analysis and Correlation – CV Mosby and Co. St Louis, MO
22. Gowenlock and Bell, Varley's Practical Clinical Biochemistry – CBS, New Delhi
23. Bishop ML, Fody EP, Schoeff LE, Clinical Chemistry; Techniques, Principles, Correlations, Wolter Kluwer (India) Pvt Ltd, New Delhi
24. Wilson Keith and Walker John, Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press
25. Williamson MA, Snyder LM. Wallachs Interpretation of Diagnostic tests, Wolter Kluwer (India) Pvt Ltd, New Delhi
26. Watson JD, Molecular Biology of gene, Pearsons education, Singapore Pvt Ltd
27. Glick BR, Pasternak JJ, Molecular Biotechnology: Principles and applications of Recombinant DNA, ASM Press, Washington DC



**Note: Students should be aware of latest WHO guidelines and updates**

**Journals and Other Periodicals:**

1. Clinical Chemistry
2. Annals of Clinical Biochemistry
3. Clinical Biochemistry
4. Clinica Chimica Acta
5. Journal of Clinical Investigation
6. Indian Journal of Clinical Biochemistry
7. Indian journal of Medical Biochemistry
8. Indian journal of Biochemistry and Biophysics
9. Indian journal of Human genetics
10. Indian Journal of Medical research
11. Annual Review of Biochemistry
12. Clinical chemistry reviews
13. Journal of Clinical Endocrinology and Metabolism
14. Diabetes care
15. Trends in Biochemical Sciences

**ADDITIONAL READING:**

1. Compendium of recommendations of various committees on Health and Development (1943-1975). DGHS, 1985 central bureau of health intelligence Directorate General of Health Services, Ministry of Health and Family Welfare, Govt Of India, Nirman Bhawan, New Delhi.
2. National health Policy, Ministry of Health and Family Welfare, Govt Of India, Nirman Bhawan, New Delhi.
3. Santosh Kumar, the elements of research, writing and editing 1994, dept of urology, JIPMER, Pondicherry.
4. Srinivasa D.K.etal, Medical Education Principles and Practice, 1995, National Teacher Training centre, JIPMER Pondicherry
5. Indian Council of Medical Research, "Policy statement of Ethical Consideration involved in research on Human Subjects", 1982, I.C.MR., New Delhi.
6. Code of medical ethics framed under section 33 of the Indian Medical Council Act 1956. Medical Council of India, Kotla Road, New Delhi.
7. Francis C.M medical Ethics, JP Publications 2nd edition 2004.
8. Indian National Science Academy, Guidelines for care and use of animals in Scientific research, New Delhi, 1994.
9. International Committee of Medical Journal Editors, Uniform requirements for manuscripts submitted to biomedical Journals, N Engl J Med 1991.
10. Kirkwood B.R, Essentials of Medical Statistics, 1st Ed., Oxford: Blackwell

Scientific Publications 1988.

11. Mahajan B K. Method in Biostatistics for medical students, 5thEd.New Delhi , Jaypee Brothers Medical Publishers ,1989.
12. Raveendran, B Gitanjali, A Practical approach to PG Dissertation, New Delhi JP Publications 1998.

## Model question papers

Rajiv Gandhi University of Health Sciences, Karnataka

Post Graduate MD BIOCHEMISTRY Examination - MMY

### Biochemistry Paper- I

**Biomolecules, cell biology, Analytical techniques and instrumentation in Biochemistry, Biostatistics and research methodology, basics of medical education in teaching and assessment of Biochemistry**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Describe the structural organisation of Proteins. Discuss the methods for studying the structure.
2. A 25-year-old Mediterranean female presents to her obstetrician at 12-weeks gestation for her first prenatal visit. This is her first pregnancy, and she is concerned about her baby and the risk of inheriting a “blood” disease like others in her family. The patient reports a personal history of her brother who required frequent transfusions and died at age 10. The patient was told by her physician that she did need not take iron supplementation for her anemia. The patient’s hemoglobin level was decreased and P/S shows a hypochromic, microcytic Anemia.
  - a. What is the most likely diagnosis? Mention the molecular defect behind this disorder?
  - b. What is the most relevant biochemical technique used to confirm the diagnosis? Give the principle, procedure and applications of the technique.
3. Discuss the structure –Function relationship of Proteins with suitable examples.
4. Describe Definition, Structure, Types and functions of Lipoproteins. Add a note on Lipoprotein (a) & its clinical importance.
5. Compare and Enumerate the differences between Turbidimetry & Nephelometry.
6. Compare and Describe the differences between Small group teaching and Large group teaching methods.
7. Describe the Statistical methods for Validation of Diagnostic tests.
8. Explain the therapeutic utility of Synthetic analogues of purine/Pyrimidine bases and Nucleosides
9. Discuss the Applications of Radioisotopes in Medicine.
10. Describe the Biochemical markers of different sub cellular organelles.

**Biochemistry Paper- II**

**Enzymes, bioenergetics, biological oxidation, Metabolism of carbohydrates, Lipids, Proteins, Nucleotides and Heme and its associated disorders, intermediary metabolism and regulation, Metabolism of xenobiotics, Free radicals and antioxidant**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Describe the Biosynthesis of Heme. Add a note on its associated disorders.
2. A 69-year-old female with new onset burning sensation in mouth and throat, nausea and vomiting, agitation, and diaphoresis after a medication error was noted. Metabolic acidosis is seen on the arterial blood gas. A thiocyanate level is in the toxic range.
  - a. What is the most likely diagnosis?
  - b. Explain the mechanism of enzyme inhibition in this condition with other examples?
3. Describe Oxidative phosphorylation. Add a note on inhibitors and uncouplers of ETC.
4. Compare and Contrast the metabolism of Liver and Adipose tissue in fed and fasting states.
5. Discuss the Principles and Applications of immobilized enzymes and add a note of Enzymes of therapeutic importance.
6. Describe how Uric Acid is formed in the body? Discuss the causes of Hypo and Hyperuricemia.
7. Describe Glycogen metabolism and add a note on its regulation.
8. Discuss the role of Cytochrome P450 in Detoxification.
9. Describe the metabolism of Tyrosine. Add a note on associated disorders.
10. Discuss the role of multienzyme complexes in metabolic pathways with suitable examples.

**Biochemistry Paper- III**

**Molecular biology, molecular and genetic aspects of cancer, immunology, Nutrition in health and disease, Vitamins, Minerals Environmental Biochemistry- Toxic elements & effects of environmental pollutants on the body, health and population**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. A 41-year-old male presents with acute burning of skin with minimal sun exposure, erythemas, severe oral pain and limitation in mouth opening due to perioral scars, hyperpigmented macules and papules all over the skin and actinic keratosis on facial skin.
2. What is the most probable diagnosis? Explain the mechanism of the defective DNA repair in this condition.
3. Describe other related disorders due to similar molecular defects.
4. Describe the process of protein synthesis and add a note on inhibition of Prokaryotic translation by antibiotics.
5. Discuss the Ethical, legal, social implications of the human genome project.
6. Describe the disorders associated with Zinc, Fluoride and Iodine
7. Tumour markers in Screening, Diagnosis, Prognosis and Monitoring of patients with breast cancer.
6. Describe polyclonal and monoclonal gammopathies.
7. Describe the source, clinical features and diagnosis of lead poisoning, Add a note on the effects of lead poisoning on Heme synthesis.
8. Growth factors – Enumerate functions and role in carcinogenesis.
9. What is genetic code, Describe the salient features of genetic code. Explain the molecular basis of degeneracy of genetic code
10. Give an account of sources, RDA, biochemical functions, absorption, transport, storage and excretion of iron in the body. Add a note on disease states and biochemical tests to detect the disorders associated with iron metabolism.

