POST GRADUATE MEDICAL EDUCATION
REGULATIONS AND CURRICULUM
FOR
POST GRADUATE DEGREE COURSES 2016

BIOCHEMISTRY

JAGADGURU SRI SHIVARATREESHWARA UNIVERSITY
MYSURU
BIOCHEMISTRY
## REGULATIONS AND CURRICULUM

FOR

POST GRADUATE DEGREE COURSES 2016

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BIOCHEMISTRY

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</table>
CHAPTER I
REGULATIONS FOR POST GRADUATE DEGREE AND DIPLOMA COURSES

1. Branch of study
   1.1 Post graduate degree courses
      1.1.1 Doctor of Medicine
         a) Anaesthesiology
         b) Anatomy
         c) Biochemistry
         d) Community medicine
         e) Dermatology, venereology and leprosy
         f) Emergency medicine
         g) Forensic medicine
         h) General medicine
         i) Hospital administration
         j) Microbiology
         k) Pathology
         l) Paediatrics
         m) Pharmacology
         n) Physiology
         o) Psychiatry
         p) TB and chest diseases
         q) Radio Diagnosis
      1.1.2 Master of Surgery
         a) General surgery
         b) Obstetrics and gynaecology
         c) Ophthalmology
         d) Orthopaedics
         e) Oto rhino laryngology
   1.2 Post graduate diploma courses
      a) Anaesthesiology (DA)
      b) Child Health (DCH)
      c) Clinical Pathology (DCP)
      d) Dermatology, Venereology & Leprosy (DDVL)
      e) Medical Radio Diagnosis (DMRD)
      f) Obstetrics & Gynaecology (DGO)
      g) Ophthalmology (DO)
      h) Orthopaedics (D Ortho)
      i) Otolaryngology (DLO)
      j) Psychiatric Medicine (DPM)
2. **Eligibility for admission**

**MD / MS Degree and Diploma courses:** A candidate who has passed final year MBBS examination after pursuing a study in a medical college recognized by the Medical Council of India and has completed one year compulsory rotating internship in a teaching institution or other institution recognized by the Medical Council of India, and has obtained permanent registration of any State Medical Council, shall be eligible for admission.

3. **Admission**

A candidate desirous of admission to Post Graduate Medical Programmes MD/ MS / PG Diploma Courses is required to complete the application form and submit to the University along with prescribed documents on or before the scheduled date. Eligibility criteria, application form and details of documents to be submitted are available in the University website: www.jssuni.edu.in.

4. **Registration**

A candidate who has been admitted to postgraduate course shall register in the university within a month of admission after paying the registration fee.

5. **Intake of students**

The intake of students to each course shall be in accordance with the MCI.

6. **Duration of study**

**6.1 MD, MS Degree Courses:** The course of study shall be for a period of 3 years consisting of 6 terms.

**6.2 Diploma courses:** The course of study shall be for a period of 2 years consisting of 4 terms.

7. **Methodology of training**

The training of postgraduate for degree/diploma shall be residency pattern, with graded responsibilities in the management and treatment of patients entrusted to his/her care. The participation of the students in all facets of educational process is essential. Every candidate should take part in seminars, group discussions, grand rounds, case demonstration, clinics, journal review meetings, CPC and clinical meetings. Every candidate shall participate in the teaching and training programme of undergraduate students. Training should include involvement in laboratory and experimental work, and research studies. 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 specialty departments or institutions.
8. Attendance, progress and conduct

8.1 A candidate pursuing degree/diploma course, shall work in the concerned department of the institution for the full period as full time student. No candidate is permitted to run a clinic/laboratory/nursing home while studying postgraduate course, nor can he/she work in a nursing home or other hospitals/clinic/laboratory while studying postgraduate course.

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

8.3 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.

8.4 Every candidate is required to attend a minimum of 80% of the training during each academic year 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 year.

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

9. Monitoring progress of study

9.1 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 shall 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 shall be scrutinised and certified by the Head of the Department and Head of the Institution, and presented in the University practical/clinical examination.

9.2 Periodic tests: In case of degree courses of three years duration (MD/MS), the concerned departments shall conduct three tests, two of them be annual tests, one at the end of first year and the other at the end of the second year. The third test shall be held three months before the final examination. The tests shall include written papers, practical / clinical and viva voce. Records and marks obtained in such tests shall be maintained by the Head of the Department and sent to the University, when called for.
9.3 In case of diploma courses of two years duration, the concerned departments shall conduct two tests, one of them at the end of first year and the other in the second year, three months before the final examination. The tests shall include written papers, practical / clinical and viva voce.

9.4 Records: Records and marks obtained in tests shall be maintained by the Head of the Department and shall be made available to the University or MCI.

10. Dissertation

10.1 Every candidate pursuing MD/MS 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 postgraduate 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 Every candidate shall submit to the Controller of Examinations of the University in the prescribed proforma, a synopsis containing particulars of proposed dissertation work within six months from the date of commencement of the course, on or before the dates notified by the University. The synopsis shall be sent through proper channel.

10.4 Such synopsis will be reviewed 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:
   a) Introduction
   b) Aims or Objectives of study
   c) Review of Literature
   d) Material and Methods
   e) Results
   f) Discussion
   g) Conclusion
   h) Summary
   i) References
   j) Tables
   k) Annexure
   l) Proof of Paper presentation and publication
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 annexure. 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. The dissertation shall be certified by the guide, head of the department and head of the Institution.

10.7 Four copies of dissertation thus prepared shall be submitted to the Controller of Examinations, 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.

10.9 Guide: The academic qualification and teaching experience required for recognition as a guide for dissertation work is as per MCI Minimum Qualifications for Teachers in Postgraduate Medical Education Regulations, 2000. Teachers in a medical college/institution having a total of eight years teaching experience out of which at least five years teaching experience as Assistant Professor gained after obtaining post graduate degree shall be recognised as post graduate teachers.

10.10 Co Guide: 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 JSS University / Medical Council of India.

10.11 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.

10.12 A postgraduate student is 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.

11. Schedule of examination

The examination for MD / MS courses shall be held at the end of three academic years (six academic terms). The examination for the diploma courses shall be held at the end of two academic years (four academic terms).
For students who have already passed Post Graduate Diploma and appearing for MD examination, the examination shall be conducted after two academic years (four academic terms, including submission of dissertation) The University shall conduct two examinations in a year at an interval of four to six months between the two examination. Not more than two examinations shall be conducted in an academic year.

12. Scheme of examination

12.1 MD/MS

12.1.1 Dissertation: Every candidate shall carryout work and submit a dissertation as indicated in Sl No 10. Acceptance of dissertation shall be a precondition for the candidate to appear for the final examination.

12.1.2 Written Examination (Theory): A written examination shall consist of four question papers, each of three hours duration. Each paper shall carry 100 marks. Out of the four papers, the 1st paper in clinical subjects will be on applied aspects of basic medical sciences. Recent advances may be asked in any or all the papers. In basic medical subjects and para-clinical subjects, questions on applied clinical aspects shall also be asked.

Pattern of Theory Examination Question Paper:

Each paper shall consist of two long essay questions each carrying 20 marks, 3 short essay questions each carrying 10 marks and 6 short answer questions each carrying 5 marks. Total marks for each paper shall be 100.

12.1.3 Practical/Clinical Examination: In case of Practical examination for the subjects in Basic Medical Sciences Practical Examination shall be conducted to test the knowledge and competence of the candidates for making valid and relevant observations based on the experimental/Laboratory studies and his ability to perform such studies as are relevant to his subject.

Clinical examination for the subjects in Clinical Sciences shall be conducted to test the knowledge and competence of the candidates for undertaking independent work as a specialist/Teacher, for which candidates shall examine a minimum one long case and two short cases.

The total marks for Practical / clinical examination shall be 200.
12.1.4 **Viva Voce:** Viva Voce shall be thorough and shall aim at assessing the candidate knowledge and competence about the subject, investigative procedures, therapeutic technique and other aspects of the speciality, which form a part of the examination.

The total marks shall be 100 and the distribution of marks shall be as under:

i) For examination of all components of syllabus 80

ii) For Pedagogy 20

If there is skills evaluation, 10 marks shall be reserved for Pedagogy and 10 marks for skill evaluation.

12.1.5 **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.

12.1.6 **Criteria for declaring as pass in University Examination:** A candidate shall pass theory and practical including clinical and viva-voce examination separately and shall obtain 40% marks in each theory paper and not less than 50% marks cumulatively in all the four papers for post graduate degree examination to be declared as pass.

A candidate obtaining less than 40% marks in any paper and obtaining less than 50% of marks cumulatively in all the four papers for post graduate degree examination shall be declared to have failed in the examination. Failed candidate may appear in any subsequent examination upon payment of fresh fee to the Controller of Examinations.

12.1.7 **Declaration of class:** A successful candidate passing the University examination in first attempt and secures grand total aggregate 75% of marks or more will be declared to have passed the examination with distinction, 65% but below 75% declared as First Class and 50% but below 65% declared as Second Class.

A candidate passing the University examination in more than one attempt shall be declared as Pass Class irrespective of the percentage of marks.
12.2 Post Graduate Diploma Examinations

Diploma examination in any subject shall consist of theory (written papers), Practical / Clinical and Viva - Voce.

12.2.1 Theory: There shall be three written question papers each carrying 100 marks. Each paper will be of three hours duration. In clinical subjects one paper out of this shall be on basic medical sciences. In basic medical subjects and Para- clinical subjects, questions on applied clinical aspects shall also be asked.

Pattern of Theory Examination Question Paper:
Each paper shall consist of two long essay questions each carrying 20 marks, 3 short essay questions each carrying 10 marks and 6 short answer questions each carrying 5 marks. Total marks for each paper shall be 100.

12.2.2 Practical Clinical Examination: In case of practical examination it shall be aimed at assessing competence, skills related to laboratory procedures as well as testing students ability to make relevant and valid observations, interpretation of laboratory or experimental work relevant to his/her subject.

In case of clinical examination, it shall aim at examining clinical skills and competence of candidates for undertaking independent work as a specialist. Each candidate shall examine at least one long case and two short cases.

The maximum marks for Practical / Clinical shall be 150.

Viva Voce Examination: Viva Voce examination shall be thorough and shall aim at assessing the candidate’s knowledge and competence about the subject, investigative procedures, therapeutic technique and other aspects of the speciality, which shall from a part of the examination. The total marks shall be 50.

12.2.3 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.
12.2.4 **Criteria for declaring as pass in University Examination:** A candidate shall pass theory and practical including clinical and viva-voce examination separately and shall obtain 40% marks in each theory paper and not less than 50% marks cumulatively in all the three papers for post graduate diploma examination to be declared as pass.