**Post Graduate MD BIOCHEMISTRY Examination - MMY**

**Basic principles and practice of clinical biochemistry along with Total quality management and Quality Control, Clinical correlates and analytical procedures including diagnostic assessment of body systems and organ functions, endocrinology and recent advances in Biochemistry, Biomedical waste management**

**Biochemistry Paper- IV**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. What is POCT? Mention the principle, types and applications of POCT. Add a note on quality control of POCT.
2. Describe the methods for determining and establishment of reference values.
3. Discuss the mechanism of hormones requiring c-AMP as second messenger.
4. Describe the Adrenocortical function tests.
5. A 30-year-old male was brought to the casualty department in unconscious state, his relatives mentioned that he was on insulin medication, on examination his breath had fruity odour, rapid and deep sighing respiration, pulse-140/min weak and thready, BP -85/35mmHg, respiratory rate-36 /min  
lab investigations: blood glucose-580 mg/dl  
ABG revealed, PO<sub>2</sub> -112 mm Hg, PCO<sub>2</sub> -20 mmHg, PH- 7.12, HCO<sub>3</sub><sup>-</sup> = 12 m Eq/L, Na<sup>+</sup> = 130 m Eq/L , K<sup>+</sup> = 5.6 m Eq/L, Cl<sup>-</sup> = 96 m Eq/L
  - a. What is your probable diagnosis?
  - b. Comment and interpret the given ABG report and mention the compensatory mechanism and other causes for the above case scenario.
  - c. Calculate the Anion gap and interpret (1+6+3)
6. Discuss the Composition of CSF and alterations in health and disease
7. Describe the indications, methods and applications of Therapeutic drug monitoring.
8. Describe the Urine screening tests for diagnosis of inborn errors of metabolism.
9. State the diagnostic value of the following lab tests in assessing Thyroid conditions.  
T<sub>4</sub>, T<sub>3</sub>, FT<sub>4</sub>, T<sub>3</sub>RU, FTI, TSH and Anti thyroid antibodies. Justify the relevant tests.
10. Describe metabolic syndrome and discuss about clinical identification of metabolic syndrome.

## **COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN PHYSIOLOGY**

### **Preamble**

The purpose of PG education is to create specialists who would provide high quality health care and advance the cause of science through research & training. The purpose of the training in Physiology is to produce experts with necessary knowledge, skills and attitude to impart education and to carry out research in Physiology, be able to serve the community as competent physiologists and render appropriate advice/service to the clinicians as and when it is required. The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of “domains of learning” under the heading “competencies”.

### ***SUBJECT SPECIFIC LEARNING OBJECTIVES***

#### **Program Objectives**

##### **Goal:**

The goal is to have uniform standards in the teaching of Physiology at Postgraduate level throughout the country. The guidelines will help achieving such standards which will in ensure availability of competent physiologists equipped with required skills for teaching and applied research.

#### **Learning Objectives**

A post graduate student having qualified the MD (Physiology) examination should be able to:

1. Understand and deal with all aspects of general, systemic and applied Physiology.
2. Teach effectively the basic physiological mechanisms of human body with reference to their implications in the pathogenesis of diseases (pathophysiology) affecting various organ systems and the physiological basis of their management to undergraduate medical, paramedical and all other basic science students.
3. Understand general principles of medical education (use of appropriate teaching techniques and resources).
4. Explain how the knowledge of physiology can be effectively used in a various clinical settings to solve diagnostic and therapeutic problems.
5. Interpret and evaluate research publications critically.

6. Use the library facilities (Literature database using computer, CD ROM, internet search and any other available newer techniques).
7. Conduct relevant clinical/experimental research which may have significant bearing on human health and patient care.
8. Interpret the research findings in the light of its basic and applied significance.
9. Acquire skills in conducting collaborative research in the field of physiology with allied sciences, clinical sciences and biomedical engineering.
10. Interact with the allied departments and render services in advanced laboratory investigations.
11. Serve as interface with society at large.
12. Acquire administrative skills to set up concerned department / laboratories and initiate purchase procedure and procure necessary items for running such laboratories.
13. Function as a member of a teaching or research team

### ***SUBJECT SPECIFIC COMPETENCIES***

***At the end of MD post graduate training in Physiology the student must be able to***

#### **A. Cognitive Domain**

1. Teach the basic physiological mechanisms of human body with reference to their implications in the pathogenesis of diseases (pathophysiology) and their management to undergraduate medical and paramedical students.
2. Conduct such clinical and experimental research, as would have a significant bearing on human health and patient care.
3. Interact with other departments by rendering services in advanced laboratory investigations and relevant expert opinion.
4. Participate actively in various workshops/seminars/journal clubs/demonstration in the allied departments, to acquire various skills for collaborative research.
5. Contribute to society by imparting physiological understanding of health problems.
6. Plan a research study and conduct basic and clinical systemic investigations.

#### **B. Affective domain**

1. Demonstrate self-awareness and personal development in routine conduct. (*Self-awareness*)
2. Communicate effectively with peers, students and teachers in various teaching-learning activities. (*Communication*)
3. Demonstrate
  - a Due respect in handling patients / standardized patients. (*Ethics & Professionalism*)



4. Acquire capacity of not letting his/her personal beliefs, prejudices and limitations come in the way of duty.
5. Appreciate the issues of equity and social accountability while exposing students to early clinical exposure (*Equity and social accountability*)

### **C. Psychomotor Domain**

The student should acquire competencies in the following tasks:

#### **I. Haematology Experiments**

1. Estimation of haemoglobin
2. Determination of Total Erythrocyte (RBC) Count and RBC Indices (Blood Standards)
3. Determination of Total Leucocytes (WBC) Count: TLC
4. Preparation of a peripheral Blood Smear and Determination of Differential Leucocyte Count: DLC
5. Determination of Arneth Count
6. Determination of Bleeding Time (BT) and Clotting Time (CT)
7. Determination of Blood groups (A, B, O and Rh system)
8. Determination of Erythrocyte Sedimentation Rate (ESR) and Packed cell volume (PCV)
9. Determination of Osmotic Fragility of Red Blood Cells
10. Determination of Platelet Count
11. Determination of Reticulocyte Count
12. Determination of Absolute Eosinophil Count
13. Study of Haemopoietic Cells Present in the Bone Marrow

The students will be given a case history and based on the case the student will perform one or more investigations which are most relevant.

Example haematology practical question

A 40-year-old woman with a 3-year h/o menorrhagia comes to O P D with c/o tiredness and fatigability. O/E she has pronounced pallor. perform the hematological examinations that would

- I. confirm the primary diagnosis
- II. help you to narrow down the causes of the problem

**II. Animal Experiments (All animal experiments must be compliant with Govt. of India Regulations, notified from time to time). Experiments in Amphibian/Dog/Cat should be conducted by computer assisted simulation models/ facilities. Other experiments should be performed as permissible by CPCSEA guidelines.**

**A. Amphibian (Frog/cat/dog) Experiments by computer assisted simulation**

1. Effect of temperature on simple muscle twitch.

2. Effect of two successive stimuli (of same strength) on skeletal muscle.
3. Effect of increasing strength of stimuli on skeletal muscle.
4. Effect of increasing frequency of stimuli on skeletal muscle (genesis of tetanus).
5. Effect of free load and after load on skeletal muscle.
6. Effect of repeated stimuli on skeletal muscle (study of phenomenon of Fatigue).
7. Study of isometric contraction in skeletal muscle.
8. Determination of conduction velocity of sciatic nerve and effect of variables on it.
9. Properties of cardiac muscle – Refractory period, All-or-None Law, extrasystole and compensatory pause, beneficial effect.
10. Regulation of Heart, Vagus dissection and effect of Vagal and WCL stimulation.
11. Effect of physiological and pharmacological variables on intact frog's heart.
12. Perfusion of isolated frog's heart-role of sodium, potassium, calcium ions and drugs.
13. Perfusion of blood vessels in the frog.
14. Capillary circulation (Frog Web).
15. Postural and protective reflex in the frog.