A candidate obtaining less than 40% marks in any paper and obtaining less than 50% of marks cumulatively in all the three papers for post graduate diploma examination shall be declared to have failed in the examination. Failed candidate may appear in any subsequent examination upon payment of fresh fee to the Controller of Examinations.

12.2.5 **Declaration of class:** A successful candidate passing the University examination in first attempt and secures grand total aggregate 75% of marks or more will be declared to have passed the examination with distinction, 65% but below 75% declared as First Class and 50% but below 65% declared as Second Class.

A candidate passing the University examination in more than one attempt shall be declared as Pass Class irrespective of the percentage of marks.

13. **Number of candidates per day**

The maximum number of candidates to be examined in Clinical/practical and Oral on any day shall not exceed eight for M.D./M.S. degree, eight for diploma.
CHAPTER II
GOALS AND GENERAL OBJECTIVES OF POSTGRADUATE MEDICAL EDUCATION PROGRAM

GOAL

The goal of postgraduate medical education shall be to produce competent specialists and/or medical teachers:

1. Who shall recognize the health needs of the community and carry out professional obligations ethically and in keeping with the objectives of the national health policy.
2. Who shall have mastered most of the competencies, pertaining to the speciality, that are required to be practiced at the secondary and the tertiary levels of the health care delivery system.
3. Who shall be aware of the contemporary advance and developments in the discipline concerned.
4. Who shall have acquired a spirit of scientific inquiry and is oriented to the principles of research methodology and epidemiology and
5. 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:

1. Recognize the importance to the concerned speciality in the context of the health needs of the community and the national priorities in the health section.
2. Practice the speciality concerned ethically and in step with the principles of primary health care.
3. Demonstrate sufficient understanding of the basic sciences relevant to the concerned speciality.
4. 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 primitive measure/strategies.
5. Diagnose and manage majority of the conditions in the speciality concerned on the basis of clinical assessment, and appropriately selected and conducted investigations.
6. Plan and advice measures for the prevention and rehabilitation of patients suffering from disease and disability related to the speciality.

7. Demonstrate skills in documentation of individual case details as well as morbidity and mortality rate relevant to the assigned situation.

8. Demonstrate empathy and humane approach towards patients and their families and exhibit interpersonal behaviour in accordance with the societal norms and expectations.

9. Play the assigned role in the implementation of national health programme, effectively and responsibly.

10. Organize and supervise the chosen/assigned health care services demonstrating adequate managerial skills in the clinic/hospital or the field situation.

11. Develop skills as a self-directed learner, recognize continuing education needs; select and use appropriate learning resources.

12. Demonstrate competence in basic concepts of research methodology and epidemiology, and be able to critically analyze relevant published research literature.

13. Develop skills in using educational methods and techniques as applicable to the teaching of medical/nursing students, general physicians and paramedical health workers.

14. Function as an effective leader of a health team engaged in health care, research or training.

**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 POSTGRADUATE CURRICULUM:**

The major components of the Postgraduate curriculum shall be:

- Theoretical knowledge
- Practical and clinical skills
- Thesis skills.
- Attitudes including communication skills.
- Training in Research Methodology, Medical Ethics and Medicolegal aspects.

(Source: Medical Council of India, Regulations on Postgraduate Medical Education, 2000)
CHAPTER III
Monitoring Learning Progress

It is essential to monitor the learning progress of each candidate through continuous appraisal and regular assessment. It not only helps teachers to evaluate students, but also students to evaluate themselves. The monitoring shall 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 outcome to be assessed should include:
1. Personal Attitudes.
2. Acquisition of Knowledge.
3. Clinical and operative skills and
4. Teaching skills.

1. **Personal Attitudes:** The essential items are:
   a) Caring attitude.
   b) Initiative.
   c) Organisational ability.
   d) Potential to cope with stressful situations and undertake responsibility.
   e) Trust worthiness and reliability.
   f) To understand and communicate intelligibly with patients and others.
   g) To behave in a manner that establishes professional relationships with patients and colleagues.
   h) Ability to work in a team.
   i) 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.

2. **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.
a) **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 III)

b) **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 III)

c) **Clinico-pathological conferences.** This should be a multidisciplinary 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 check list similar to that used for seminar.

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

3. **Clinical skills:**

   a. **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 III).

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

   c. **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 log book. (Table No.3, Chapter III).

4. **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 III).
5. **Periodic tests:** In case of degree courses of three years duration, the department may conduct three tests, 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. In case of diploma courses of two year duration, the departments may conduct two tests. One of them at the end of first year and the other in the second year, three months before the final examination. The tests may include written papers, practical / clinical and viva voce.

6. **Work diary:** 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.

7. **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.

8. **Log book:** The log book 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 log book for the different activities is given in Tables 1, 2 and 3 of Chapter III. 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 counseled 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 fulfill the require ments in spite of being given adequate chances to set him or herself right.
# 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:**

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Items for observation during presentation</th>
<th>Poor 0</th>
<th>Below Average 1</th>
<th>Average 2</th>
<th>Good 3</th>
<th>Very Good 4</th>
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<tbody>
<tr>
<td>1.</td>
<td>Article chosen was</td>
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<td>2.</td>
<td>Extent of understanding of scope &amp; objectives of the paper by the candidate</td>
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<td>3.</td>
<td>Whether cross references have been consulted</td>
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<td>4.</td>
<td>Whether other relevant publications consulted</td>
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<td>5.</td>
<td>Ability to respond to questions on the paper / subject</td>
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<td>6.</td>
<td>Audio-visual aids used</td>
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<td>7.</td>
<td>Ability to defend the paper</td>
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<td>8.</td>
<td>Clarity of presentation</td>
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<td>9.</td>
<td>Any other observation</td>
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**Total Score**
Name of the Student:

Name of the Faculty/Observer:

Date:

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

MODEL CHECK LIST FOR EVALUATION OF
CLINICAL WORK IN WARD / OPD

(To be completed once a month by respective Unit Heads, including posting in other departments)

Name of the Student:

Name of the Faculty/Observer:

Date:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Points to be considered</th>
<th>Poor 0</th>
<th>Below Average 1</th>
<th>Average 2</th>
<th>Good 3</th>
<th>Very Good 4</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Regularity of attendance</td>
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<td>2.</td>
<td>Punctuality</td>
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<td>3.</td>
<td>Interaction with colleagues and supportive staff</td>
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<td>4.</td>
<td>Maintenance of case records</td>
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<tr>
<td>5.</td>
<td>Presentation of cases during rounds</td>
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<td>6.</td>
<td>Investigations work up</td>
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<td>7.</td>
<td>Beside manners</td>
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<td>8.</td>
<td>Rapport with patients</td>
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<tr>
<td>9.</td>
<td>Counseling patient's relatives for blood donation or Postmortem and Case follow up.</td>
<td></td>
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<td>10.</td>
<td>Overall quality of ward work</td>
<td></td>
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</table>

Total Score
**Check List - IV**

**EVALUATION FORM FOR CLINICAL PRESENTATION**

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

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

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

**MODEL CHECK LIST FOR DISSERTATION PRESENTATION**

**Name of the Student:**

**Name of the Faculty:**

**Date:**

<table>
<thead>
<tr>
<th>SI No</th>
<th>Points to be considered divine</th>
<th>Poor 0</th>
<th>Below Average 1</th>
<th>Average 2</th>
<th>Good 3</th>
<th>Very Good 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Interest shown in selecting a topic</td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
<td>Appropriate review of literature</td>
<td></td>
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<tr>
<td>3.</td>
<td>Discussion with guide &amp; other faculty</td>
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<td>4.</td>
<td>Quality of Protocol</td>
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<td>5.</td>
<td>Preparation of proforma</td>
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</table>

**Total Score**
### Check List - VII

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

**Name of the Student:**  

**Name of the Faculty:**  

**Date:**

<table>
<thead>
<tr>
<th>SI No</th>
<th>Items for observation during presentations</th>
<th>Poor 0</th>
<th>Below Average 1</th>
<th>Average 2</th>
<th>Good 3</th>
<th>Very Good 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Periodic consultation with guide/co-guide</td>
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<tr>
<td>2.</td>
<td>Regular collection of case Material</td>
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<td>3.</td>
<td>Depth of analysis / discussion</td>
<td></td>
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<td>4.</td>
<td>Departmental presentation of findings</td>
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<td>5.</td>
<td>Quality of final output</td>
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<td>6.</td>
<td>Others</td>
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**Total Score**
LOG BOOK

Table 1: Academic activities attended

<table>
<thead>
<tr>
<th>Name:</th>
<th>Admission Year:</th>
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</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Type of Activity Specify Seminar, Journal Club, Presentation, UG teaching</th>
<th>Particulars</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
Table 2: Academic presentations made by the student

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Type of Presentation Specify Seminar, Journal Club, Presentation, UG teaching</th>
</tr>
</thead>
<tbody>
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</table>
**LOG BOOK**

**Table 2**: Diagnostic and Operative procedures performed

<table>
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<tr>
<th>Date</th>
<th>Name</th>
<th>ID No.</th>
<th>Procedure</th>
<th>Category O, A, PA, PI*</th>
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<tbody>
<tr>
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*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
Model Overall Assessment Sheet

Academic Year:

<table>
<thead>
<tr>
<th>SI No</th>
<th>Faculty Member &amp; Others</th>
<th>Name of Student and Mean Score*</th>
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<tr>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1.</td>
<td>Journal Review Presentations</td>
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</tr>
<tr>
<td>2.</td>
<td>Seminars</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Clinical work in wards</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Clinical presentation</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Teaching skill practice</td>
<td></td>
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<tr>
<td></td>
<td>Total Score</td>
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</tbody>
</table>

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 IV
Medical Ethics
Sensitisation and Practice

Introduction

There is now a shift from the traditional individual patient-doctor relationship and medical care. With the advances in science and technology and the needs of patients, their families and the community, there is an increased concern with the health of society. There is a shift to greater accountability to the society. Doctors and health professionals are confronted with many ethical problems. It is, therefore necessary to be prepared to deal with these problems. To accomplish the Goal and General Objective stated in Chapter II and develop human values it is urged that ethical sensitisation be achieved by lectures or discussion on ethical issues, clinical discussion of cases with an important ethical component and by including ethical aspects in discussion in all case presentation, bedside rounds and academic postgraduate programmes.

Course Contents

1. Introduction to Medical Ethics

- What is Ethics?
- What are values and norms?
- Relationship between being ethical and human fulfillment.
- 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 = fraternity
  - Justice = equality
  - Self determination (autonomy) = liberty

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 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 Intra-fallopian Transfer (SIFT).
- Gamete Intra-fallopian Transfer (GIFT).
- Zygote Intra-fallopian 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. Profession 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 / humaneness.
- 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.