**B. Mammalian Experiments (Dog/Rabbit/Guinea pig/Rat/Mice)**

1. General management of mammalian experiments.
2. Recording of heart rate, blood pressure and respiration and study the effects of various factors; drugs; asphyxia; occlusion of common carotid artery.
3. Effect of stimulation of central and peripheral end of vagus on arterial blood pressure and respiration after vagotomy.
4. Effect of stimulation and distension of carotid sinus on blood pressure and respiration.
5. Effect of stimulation of splanchnic nerve.
6. Effect of stimulation of peripheral somatic nerve (sciatic nerve).
7. Study of hypovolemic shock and its reversal.

Experiments that can be done as per CPSEA Guidelines

1. Perfusion of isolated mammalian heart and study the effects of drugs and ions.
2. Recording of Isolated Intestinal movement and tone and studying the effect of drugs and ions.
3. Study of various stages of menstrual cycle, cervical smear and vaginal smear

**III. Human Physiology**

## **Laboratory procedures using normal subjects**

### **Clinical Physiology**

1. Physiological principles of clinical examination.
2. General Physical examination, physiological basis of some clinical symptoms and signs.
3. General principles of Inspection/Palpation/Percussion/Auscultation.

### **Nerve muscle physiology**

1. Ergography and hand grip spring dynamography and study of human fatigue.
2. Recording of electromyography (EMG) and its application.
3. Recording of nerve conduction.

### **Cardiovascular system (CVS)**

1. Clinical examination of CVS.
2. Examination of arterial & venous pulses.
3. Measurements of arterial blood pressure and effect of head-up/head-down tilt.
4. Recording of 12 lead Electrocardiography (ECG) and its interpretation.
5. Measurement of blood flow.

### **Respiratory system**

1. Clinical examination of respiratory system
2. Stethography – study of respiratory movements and effect of various factors
  - a) effect of hyperventilation, effect of breath. holding and effect of deglutition
3. Assessment of respiratory functions (spirometry, vitalography, and gas analysis).
  - a) spirometry using benedict Roth spirometer/computerized spirometer
    1. evaluation of lung functions in relation to FVC, FEV1, PEFr
    2. To calculate dyspnoeic index after making appropriate measurement
    3. To demonstrate chemical regulation of respiration
4. Measurement of BMR.
5. Cardio pulmonary resuscitation (CPR) and Artificial respiration.

Principles of artificial respiration and to demonstrate manual method of Resuscitation provided mannequins are available in the department

### **Gastrointestinal system:**

1. Clinical examination of abdomen.

### **Integrative Physiology / Excretory system**

1. Recording of body temperature/effect of exposure to cold and hot environment
2. Studies in stimulated environment - microgravity; high altitude; hot and cold environment.
3. Human studies involving sweat, salivation and urine.

## **Reproductive system**

1. Determination of ovulation time by basal body temperature chart and pregnancy diagnostic test - Immunological Tests.
2. Semen analysis: sperm count and motility.

## **Nervous System including Special senses**

1. Clinical examination of the nervous system and its physiological basis.
2. Examination of higher mental functions.
3. Examination of cranial nerves.
4. Examination of sensory system.
5. Examination of motor system including reflexes.
6. Clinical examination of special senses:
  - (i) Smell and Taste
  - (ii) Test for hearing to deafness
  - (iii) Physiology of eye:
    - (a) Clinical examination of the eye and pupillary reflex
    - (b) Visual acuity
    - (c) Perimetry – mapping out of visual field and blind spot
    - (d) Accommodation
    - (e) Fundoscopy
    - (f) Colour vision and colour blindness

The subject could be a normal volunteer. The examiners should not insist on a patient to be brought from the hospital. The students will be given a case history and based on the case the student will perform the examination of the system in normal subjects.

### **Case history Clinical Examination**

A soldier in the war got a bullet shot at lumbar region and thereafter c/o loss of altered sensation on the right leg and paralysis of the left leg. Examine the given subject in the direction of above case history and report

7. Reaction (visual and auditory) and reflex time.
8. Electroencephalography (EEG) and Polysomnography
9. Autonomic Nervous System (ANS) Testing.
  1. By using the following standard tests
    - a) Timed deep breathing
    - b) Sustained isometric contraction
    - c) Valsalva maneuver
    - d) Effect of posture
    - e) Compare the contrasting effect of cold on heart rate by the
      - a) Ice cold pressor test
      - b) Diving reflex (head immersion)

## 10. Neuro-electrodiagnostic techniques:

- (i) Nerve conduction study.
  - a) measure nerve conduction
  - b) To record E M G
  - c) To demonstrate strength duration curve
- (ii) Visual evoked potential (VEP).
- (iii) Brainstem auditory evoked potential (B.A.E.P).
- (iv) Somato-sensory evoked potential (SEP).
- (v) Motor evoked potential (MEP).

## **Others**

1. Construction of dietary chart for growing children, pregnant woman, elderly individuals, hypertensive patients, & diabetes mellitus patients and case histories-problem based learning.

## **2. Body Composition:**

### **Measurement of anthropometry and to comment on**

- a) Nutritional status**
- b) Central obesity**

2. Tests for physical fitness: Cardio – respiratory responses to steady state exercise using

- (i) Harvard step test
- (ii) Bicycle Ergometry
- (iii) Treadmill test for determination of VO<sub>2</sub> max

## ***Syllabus***

### **Course contents:**

#### ***Paper-I: General and Cellular Physiology including Genetic Basis and Historical perspectives:***

1. Physiology of cell, various cellular mechanisms and genetic control mechanisms.
2. Various principles of Physics and Physical Chemistry involved in physiological phenomenon e.g. haemo-dynamics, bio-electrical potentials, body fluids, methods of measurements.
3. History of Physiology.
4. Biostatistics and Research methodology, Biophysics, Biochemistry, Micro-anatomy.
5. Growth and Development including aging.
6. Excretion, pH, water and Electrolyte balance.

**Paper-II: Systemic Physiology (system providing transport, nutrition and energy) including comparative Physiology.**

1. Blood and Immunity.
2. Cardiovascular System.
3. Respiratory System.
4. Gastro- Intestinal Tract (GIT) and dietary requirements.

**Paper-III: Systemic Physiology (system concerned with procreation, regulation and neural control)**

1. Nerve-Muscle Physiology including muscle mechanics
2. Endocrine Physiology
3. Nervous System (Central, peripheral and autonomic)
4. Special Senses
5. Reproduction & family planning/foetal & neonatal Physiology

**Paper-IV: Applied Physiology including recent advances**

1. Patho-physiology pertaining to systemic Physiology
2. Physiological basis of various clinical investigation tests
3. Interaction of human body in ambient environment- high altitude, space and deep sea
4. Sports physiology
5. Yoga and Meditation
6. Recent advances relevant to Physiology
7. Social responsibilities of physiologists

#### **Departmental resources**

It is to be mandatory for the department to establish and develop the following laboratories. In addition to teaching, these laboratories should be involved in active research and in-patient care services in one or more well defined fields.