Recommended Reading

1. Francis C.M., Medical Ethics, 1 Ed, 1993, Jaypee Brothers, New Delhi, p 189, Rs. 150/-


4. CPCSEA Guidelines 2001 (www.cpcsea.org.)


CHAPTER V
SYLLABUS

I. Goal:
The student who has obtained MD degree in Biochemistry should be well-versed in basic concepts and recent advances in the subject and should 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 should 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.

II. Objectives
At the end of the MD training programme in Biochemistry, the post graduate student should have acquired competencies in the following areas, as detailed below.

1. Acquisition of knowledge
The student should 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 should 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 postgraduate post graduate students.

SUBJECT SPECIFIC COMPETENCIES

The student during the training programme should acquire the following 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 macro-nutrition 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, analyze 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 should 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.

Outline of course contents.

III. Theory

Paper I - Biomolecules, cell biology, biochemical techniques, 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, properties and functions of amino acids and peptides
  - Structural organization of proteins and relationship with their functions
  - Primary, secondary, tertiary and quarternary structure of proteins
  - Methods of study of structure of proteins and different levels of structural organization
  - Methods of determination of molecular weight of proteins
  - Protein folding and denaturation
  - Biologically important peptides, conjugated proteins, lipoproteins and glycoproteins
Structure-function relationship of proteins
  - Structure and functions of hemoglobin and myoglobin
  - Structure and function of collagen & Insulin
  - Structure and function of immunoglobulins
Classification, Structure, functions, properties and reactions 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.
  - Chemistry of steroids
  - Biological membranes - structure, function, properties and importance.
  - Micelles and liposomes
    - Nucleotides and nucleic acids
o Purine and pyrimidine bases in DNA and RNA
o Nucleosides and nucleotides
o Physiologically important nucleotides
o Synthetic analogues of purine/pyrimidine bases and nucleosides used as therapeutic agents (anti-cancer drugs, anti-viral drugs)

o Watson and Crick model of DNA structure
o Structure and functions of different types of RNA.

o Methods of study of base sequence of DNA. Structure and functions of gene with respect to mammalian genome, recombinant DNA technology. General principles of blotting techniques. PCR and its application in medicine. Principle, procedure and application of RFLP, Transgenic animals and knock out animal

Biophysical Chemistry pH, buffers, Henderson – Hasselbalch equation, principles and procedures of determination of pH, pO₂, pCO₂ (blood gas analysis).

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

Biochemical techniques
- Spectrophotometry (UV and visible spectrophotometry),
- Ultra centrifugation techniques: Their applications in the study of lipoproteins
- Radio immuno assay: competitive binding assay – Principles procedure and applications.
  - Elisa – Principles and applications
- Cell fractionation: Isolation and purification of sub cellular particles, biochemical markers of
  - different subcellular organelles
- Osmometry, Nephelometry, Blood gas analyzer
- Atomic absorption spectrophotometry
- Flame photometry
- Fluorometry
- Turbidimetry and nephelometry
- Gravimetry
- Electrochemistry (pHelectrodes, 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])
- 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
- Recent advances in medical laboratory technology and instrumentation: semi auto analyser, auto analyzer, PCR etc.
- Nanotechnology and microfabrication
  - Techniques to study in vivo metabolism - NMR, SPECT, PET scans, etc
- Radioisotope-based techniques and its applications
  - Isotopes – detection and measurement of stable and radioactive isotopes.

**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 paper setting, methods of assessing knowledge, appropriate use of media, microteaching, small group teaching.
- Environmental Biochemistry:
  - Health and pollution.

**Paper–II: Enzymes, bioenergetics, biological oxidation, intermediary metabolism and regulation, inborn errors of metabolism and nutrition**

**Enzymes:**
- Properties, classification, mechanism of action, coenzymes and cofactors, kinetics of enzyme activity, regulation of enzyme activity, isoenzymes, diagnostic and therapeutic enzymes, principles of assays of enzymes, enzymes as therapeutic targets of drugs.
- Enzyme inhibition – competitive, non-competitive, uncompetitive and allosteric, mechanism and application. Enzyme poisons.
- Immobilized enzymes – application.
Factors affecting enzyme catalyzed reactions, Michaelis – Menten constant, Lineweaver – Burk plot, Edee-Hofstee plot.

**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
- OXPHOS diseases

Integration of metabolic pathways of carbohydrate, protein and lipid. Regulation of metabolic pathways

*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
- 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
- Role of lipids in atherogenesis
- Metabolism of phospholipids and associated disorders
- Hyper and hypolipoproteinemias.

*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
• Synthetic analogues of purine/pyrimidine bases and nucleosides used as therapeutic agents

**Metabolism of haem**
• Biosynthesis of heme and associated disorders
• Degradation of heme and associated disorders

**Metabolism in individual tissues and in the fed and fasting states**
   Liver, adipose tissue, brain, RBCs

**Nutrition**
• Principal food components
• General nutritional requirements
• Energy requirements
• Biological value of proteins
• Thermogenic effect of food
• Balanced diet, diet formulations in health and disease, mixed diet
• Nutritional supplements
• Food toxins and additives
• Parenteral nutrition
• Disorders of nutrition, obesity, protein and protein energy malnutrition, dietary fibers, under-nutrition, laboratory diagnosis of nutritional disorders
• National Nutrition Programme.
• Energy metabolism – BMR, RQ. Energy requirement at different stages, balanced diet. Diet planning in health and disease, SDA of foods.
• Malabsorption syndromes,
• Diet formulation in health and disease: pregnancy and lactation, diabetes, obesity, coronary artery disease, chronic kidney disease, cancer, hypertension, anemia, rickets, osteomalacia, mixed diet, food toxins and additives

**Vitamins**
   Classification, biochemical role, sources, RDA and deficiency state of each vitamin (including diagnostic tests for deficiency and treatment)

**Minerals**
   Classification, biochemical role, sources, requirement and deficiency state of each mineral (including diagnostic tests for
deficiency and treatment)

Metabolism of xenobiotics

Free radicals and anti-oxidant defence systems in the body and associations with disease processes

Paper III:
Molecular biology, molecular and genetic aspects of cancer, immunology and effects of environmental pollutants on the body
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 and phages.
• Genomic and cDNA libraries.
• Applications of recombinant DNA technology in medicine.
• Gene therapy
• Diagnosis of genetic diseases and genetic counseling
• 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
• karyotyping, fetal lung maturity testing, Nucleic acid hybridization,
• Genetic engineering

**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
• Tumor 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

Specialized tissues
i) Muscle tissue – composition, mechanism of muscle contraction.
ii) Nerve tissue – composition, transmission of nerve impulse, neurotransmitters.
iii) Erythrocytes – composition and metabolism, blood clotting, other blood cells. Phagocytosis.
iv) Connective tissue – composition, chemistry of collagen, elastin and other fibrous proteins.
v) Adipose tissue including brown adipose tissue metabolism.
vi) Bone and teeth – composition, osteocalcin.
vii) Composition of lens – biochemical changes during cataractogenesis.
viii) Structure of biomembranes, transport across membranes.
**Paper IV**

**Clinical biochemistry and molecular diagnostics related to different body systems/organs, endocrinology, and recent advances in biochemistry**

**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, quality management, clinical laboratory informatics.

**Analytical techniques and instrumentation**

Principles of basic techniques used in a clinical biochemistry laboratory (spectrophotometry, electrochemistry, electrophoresis, osmometry, chromatography, mass spectrometry, immunochemical techniques, molecular techniques, automation, point of care testing,

**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
- Electrolytes
- Blood gases and pH
- Hormones and associated disorders
- Catecholamines and serotonin
- Vitamins; trace and toxic elements
- Hemoglobin, 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
- Newborn screening
- Inborn errors of metabolism
- Hemostasis
- Therapeutic drug monitoring
- Clinical toxicology
- Molecular diagnostics
- Body fluid analyses
- Diabetes mellitus: recent concepts.
- Biochemistry of aging

**Regulation of fluid and electrolyte balance and associated disorders**

**Regulation of acid-base balance and associated disorders**
**Biochemistry of the endocrine system**
- Classification and general mechanism of action of hormones
- Biosynthesis, secretion, regulation, transport and mode of action of hypothalamic peptides, adenohypophyseal 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
- Hemolytic anaemia - inherited defects in RBC membrane and enzymes (G6PD deficiency), immunologic causes of hemolysis
- ABO blood group system - biochemical basis, transfusion biology.
- Plasma cell disorders - multiple myeloma.

**Hemostasis 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

**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

**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

**By the end of the course, the post graduate student should have acquired practical skills in the following:**

**Practical**

**Part I – General Biochemistry**

1. Performance of reactions of carbohydrates, amino acids and proteins, and lipids
2. Estimation of phosphorus by Fiske Subbarao method
1. Experiments to demonstrate normal and abnormal constituents of urine
2. Estimation of proteins by Folin’s method and dye binding method
5. Amino acid – paper chromatography, TLC. Two dimensional paper chromatography
7. Absorption spectra of phenylalanine, tyrosine, tryptophan (UV).
8. Ion exchange chromatography of amino acids.
10. Separation of mono and disaccharides by paper chromatography.
13. Estimation of vitamin C.
14. Estimation of vitamin A.
15. Estimation of vitamin E.
17. Enzyme inhibitions.
18. Effect of pH, temperature on enzyme activity: Determination of Km, Vmax.
22. Affinity chromatography
23. Isolation of DNA from Mammalian Tissue using Phenol chloroform method & Kit Method
24. Estimation of DNA Content by UV-Visible spectrophotometry & Determination of Purity of DNA
25. Design of Primers using manual procedures as well as primer 3 software
26. DNA amplification using PCR
27. ELISA
28. Estimation of Antioxidant activity using a) FRAP- ferric reducing antioxidant power
29. b) DPPH- 2,2 Diphenyl-1-picryl hydrazyl method.