#### **1. Clinical Neurophysiology Laboratory**

The department should generate liaison with clinical department and provide routine services for health monitoring and diagnostics (disease).

- (i) Electroencephalography
- (ii) Evoked potential recording
- (iii) Electromyography
- (iv) Nerve conduction studies
- (v) Autonomic nervous system (ANS) testing
- (vi) Any other newer technology

#### **2. Cardio-Respiratory Laboratory**

The department should generate liaison with clinical department and provide routine services for health monitoring and diagnostics (disease).

- (i) Electrocardiography
- (ii) Blood-gas Analysis
- (iii) Computerized multifunctional spirometry
- (iv) Laboratory for measuring pulmonary diffusion capacity and functional residual capacity (FRC)
- (v) Whole-body plethysmography
- (vi) Laboratory for Blood flow measurements (Impedance plethysmograph/Laser flow meter/Doppler flow meter)

### **3. Exercise Physiology Laboratory**

The department should generate liaison with ports authorities and clinical departments to provide services for testing and grading exercise and physical efficiency for health monitoring and diagnostics (disease). This should be done by using the following techniques:

- (i) Two step test exercisers
- (ii) Bicycle Ergometry
- (iii) Tread mill
- (iv) Respiratory gas analysis and measurement of basal metabolic rate (BMR)

### **4. Metabolic/ Endocrinology/ Reproductive Bio-medicine laboratory**

This laboratory should perform various tests pertaining to gastrointestinal, renal, metabolic, endocrinal and reproductive bio-medicine. The department should generate liaison with clinical departments and provide routine services for health monitoring and diagnostics (disease).

- (i) Spectrophotometer
- (ii) pH meter
- (iii) Elisa Reader/Washer
- (iv) Luminometer
- (v) Semi-autoanalyzer

Post graduate students should be posted in the above laboratories and extend the required services on routine basis.

The Department should be equipped with general facilities like PG resource room with internet access and a departmental library with books especially those related to pertinent higher studies in Physiology and field of research. The college/department should make important journals available (at least four Indian journals and two international journals).

## ***TEACHING AND LEARNING METHODS***

### **Teaching methodology**

Based on the above laboratory facilities the department can prepare a list of post-graduate experiments pertaining to basic and applied physiology. Active learning should form the mainstay of postgraduate training.

## **SEMINARS AND JOURNAL REVIEW MEETINGS**

1. The postgraduate students should actively participate in departmental seminars and journal Reviews
2. Logbook record showing the involvement of the student shall be maintained by candidate.
3. Seminars and journal review: Minimum of 4 presentations (inclusive of both seminars, journal) is mandatory per candidate per academic term (six month)
4. These are to be assessed by the faculty as per the checklists in chapter IV

### **Method of training**

1. The training of postgraduate shall be Residency pattern with graded responsibilities in each academic year
2. The participation of the students in all facets of educational process is essential. Every candidate should take part in seminars, journal clubs, recent advance conducting practical/small group teachings
3. Every candidate should be required to participate in the teaching and training program of undergraduate students
4. Training should include involvement inpatient based/ laboratory or skill based learning and experimental work and research studies
5. Postgraduate students should be posted to allied and relevant clinical departments or institutions
6. Self-directed learning and teaching

## **MAINTENANCE OF RECORD OF WORK DONE**

A Log book showing each day's work must be maintained by the candidate which shall be submitted to head of the department for scrutiny on first working day of every month.

A practical record of work done in practical's like haematology, amphibian, mammalian human and clinical physiology has to be maintained by candidate and duly scrutinized and certified by head of the department

A list of seminars and journal clubs that have been made by student and also participated by student in others presentations must be maintained and it should be scrutinized by head of the department

- The department should generate liaison with clinical departments and provide routine services for health monitoring and diagnostics (disease) and for periodical posting of Physiology PGs in clinical settings.



- The PG students should render special investigative services in their respective area of specialization. In consultation with the concerned clinical departments a 3-month roster should be made for the post-graduate students to attend the ward rounds of selected cases of pathophysiologic interest for PG teaching.
- The PG students should pay formal and scheduled visits to various hospital laboratories of interest for the purpose of learning.
- The student should be trained to generate teaching resource material for UG and develop problem solving modules.
- Department should encourage e-learning activities.
- The postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.

**During the training programme, patient safety is of paramount importance therefore, skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently; for this purpose, provision of skills laboratories in medical colleges is mandatory.**

**Rotation:**

Each post graduate student should undergo minimum of six terms training spread over a period of 03 years. The postings should be as under: -

1. **I semester:** Department of Physiology to cover (i) General aspects of UG teaching, (ii) Selection of thesis topics and collection of relevant references
2. **II Semester:** (i) submission of thesis synopsis (ii) Posting in departmental UG – PG laboratories
3. **III semester:** Posting in clinical departments: Medicine and allied disciplines.
4. **IV, V & VI semesters:** (i) UG-PG teaching (ii) thesis work.

**Note:** (1) UG, PG teaching and thesis work to continue throughout the course.  
(2) 50% of time during III and IV Semester should be spent in the department of Physiology.

## SUGGESTED GUIDELINES FOR THREE YEAR M D PHYSIOLOGY ACTIVITIES

Year	ACADEMICS/RESEARCH /PROFESSIONALISM
<b>1<sup>st</sup> year</b>	<ul style="list-style-type: none"> <li>a) Orientation to the subject and departmental activities</li> <li>b) Understand the competency, syllabus and assessment of the PG curriculum in physiology as per the RGUHS Requirement</li> <li>c) Attend regular M. B. B. S theory and practical classes</li> <li>d) Start taking undergraduate small group teaching under supervision</li> <li>e) Start taking seminars and journal reviews</li> <li>f) Attend the PG research methodology training program and mandatory to complete NMC/MCI Prescribed online research methodology course</li> <li>g) Attend the postgraduate Medical education training program (PG MET)</li> <li>h) Selection of topic for dissertation—synopsis</li> <li>i) Preparation and submission of the synopsis</li> <li>j) Maintain logbook entry of all activities</li> <li>k) Internal assessment I—theory, practical and viva-voce</li> <li>l) Data collection of dissertation and review</li> <li>m) Attend CME/ Conferences / workshops</li> <li>n) Preparation paper presentation in state / National / international conference</li> <li>o) Feedback from guide and H O D</li> <li>p) Submission of first year log book to HOD for signature</li> </ul>
<b>2<sup>nd</sup> Year</b>	<ul style="list-style-type: none"> <li>a) Continue academic activities of teaching undergraduate medical students</li> <li>b) Plan for Rotational postings</li> <li>c) Seminar and journal clubs</li> <li>d) Complete record book</li> <li>e) Plan and preparation paper presentation in state / national / international conferences</li> <li>f) Submission of Log book entry to H O D signature with all entries of all activities</li> <li>g) Internal assessment II—both theory, practical and viva-voce</li> <li>h) Review dissertation preparation</li> <li>i) Feedback from guide and H O D</li> </ul>
<b>3<sup>rd</sup> Year</b>	<ul style="list-style-type: none"> <li>a) Continue academic activities of teaching undergraduate medical students</li> <li>b) Complete dissertation work</li> <li>c) Presentation of dissertation</li> <li>d) Complete Log book</li> <li>e) Practice pedagogy sessions</li> <li>f) Preliminary examination (III IA-theory, practical and viva-voce)</li> <li>g) Feedback from guide and H O D</li> </ul>