Part – II: Clinical Biochemistry

1. Albumin / globulin ratio.
2. Serum calcium.
3. Serum bilirubin – direct and total.
4. Alkaline & acid phosphatases.
5. Serum amylase – Somogyi amylolytic method
6. Fe, Fe binding capacity.
15. Lipoproteins – electrophoresis.
16. 17-ketosteroids in urine.
17. Estriol – by fluorimetry.
18. Creatinine clearance.
19. blood glucose and glycated haemoglobin;
20. performance of glucose tolerance test
21. electrolytes, arterial blood gas analysis,
22. cholesterol, triglycerides, free fatty acids, phospholipids, Lp (a),
23. urea, creatinine, uric acid, ammonia,
24. microalbuminuria
25. parameters of liver function tests (bilirubin, hepato-biliary enzymes such as AST, ALT, ALP, GGT, serum proteins/albumin and prothrombin time)
26. Calcium, magnesium, copper (and ceruloplasmin), serum iron, TIBC and ferritin
27. markers of myocardial damage (CK, CK MB, troponins, LDH)
28. other enzymes of diagnostic relevance (eg. phosphatases, amylase etc)
29. vitamins D and B₁₂ and folate
30. Electrophoresis of serum proteins
31. Electrophoresis of lipoprotein (Optional)
32. Electrophoretic separation of LDH isozymes or any other isoenzymes
33. CSF analysis
34. Thyroid function tests and other hormone assays by ELISA/RIA
35. Preparation of buffers.

Clinical Laboratory
- Taking any one parameter, students should prepare a Levy Jennings chart and plot inter-assay and intra-assay variation for the laboratory.
- Implementation of Westgard rules.

Optional:
- Determination of reference values for any one parameter for the clinical laboratory

In addition, all efforts should be made to ensure that students at least see a demonstration of the following techniques.
- 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 proteins and nucleic acids
- Basic techniques in cell culture
- High performance liquid chromatography (HPLC)

IV. Practical Training in Biochemistry: (First half of 1st year)
1. Introduction to research methodology and bio statistics. Every postgraduate student should be given an introductory course in research methodology and research techniques. He / she must be taught as to how a research project can be planned and implemented. He / she must also acquire a basic knowledge in the statistical methods and their applications.
2. The postgraduate student will be posted in departments of:
   a) Medicine    Months
   b) Paediatrics  30 days
   c) Nephrology   15 days
c) Gastroenterology  15 days  
d) Obstetrics & Gynaec  15 days  
e) Cardiology  15 days  
f) Haematology  30 days  
g) Microbiology  30 days  

The student has to attend the clinical postings in the forenoon from 09.00 am to 12.00 noon and return back to the department of biochemistry, to do the experimental work in the afternoon. They shall not be posted for any duties in the clinical departments.

Every post graduate student shall be posted for six months to the clinical biochemistry laboratory of the department where clinical investigations of the attached hospital are done, from 9.00 AM to 1.00 pm every day on all days, including holidays, in the 2nd year and 3rd year. The post graduate students may also be posted at the clinical biochemistry laboratory for night duties during the 2nd and 3rd academic year.

Skills to be acquired during the clinical/laboratory postings

Clinical postings: During posting in clinical departments, the student should acquire relevant knowledge and skills. These generally include:
1. Taking the history, Clinical examination of a patient and presenting the case.
2. Investigations to be carried and their relevance.
3. Drawing of blood, collection of urine and / or other relevant specimens of 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.

Clinical biochemistry laboratory posting:

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; towards this end, it would help if they are posted in the laboratory out of regular hours as well.

Practical – Observation book and Practical record:

Post graduate student should maintain an observation book, practical record for general & clinical biochemistry, separately of all practical carried out during the course. The practical exercises shall be carried out under the supervision of the assigned teaching staff (assistant professor and above) and get them approved after the completion of each exercise. At the end of the 3rd year, the practical records have to be submitted to the Head of the Department for certification. The observation book and the practical records, along with the log books and diary are to be presented compulsorily, to the examiners at the University examination.
VI. Seminars, Journal Clubs

Students of biochemistry are expected to actively participate in the departmental seminars and journal clubs. A record should be maintained for each student and the list of seminars and paper presented in journal club by each student should be presented at the time of University examination. The journal club and the subject seminars shall be held on alternate weeks.

Post graduate students should participate in undergraduate teaching, in theory, practical and tutorials.

Each of the above activities are to be assessed as per the annexures.

VII. Dissertation – Synopsis & Dissertation

The synopsis of the dissertation should be submitted within 6 months from the date of commencement of course. Every student should submit a dissertation on a selected research problem involving laboratory investigations. The dissertation has to be prepared by the student, in consultation with the allotted guide and submitted to the University 6 months prior to the final examination, as notified by the University.

VIII. Log Book:
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.

IX. Department should encourage e-learning activities.

X. Periodical Assessment

Formative assessment during the training FORMATIVE ASSESSMENT, ie., during the training

General Principles
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 practical/clinical 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 periodic internal assessment shall be conducted once a year as follows:

1. Internal assessment (at the end of twelve months).
2. Internal assessment (at the end of twenty four months).
3. Internal assessment (at the end thirty two months).
XI. Scheme of Examination

A. Theory – There shall be four papers of 100 marks each. Each paper shall be of three hours duration. Each paper shall have two long essay questions of 20 marks (20 x 2 = 40), three short essay of 10 marks (10 x 3 = 30) and six short answer questions of 5 marks (5 x 6 = 30).

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


Paper – II - Enzymes, bioenergetics, biological oxidation, metabolism of biomolecules, intermediary metabolism and regulation, inborn errors of metabolism and nutrition

Paper – III - Molecular biology, molecular and genetic aspects of cancer, immunology and effects of environmental pollutants on the body

Paper – IV - Clinical biochemistry and molecular diagnostics related to different body systems/organs, endocrinology, and recent advances in biochemistry

* 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.

Questions on recent advances may be asked in any or all papers

WEIGHTAGE OF MARKS IN EACH PAPER

<table>
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<tr>
<th>Paper I</th>
<th>Topic</th>
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<tbody>
<tr>
<td></td>
<td>Biomolecules</td>
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<td>cell biology</td>
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<td>Biochemical techniques</td>
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<td>Biostatistics</td>
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<td>Basics of Medical education</td>
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<td>Biological oxidation</td>
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<td>Integration of metabolic pathways</td>
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<td>Metabolism in fed and fasting state</td>
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<td>Amino acid metabolism</td>
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<td>Nucleotide Metabolism</td>
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<td>Nutrition</td>
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<td>Vitamins &amp; minerals</td>
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<td>Antibiotics</td>
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**Paper III**

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<td>Human genetics</td>
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<td>Stem cells</td>
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<td>Cancer</td>
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<td>Immunology</td>
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<td>Specialised tissue</td>
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**Paper IV**

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<th>Topic</th>
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<td>Principals and practice of Clinical Biochemistry</td>
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<tr>
<td>Analytical techniques &amp; Instrumentation</td>
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<tr>
<td>Clinical correlation and procedure</td>
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<td>Fluid and electrolyte balance and disorders</td>
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<td>Regulation of acid base balance and disorders</td>
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<td>Biochemistry of endocrine system</td>
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<td>Hematopoietic disorders &amp; Hemostasis and thrombosis</td>
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<td>Cardiovascular, respiratory, renal, Liver, and gastric, Liver, Nervous, Bone and mineral metabolism</td>
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**B. Practical Examination: 200 marks**

**Duration:** Two days

**Part – I** - Clinical examination of a patient and listing of relevant investigations in clinical biochemistry.

**Part – II** - Laboratory procedures in general biochemistry.

The assignment of work under part I and part II should begin on first day and the candidate is expected to complete the work by forenoon on second day, so that viva voce
Part I – Clinical Examination & Clinical Chemistry Experiments

Each candidate is expected to take the history, perform clinical examination, list the laboratory investigations and present the case to the examiners. The examiners would select two or three laboratory investigations, which the candidate will perform.

Clinical examination and discussion (30 minutes) 25 Marks

Clinical biochemistry (Three relevant biochemical investigations which includes preparation of standard graph, estimation of a relevant analyse in blood /plasma/ serum / or other body fluids) and Quality Control, its interpretation and Method validation 75 Marks

Part II – General Biochemistry

<table>
<thead>
<tr>
<th></th>
<th>1 Qualitative analysis of any biological fluid (urine, CSF, pleural fluid) – interpretation and discussion.</th>
<th>20 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Experiments on enzymes kinetics. ex. determination of pH optimum or Km value or temperature optimum or Vmax etc.</td>
<td>40 Marks</td>
</tr>
<tr>
<td>3</td>
<td>Experiments involving chromatography or electrophoresis to be given, separation and identification of amino acids or carbohydrates by chromatography or separation and interpretation of serum proteins, lipoproteins, isoenzymes of (LDH &amp; CPK) by electrophoresis to be given.</td>
<td>40 Marks</td>
</tr>
</tbody>
</table>

TOTAL 100 Marks

C. Viva – Voce 100 Marks

1) Viva-Voce Examination: 80 Marks

Viva voce examination will be conducted conjointly by all the examiners to test comprehension, analytical approach, expression and interpretation of facts. Student shall also be given case reports, charts for interpretation. It includes discussion on dissertation.

2) Pedagogy Exercise: 20 Marks

A topic would be given to each candidate along with the practical examination question paper on the first day. Student is asked to make a presentation on the topic on the second day for 8 – 10 minutes.
<table>
<thead>
<tr>
<th>Maximum marks for</th>
<th>Theory</th>
<th>Practical</th>
<th>Viva-Voce+Pedagogy</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>MD Biochemistry</td>
<td>400</td>
<td>200</td>
<td>(80 + 20)</td>
<td>700</td>
</tr>
</tbody>
</table>

**X. Recommended Books and Journals**

3. Colleen Smith, Allan D Marks, Michael Lieberman, Marks Basic Medical Biochemistry- A clinical approach; Lippincot Williams; 2nd edition; 2005.
8. Robert F. Dons and Frank H Wians; Endocrine and Metabolic Disorders; Clinical laboratory testing; CRC Press; 4th edition; 2009.

**Journals and other periodicals:**

1. Annual Review of Biochemistry
2. Clinical Chemistry (J).
5. Medical Biochemistry (J).
6. Recent Advances in Endocrinology and Metabolism.
7. Essays in Biochemistry, Biochemical Society, UK.
9. Indian Journal of Medical Research (J).

Postgraduate Students Appraisal Form Pre / Para / Clinical Disciplines

**Name of the Department/Unit:**

**Name of the PG Student:**

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

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>PARTICULARS</th>
<th>Not Satisfactory</th>
<th>Satisfactory</th>
<th>More Than Satisfactory</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Journal based / recent advances learning</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Patient based / Laboratory or Skill based learning</td>
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<tr>
<td>3</td>
<td>Self directed learning and teaching</td>
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<tr>
<td>4</td>
<td>Departmental and interdepartmental learning activity</td>
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<tr>
<td>5</td>
<td>External and Outreach Activities / CMEs</td>
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<tr>
<td>6</td>
<td>Thesis / Research work</td>
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<td>7</td>
<td>Log Book Maintenance</td>
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</tbody>
</table>

**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 CONSULTANT | SIGNATURE OF HOD |