### **Dissertation work**

1. Selection of topic under the guidance of recognized postgraduate guide as per MCI and RGUHS regulations
2. Submission of synopsis within six months from the commencement of course or as per the dates notified by university in calendar of events
3. Synopsis is submitted in prescribed format for registration of dissertation topic by university after scrutinized by research or PG training committee of concern institute.
4. The dissertation shall be submitted to registrar (Evaluation) of the university
5. Approval and Acceptance of the dissertation by panel of examiners is prerequisite for candidate to appear for the university examination

It is mandatory to complete the MCI / NMC PRESCRIBED

### **BASIC RESEARCH METHODOLOGY COURSE**

It is mandatory to complete the MCI / NMC prescribed online basic research methodology course during first academic year. This is to introduce the student to basic research methods and facilitate the completion of dissertation work in partial fulfilment of the course

A postgraduate should present poster presentation, to read one paper at national / state conference

One paper to be published in index journal which is accepted during the course

So that postgraduate is eligible to appear for final examination

### **ASSESSMENT**

**FORMATIVE ASSESSMENT** i.e., during the training **Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning and ability to practice in the system. (refer checklists in chapter IV)**

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

The Internal Assessment should be conducted in theory and clinical examination.

**Quarterly Assessment during the MD training programme should be based on:**

- 1. Journal based / recent advances learning**
- 2. Patient based /Laboratory or Skill based learning**
- 3. Self-directed learning and teaching**

#### **4. Departmental and interdepartmental learning activity**

#### **5. External and Outreach Activities / CMEs**

**The student to be assessed periodically as per categories listed in postgraduate student appraisal form (refer checklists in chapter IV)**

#### **SUMMATIVE ASSESSMENT i.e., assessment at the end of training**

The post-graduate examinations should be conducted in 3 parts:

##### **1. Thesis**

Every post graduate student shall carry out work on an assigned research project under the guidance of a recognized Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis. Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the post graduate student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

**Thesis shall be submitted at least six months before the Theory and Clinical / Practical examination minim. The thesis shall be examined by three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Clinical examination. A post graduate student shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the thesis by the examiners.**

#### **UNIVERSITY THEORY AND PRACTICAL EXAM**

- 1) The examination of M D shall be held at the end of three academic years (six academic terms)
- 2) The university shall conduct two examinations in a year at an interval of six months between the two examinations
- 3) Examination shall consist of dissertation, written paper (theory), practical and viva - voce

##### **Criteria for pass**

- a) The examinations shall be organized based on Marking system to evaluate and to certify post graduate students' level of knowledge, skill and competency at the end of the training
- b) Paper Minimum 40% for individual theory paper
- c) Minimum 50% in theory aggregate
- d) Minimum 50% in practical and viva-voce

## 2. Theory Examination

### Total marks 400

There should be 4 theory papers:

Each paper carries 100 marks (10 essay questions of 10 marks each)

Each paper will be of three hours

**Paper I:** General Physiology including history of Physiology

**Paper II:** Systemic Physiology (system providing transport, nutrition and energy)

**Paper III:** Systemic Physiology (system concerned with regulation, neural control and procreation)

**Paper IV:** Applied Physiology including recent advances

### QUESTION FORMAT

- Ten question of Long essay carrying 10 marks each
- Question should be structured so that evaluation is better, unbiased and uniform
- 10% of each question paper should be based on problem / case-based learning with relevant applied physiology

PAPER	SYLLABUS	DURATION	MARKS
<b>Paper I</b>	General physiology including history of physiology	3hours	100marks
<b>Paper II</b>	Systemic physiology (systems providing transport, nutrition and energy)	3hours	100marks
<b>Paper III</b>	1. Systemic physiology (systems concerned with regulation Neural control And procreation)	3hours	100marks
<b>Paper IV</b>	Applied physiology Including recent advances	3hours	100 marks

### 3. Practical and oral examination

Practical examination should be spread over two days and include the following

Components:

1. Objective Structured Practical Exam (OSPE)/ Spotting. ---(15 Marks)
2. Problem solving exercises pertaining to Clinical Physiology ---(50 Marks)
3. Performing and reporting two special laboratory investigations---(20 Marks)
4. Two animal experiments (one long and one short) illustrating mechanisms, physiological concepts and their applications to humans. (Subject to current regulation of Government of India regarding animal usage). This is optional. It is advisable to use simulated experiments for this purpose. ---(30 Marks)
5. Two human experiments (one long and one short), dealing with clinical Physiology as would have significant bearing on human health and patient care. --- (50 Marks)
6. Haematology--- (35)

Viva-voce examination should include the following components:

- |  |   |                    |
|--|---|--------------------|
| <ul style="list-style-type: none"> <li>(i) Theoretical discussion (General and systemic Physiology)</li> <li>(ii) Teaching techniques</li> <li>(iii) Thesis</li> <li>(iv) Eminent Physiologists (Foreign/Indian)</li> <li>(v) Journals (Indian/Foreign)</li> <li>(vi) Recent advances</li> </ul> | } | Total – (60 Marks) |
|--|---|--------------------|
- (vii) Micro-teaching session for assessing communication skills. ---(20 Marks)
  - (viii) Dissertation---(20 Marks)

#### Practical and oral examinations

Practical examination should be spread over two days and include following component

Serial number	Practical Component	marks
1	Objective structured practical exam (OSPE)	15 marks
2	Problem solving exercises pertaining to clinical physiology	50 marks
3	Performing and reporting two special laboratory investigations	20marks
4	Two animal experiments (one long and one short) illustrating mechanisms, physiological concepts and their applications to humans (subject to current regulation of government of India regarding animal usage) .This is optional . it is advisable to use simulated experiments for this purpose	30 marks

5	Two human experiment (one long and one short), dealing with clinical physiology as would have significant bearing on human health and patient care	50 marks
6	Hematology	35 marks

VIVA-VOCE (100marks) The division of marks should be demarcated clearly

Viva-voce examination should include the following components

**Subject viva-60marks**

- i) Theoretical discussion (general and systemic physiology)
- ii) Teaching techniques
- iii) Thesis
- iv) Eminent physiologists (foreign/Indian)
- v) Journals (foreign/Indian)
- vi) Recent advances

**Micro-teaching session for assessing communication skills-20marks**

**Dissertation-20marks**

**Question Paper Setting:**

- On Each theory paper the topics have to be mentioned
- The Question should be structured
- One question should be case/problem based

<b>MD Physiology Examination</b>	<b>Theory</b>	<b>Practical's</b>	<b>Viva-Voce</b>	<b>Total Marks</b>
<b>Maximum marks</b>	<b>400</b>	<b>200</b>	<b>100</b>	<b>700</b>

## **Recommended Reading**

### **Books (latest edition)**

1. A.C. Guyton – Text book of Medical Physiology
2. W.F. Ganong – Review of Medical Physiology
3. Vernon B. Mountcastle– Medical Physiology Vol. I & II
4. William's Textbook of Endocrinology
5. J.E. Cotes- Respiratory Physiology
6. D.T. Harris – Experimental Physiology
7. Wintrobe's – Clinical Hematology
8. Brown B.L. – Cell signaling, Biology and medicine of signal transduction
9. Berne and Levy- Medical Physiology
10. Textbook of Medicine by Harrison
11. API Textbook of Medicine

### **Journals**

03-05 international Journals and 02 national (all indexed) journals

International journal of physiology

Indian journal of clinical anatomy and physiology

International journal of basic and applied physiology

International journal of physiology, pathophysiology and pharmacology

Journal of applied physiology by American physiological society

Physiological reviews by American physiological society

Annual review of physiology by American physiology society

Journal of physiology British publication

Indian journal of physiology and pharmacology—IJPP by association of physiologist and pharmacologist of India

Indian journal of medical research by Indian of medical council of Medical Research

News in physiological sciences

New England journal of medicine



# BLUEPRINT FOR THE MD PHYSIOLOGY THEORY EXAMINATION

## PAPER 1

### General and cellular physiology including genetic basis and historical perspectives

TOPICS	MARKS
Physiology of cells, various cellular mechanisms and genetic control mechanisms	20
Various principles of physics and physical chemistry involved in physiological phenomenon e.g. haemo-dynamics, bio-electrical potential, body fluids, methods of measurements	20
History of physiology	10
Biostatistics and research methodology, biophysics, biochemistry, microanatomy	20
Growth and development including aging	10
Excretion, pH water, electrolyte balance	20
<b>Total</b>	<b>100</b>

## PAPER II

### Systemic Physiology (system providing transport, nutrition and energy) Including comparative physiology

TOPIC	MARKS
Blood and Immunity	25
Cardiovascular system	25
Respiratory system	25
Gastro-Intestinal Tract (GIT) and dietary requirement	25
<b>Total</b>	<b>100</b>

## PAPER III

### Systemic Physiology (system concerned with procreation, regulation and neural control)

TOPIC	MARKS
Nerve-Muscle physiology including muscle mechanics	20
Endocrine physiology	20
Nervous System (central, peripheral and autonomic)	20
Special senses	20
Reproduction & family planning / foetal & neonatal physiology	20
<b>TOTAL</b>	<b>100</b>

## PAPER IV

### Applied physiology including recent advances

TOPIC	MARKS
Patho-physiology pertaining to systemic physiology	20
Physiology basis of various clinical investigation tests	10
Interaction of human body in ambient environment-high altitude, space and deep sea	20
Sports physiology	10
Yoga and Meditation	10
Recent advances relevant to physiology	20
Social responsibilities of physiology	10
<b>Total</b>	<b>100</b>

## MODEL QUESTION PAPERS

**Rajiv Gandhi University of Health Sciences, Karnataka**

**Post Graduate MD PHYSIOLOGY Examination – MMY**

**Physiology Paper- I**

**General and cellular physiology including genetic basis and historical perspectives**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Describe the ionic basis and properties of action potential.
2. Describe the Recombinant DNA technology with illustrations.
3. Contribution of Ivan Pavlov to physiology.
4. Describe the molecular basis of apoptosis.
5. Write about application of Standard deviation in research methodology. Add a note on its importance.
6. Describe the mechanism of passive transport of substance through the cell membrane.
7. Describe tissue fluid formation and explain two mechanisms which produce oedema.
8. Describe the comparative physiology of circulation in vertebrates.
9. Describe the regulation of acid base balance. Add a note on disturbance of the acid base balance.
10. A 40-year-old man presented with severe cough and breathlessness. On examination there was wheezing and harsh breathing. Investigation shows absence of ciliary processes and diagnosed with the Ciliary disease. Describe in detail about the cilia and its clinical importance.

**Rajiv Gandhi University of Health Sciences, Karnataka**

**Post Graduate MD PHYSIOLOGY Examination – MMY  
Physiology Paper- II**

**Systemic Physiology (System providing Transport, Nutrition and Energy including  
Comparative Physiology)**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Explain ventilation -perfusion ratio, its importance and mention the normal values.
2. Describe a non-invasive method of determination of cardiac output. List the factors regulating it.
3. Describe the clinical importance of Monoclonal antibodies, immunotherapy and hypersensitivity.
4. Describe the mechanism of Trans capillary exchange.
5. Describe the Chemical regulation of respiration.
6. Describe the mechanism of acclimatization to high altitudes.
7. Describe the basic mechanism of Echocardiography and its applied aspect.
8. Pulmonary function tests and their physiological basis.
9. Give an account of the principles and methods used to obtain E C G. Add a note on conduction disorders.
10. A women aged 30 years complaints of general fatigue, breathlessness on exertion, giddiness, headache, palpitation, anorexia and dysphagia. On examination there was pallor, glossitis, spooning of nails and tachycardia. She was diagnosed with Nutritional deficiency anaemia. Describe the etiological types of anaemia and add a note on nutritional deficiency anaemia.

**Rajiv Gandhi University of Health Sciences, Karnataka**

**Post Graduate MD PHYSIOLOGY Examination - MMY  
Physiology Paper- III**

**Systemic Physiology (System concerned with Procreation, Regulation and Neural control)**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Mention various methods through which growth hormone acts and describe the physiological actions in detail with applied aspects.
2. Describe the Haemolytic disease of new born
3. Describe the pathophysiology of peptic ulcer and basis of management
4. Describe the counter current mechanism
5. Mechanism of action and actions of testicular hormones
6. Describe the physiology of growth and development
7. Describe the Endocrine functions of placenta.
8. Describe the renal mechanism of pH regulation
9. Explain the mechanism of action of oral contraceptive
10. A middle aged individual comes with history of weakness, increased thirst, increased frequency of urination and increased appetite. He also complaints of loss of weight and poor healing of wound. He was diagnosed with Diabetes Mellitus. Describe the endocrine regulation of blood glucose level. Add a note on human insulin.

**Rajiv Gandhi University of Health Sciences, Karnataka**

**Post Graduate MD PHYSIOLOGY Examination – MMY  
Physiology Paper- IV  
Applied Physiology including Recent Advances**

**QP CODE: XXXX**

**Time: 3 hours**

**Maximum marks: 100**

**Instructions:** Answer all questions

Draw diagrams and write structures wherever necessary

1. Explain changes during Wallerian degeneration and regeneration of injured nerve
2. Describe the respiratory and cardiovascular changes in different degrees of exercise
3. Describe the connections, functions of cerebellum with its lesions
4. Describe the mechanism of NREM and REM sleep. explain different theories of sleep
5. Describe the process of excitation and contraction in smooth muscle.
6. Describe the immediate effects of complete transection of the spinal cord
7. Write about Lumbar puncture and its clinical significance.
8. Describe the mechanism of perception of colour vision
9. Write about Cochlear microphonics and its application
10. A woman aged 63 years, suddenly fainted and became unconscious. when she became conscious was unable to move left arm and left leg an examination made after 6 weeks showed spastic paralysis with increased muscle tone and exaggerated tendon reflex. There was left sided facial palsy. Describe the origin course, and function of corticospinal tract. Add a note on lesion at the level of internal capsule.

## Chapter IV

### Monitoring Learning Progress

It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only also helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by the staff of the department based on participation of students in various teaching / learning activities. It may be structured and assessment be done using checklists that assess various aspects. Model Checklists are given in this Chapter, which may be copied and used.

The learning out comes to be assessed should include: (i) Personal Attitudes, (ii) Acquisition of Knowledge, (iii) Clinical and operative skills, and (iv) Teaching skills.

*i) Personal Attitudes.* The essential items are:

- Caring attitudes
- Initiative
- Organisational ability
- Potential to cope with stressful situations and undertake responsibility
- Trust worthiness and reliability
- To understand and communicate intelligibly with patients and others
- To behave in a manner which establishes professional relationships with patients and colleagues
- Ability to work in team
- A critical enquiring approach to the acquisition of knowledge

The methods used mainly consist of observation. It is appreciated that these items require a degree of subjective assessment by the guide, supervisors and peers.

*ii) Acquisition of Knowledge:* The methods used comprise of 'Log Book' which records participation in various teaching / learning activities by the students. The number of activities attended and the number in which presentations are made are to be recorded. The log book should periodically be validated by the supervisors. Some of the activities are listed. The list is not complete. Institutions may include additional activities, if so, desired.

*Journal Review Meeting (Journal Club):* The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting using a checklist (see Model Checklist – I, Chapter IV)

*Seminars / Symposia:* The topics should be assigned to the student well in advance to facilitate in depth study. The ability to do literature search, in depth study, presentation skills and use of audio- visual aids are to be assessed using a checklist (see Model Checklist-II, Chapter IV)

*Clinico-pathological conferences:* This should be a multidisciplinary case study of an interesting case to train the candidate to solve diagnostic and therapeutic problems by using an analytical approach. The presenter(s) are to be assessed using a checklist similar to that used for seminar.

*Medical Audit:* Periodic morbidity and mortality meeting be held. Attendance and participation in these must be insisted upon. This may not be included in assessment.

### *iii) Clinical skills*

*Day-to-Day work:* Skills in outpatient and ward work should be assessed periodically. The assessment should include the candidates' sincerity and punctuality, analytical ability and communication skills (see Model Checklist III, Chapter IV).

*Clinical meetings:* Candidates should periodically present cases to his peers and faculty members. This should be assessed using a checklist (see Model checklist IV, Chapter IV).

*Clinical and Procedural skills:* The candidate should be given graded responsibility to enable learning by apprenticeship. The performance is assessed by the guide by direct observation. Particulars are recorded by the student in the logbook. (Table No.3, Chapter IV)

*iv) Teaching skills:* Candidates should be encouraged to teach undergraduate medical students and paramedical students, if any. This performance should be based on assessment by the faculty members of the department and from feedback from the undergraduate students (See Model checklist V, Chapter IV)

*vi) Formative assessment / internal assessment:* Three tests may be conducted, two of them be annual tests, one at the end of first year and the other in the second year. The third test may be held three months before the final examination. The tests may include written papers, practicals / clinicals and viva voce.

*vii) Work diary / Log Book-* Every candidate shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical or laboratory procedures, if any conducted by the candidate.

*viii) Records:* Records, log books and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University or MCI/ NMC.

### **Logbook**

The logbook is a record of the important activities of the candidates during his training, Internal assessment should be based on the evaluation of the log book. Collectively, log books are a tool for the evaluation of the training programme of the institution by external agencies. The record includes academic activities as well as the presentations and procedures carried out by the candidate.

**Format for the logbook** for the different activities is given in Tables 1, 2 and 3 of Chapter IV. Copies may be made and used by the institutions.

**Procedure for defaulters:** Every department should have a committee to review such situations. The defaulting candidate is counselled by the guide and head of the department. In extreme cases of default, the departmental committee may recommend that defaulting candidate be withheld from appearing the examination, if she/he fails to fulfil the requirements in spite of being given adequate chances to set himself or herself right.



CHAPTER IV (Contd.)

Format of Model Check Lists

Check List -I.

MODEL CHECK-LIST FOR EVALUATION OF JOURNAL REVIEW PRESENTATIONS

Name of the Student:

Name of the Faculty/Observer:

Date:

Sl. No.	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Article chosen was					
2.	Extent of understanding of scope & objectives of the paper by the candidate					
3.	Whether cross references have been consulted					
4.	Whether other relevant publications consulted					
5.	Ability to respond to questions on the paper / subject					
6.	Audio-Visual aids used					
7.	Ability to discuss the paper					
8.	Clarity of presentation					
9.	Any other observation					
	<b>Total Score</b>					

**Check List - II**

**POSTGRADUATE STUDENTS APPRAISAL FORM  
PRE-CLINICAL DISCIPLINES**

**Name of the Department:**

**Name of the PG Student:**

**Period of Training: FROM.....TO.....**

**1: Poor, 2: Average, 3: Good, 4: Very good, 5: Exceptional**

Sl no	Particulars	1	2	3	4	5
1	Ability to teach UG students and Juniors					
2	Knowledge of Subject in PG course					
3	Performance in Journal Club					
4	Performance in Seminar					
5	Punctuality at work					
6	Ability to work in a team					
7	Attitude towards colleagues/Faculty					
8	Ability to communicate with students					
9	Departmental and interdepartmental activity initiatives					
10	Thesis /Research work					
11	Logbook maintenance					

**Publications**

**Yes/ No**

Remarks\* \_\_\_\_\_

\_\_\_\_\_ \*REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.

**SIGNATURE OF ASSESSEE**

**SIGNATURE OF HOD**

**Check List – III**

**RGUHS MD/MS Postgraduate Viva Examination**

**Assessment /Evaluation of PEDAGOGY**

**Name of the candidate:**

**Date:**

**Register No**

**Centre:**

**Topic:**

**Max. Marks: 20**

Skills		Marks
Marks Set induction (1.5marks)	<ul style="list-style-type: none"> <li>• Aroused interest in the beginning by relating to previous learning, throwing a new idea, questioning, etc.</li> <li>• Specified the objectives of presentation</li> </ul>	
Planning (5 marks)	<ul style="list-style-type: none"> <li>• Organized material in a logical sequence</li> <li>• Used relevant content matter</li> </ul>	
Presentation (5 marks)	<ul style="list-style-type: none"> <li>• Changed the pace of presentation by shifting emphasis, joke, etc</li> <li>• Used specific example to illustrate main Ideas</li> <li>• Used non-verbal cues, eye contact, etc</li> </ul>	
Pupil participation (5 marks)	<ul style="list-style-type: none"> <li>• Allowed questions from students</li> <li>• Asked question</li> <li>• Solicited/Raised questions</li> <li>• Rewarded pupil effort</li> </ul>	
Use of AV aids (2.5 marks)	<ul style="list-style-type: none"> <li>• Used proper AV aids</li> <li>• used the aid(s) effectively</li> </ul>	
Closure (1 mark)	<ul style="list-style-type: none"> <li>• Summarized most important points at the end of the session</li> </ul> <p>Overall marks</p>	
<p>_____ (out of 20)</p> <p align="right">Signature of the Examiner</p>		

**Checklist IV**  
**EVALUATION FORM FOR CLINICAL PRESENTATION**

Name of the Student:

Name of the Faculty:

Date:

Sl. No.	Points to be considered	Poor 0	Below Average 1	Average 2	Above Average 3	Very Good 4
1.	Completeness of history					
2.	Whether all relevant points elicited					
3.	Clarity of Presentation					
4.	Logical order					
5.	Mentioned all positive and negative points of importance					
6.	Accuracy of general physical examination					
7.	Whether all physical signs elicited correctly					
8.	Whether any major signs missed or misinterpreted					
9.	Diagnosis: Whether it follows logically from history and findings					
10.	Investigations required					
	▪ Complete list					
	▪ Relevant order					
	▪ Interpretation of investigations					
11.	Ability to react to questioning Whether it follows logically from history and					
12.	Ability to defend diagnosis					
13.	Ability to justify differential diagnosis					
14.	Others					
	<b>Grand Total</b>					

**Check List - V**

**MODEL CHECK LIST FOR EVALUATION OF TEACHING SKILL PRACTICE**

<b>Sl. No.</b>		<b>Strong Point</b>	<b>Weak Point</b>
1.	Communication of the purpose of the talk		
2.	Evokes audience interest in the subject		
3.	The introduction		
4.	The sequence of ideas		
5.	The use of practical examples and/or illustrations		
6.	Speaking style (enjoyable, monotonous, etc., specify)		
7.	Attempts audience participation		
8.	Summary of the main points at the end		
9.	Asks questions		
10.	Answers questions asked by the audience		
11.	Rapport of speaker with his audience		
12.	Effectiveness of the talk		
13.	Uses AV aids appropriately		

### Checklist VI

#### MODEL CHECK LIST FOR DISSERTATION PRESENTATION

Name:

Faculty/Observer:

Date:

Sl. No.	Points to be considered	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Interest shown in selecting a topic					
2.	Appropriate review of literature					
3.	Discussion with guide & other faculty					
4.	Quality of protocol					
5.	Preparation of proforma					

**Checklist-VII**

**CONTINUOUS EVALUATION OF DISSERTATION WORK BY GUIDE / CO-GUIDE**

Name of the Student:

Name of the Faculty/Observer:

Date:

<b>Sl. No.</b>	<b>Items for observation during presentation</b>	<b>Poor 0</b>	<b>Below Average 1</b>	<b>Average 2</b>	<b>Good 3</b>	<b>Very Good 4</b>
1.	Periodic consultation with guide/co-guide					
2.	Regular collection of case material					
3.	Depth of analysis / discussion					
4.	Departmental presentation of findings					
5.	Quality of final output					
6.	Others					
	<b>Total Score</b>					

## Check List - VIII

**MODEL CHECK-LIST FOR EVALUATION OF SEMINAR  
PRESENTATIONS**

Name of the Student:

Name of the Faculty/Observer:

Date:

Sl no.	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3
1	Whether other relevant publications consulted				
2	Whether cross references have been consulted				
3	Completeness of Preparation				
4	Clarity of Presentation				
5	Understanding of subject				
6	Ability to answer questions				
7	Time scheduling				
8	Appropriate use of Audio-Visual aids				
9	Overall Performance				
10	Any other observation				
	<b>Total</b>				



## LOG BOOK

**Table 1: Academic activities attended**

Name:

Admission Year:

College:

Date	Type of Activity	Particulars
	Seminar/ Journal Club/ Presentation/ UG teaching	

**LOG BOOK**

**Table 2: Academic presentations made by the student**

Name:

Admission Year:

College:

<b>Date</b>	<b>Topic</b>	<b>Specify type of presentation</b> <b>Seminar/ Journal Club</b> <b>presentation/ UG teaching etc.</b>

## LOG BOOK

**Table 3: Diagnostic and Operative Procedure**

**Name:**

**College:**

**Date:**

<b>Date</b>	<b>Name</b>	<b>ID No.</b>	<b>Procedure</b>	<b>Category O, A, PA, PI*</b>

- \* **Key:** O - Washed up and observed  
A - Assisted a more senior Surgeon  
PA - Performed procedure under the direct supervision of a senior surgeon  
PI - performed independently

**Table.4****Model Overall Assessment Sheet**

Name of the College:

Academic Year:

Sl. No	Particulars	Name of Student* and Mean Score									
		A*	B*	C*	D*	E*	F*	G*	H*	I*	J*
1	Journal Review Presentations										
2	Seminars										
3	Clinical work in wards										
4	Clinical presentation										
5	Teaching skill practice										
<b>Total Score</b>											

Note: Use separate sheet for each year.

*Signature of HOD**Signature of Principal*

The above overall assessment sheet used along with the logbook should form the basis for certifying satisfactory completion of course of study, in addition to the attendance requirement.

**KEY:****Mean score:** Is the sum of all the scores of checklists 1 to 7.**A, B, ....:** Name of the trainees.

## Chapter V

### Medical Ethics

#### Sensitisation and Practice

#### Introduction

Doctors and health professionals are confronted with many ethical problems. They may range from simple ones to those which have complex ramifications. Though the AETCOM module has been introduced in the undergraduate curriculum, it requires reinforcement during speciality training as there is a shift to greater accountability to the society. It is, therefore necessary to be prepared to deal with these problems. To accomplish the competencies as specified by concerned speciality subjects, and to develop human values, it is urged that strengthening in the practice of ethics be achieved by lectures or discussion on ethical issues, clinical case discussion of cases with an important ethical component relevant to the speciality and by including participation in academic undergraduate programmes.

#### Course Contents

##### 1 *Introduction to Medical Ethics*

What is Ethics  
 What are values and norms  
 Relationship between being ethical and human fulfilment  
 How to form a value system in one's personal and professional life  
 Heteronomous Ethics and Autonomous Ethics  
 Freedom and personal Responsibility

##### 2 *Definition of Medical Ethics*

Difference between medical ethics and bio-ethics  
 Major Principles of Medical Ethics – beneficence, justice, respect for autonomy, non-maleficence

##### 3 *Perspective of Medical Ethics*

The Hippocratic oath, The Declaration of Helsinki, The WHO Declaration of Geneva  
 International code of Medical Ethics (1993) Medical Council of India/NMC Code of Ethics

##### 4 *Ethics of the Individual*

The patient as a person, The Right to be respected, Truth and Confidentiality  
 The autonomy of decision, The concept of disease, health and healing  
 The Right to health  
 Ethics of Behaviour modification The Physician – Patient relationship Organ donation

##### 5 *The Ethics of Human life*

What is human life  
 Criteria for distinguishing the human and the non-human  
 Reasons for respecting human life

- The beginning of human life
  - Conception, contraception, Abortion
  - Prenatal sex-determination
  - In vitro fertilization (IVF), Artificial Insemination by Husband (AIH)
  - Artificial Insemination by Donor (AID),
  - Surrogate motherhood, Semen Intrafallopian Transfer (SIFT),
  - Gamete Intrafallopian Transfer (GIFT), Zygote Intrafallopian Transfer (ZIFT),
  - Genetic Engineering
- 6 *The Family and Society in Medical Ethics*
- The Ethics of human sexuality
  - Family Planning perspectives
  - Prolongation of life
  - Advanced life directives – The Living Will
  - Euthanasia
  - Cancer and Terminal Care
- 7 *Professional Ethics*
- Code of conduct
  - Contract and confidentiality
  - Charging of fees, Fee-splitting
  - Prescription of drugs
  - Over-investigating the patient
  - Low – Cost drugs, vitamins and tonics
  - Allocation of resources in health care
  - Malpractice and Negligence
- 8 *Research Ethics*
- Animal and experimental research / humanness
  - Human experimentation
  - Human volunteer research – Informed Consent
  - Drug trials
- 9 *Ethical workshop of cases*
- Gathering all scientific factors
  - Gathering all human factors
  - Gathering all value factors
  - Identifying areas of value – conflict, Setting of priorities, Working out criteria towards decisions
- 10 *Law & Medicine*
- Medical Council Act
  - Consumer Protection Act
  - Statutory Laws
  - Article 21 of the Constitution – Right to life, 304 IPC (Indian Penal Code), Drug Act

### **Recommended Reading**

1. Francis C.M., Medical Ethics, 11 Ed, 2004, Jaypee Brothers, New Delhi, Rs. 150/-
2. Ethical Guidelines for Biomedical Research on Human Subjects, Indian Council of Medical Research (ICMR), New Delhi, 2000.
3. ICMR Guidelines on Animal Use, 2001, ICMR, New Delhi.