



BLDE

(DEEMED TO BE UNIVERSITY)

Competency Based Medical Education

(CBME)

PG CURRICULUM

2019-20

MD Biochemistry

Published by

BLDE

(DEEMED TO BE UNIVERSITY)

Declared as Deemed to be University u/s 3 of UGC Act, 1956

The Constituent College

SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.

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SHRI B. M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE

BLDE(DU)/REG/PG-Curr/2019-20/268

May 06, 2019

NOTIFICATION

Sub: Competency Based Medical Education (CBME) based Revision of Post Graduate Curriculum

- Ref: 1. Medical Council of India Regulation on Graduate Medical Education, 1997 and subsequent amendments of the same from time to time.
2. Minutes of the 28th meeting Academic Council of the University held on April 26, 2019.
3. Minutes of the 47th meeting Board of Management held on May 04, 2019.

The Board of Management of the University is pleased to approve the CBME based Revised Curriculum for Post Graduate Degree Course at in its 47th meeting held on May 04, 2019.

The Revised Curriculum shall be effective, from the Academic Session 2020-21 onwards, for Post Graduate Degree Course in the Constituent College of the University viz. Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapura.

REGISTRAR
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BLDE (Deemed to be University)
Vijayapura-586103, Karnataka.

To,

The Dean, Faculty of Medicine and Principal
Shri B. M. Patil Medical College,
Hospital and Research Centre,
Vijayapura

Copy to:

- The Secretary, UGC, New Delhi
- The Secretary, MCI
- The Controller of Examinations
- The Vice Principal
- The Vice Principal (Academics)
- The Prof. & HODs Pre, Para and Clinical Departments
- The Co-ordinator, IQAC
- PS to the Hon'ble Chancellor
- PS to the Hon'ble Vice-Chancellor

Smt. Bangaramma Sajjan Campus, B. M. Patil Road (Sholapur Road), Vijayapura - 586103, Karnataka, India.

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Our Vision

“To be a Leader and be recognized as an Institution striving for maintenance and enhancement of Quality Medical Education and Healthcare”

Our Mission

- To be committed to promote sustainable development of higher education including Health science education, consistent with the statutory and regulatory requirements.
- Reflect the needs of changing technology and make use of the academic autonomy to identify the academic programs that are dynamic.
- Adopt global concepts in education in the healthcare sector.

Section - I

Goals and General Objectives of Postgraduate Medical Education Program

Goal

The goal of postgraduate medical education shall be to produce a competent specialist and / or a medical teacher as stated in the Post Graduate Medical Education Regulations 2000 and its amendments thereof [May2018]

- (i) 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.
- (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
- (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) Recognize the importance of the concerned specialty in the context of the health need of the community and the national priorities in the health sector.
- (ii) Practice the specialty concerned ethically and in step with the principles of primary health care.
- (iii) Demonstrate sufficient understanding of the basic sciences relevant to the concerned specialty.
- (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 specialty 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 specialty.
- (vii) Demonstrate skills in documentation of individual case details as well as morbidity and mortality data relevant to the assigned situation.
- (viii) Demonstrate empathy and humane approach towards patients and their families and exhibit interpersonal behavior in accordance with the societal norms and expectations.

- (ix) Play the assigned role in the implementation of national health programs, effectively and responsibly.
- (x) Organize and supervise the chosen/assigned health care services demonstrating adequate managerial skills in the clinic/hospital or the field situation.
- (xi) Develop skills as a self-directed learner; recognize continuing educational needs, select and use appropriate learning resources.
- (xii) Demonstrate competence in basic concept of research methodology and epidemiology, and be able to critically analyse relevant published research literature.
- (xiii) Develop skills in using educational methods and techniques as applicable to the teaching of medical/nursing students, general physicians and paramedical health workers.
- (xiv) Function as an effective leader of a 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 program 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 writing thesis/research articles
- Attitudes, including communication.
- Training in research methodology, medical ethics & medicolegal aspects
- Teaching skills to the undergraduates, juniors and support teams

Source: Medical Council of India, Regulations on Postgraduate Medical Education, 2000. [amended upto May 2018]

Eligibility for Admission:

1. Post graduate degree course:

The candidate seeking admission should have passed MBBS from a college recognized by Medical Council of India.

As per requisites of statutory bodies & as laid out in Post graduate regulations of MCI & its amendments thereof, the minimum percentage of marks obtained in the entrance test

conducted by competent authority shall be as per MCI regulations & its amendments as applicable time to time.

Eligibility for Foreign / PIO / NRI students will be based on qualifying examination marks and MCI amendments as applicable at the time of selection and admission process.

Candidates seeking admission to superspeciality [M.Ch]

The candidate seeking admission to superspeciality course should have passed MS/MD in concerned subjects (As per MCI regulations & its amendments thereof) or passed DNB in concerned broad specialities & should fulfill requirements of MCI regulations.

2. As per requisites of statutory bodies & as laid out in Post graduate regulations of MCI & its amendments thereof, the minimum percentage of marks obtained in the entrance test conducted by competent authority shall be as per MCI regulations & its amendments as applicable time to time.

Eligibility for Foreign / PIO / NRI students will be based on qualifying examination marks and MCI amendments as applicable at the time of selection and admission process.

The MCI norms to qualify for Admissions

Candidates seeking admission to these Post Graduate Degree courses should have passed M.B.B.S. recognized by Medical Council of India or equivalent qualification and should have obtained permanent Registration from the Medical Council of India or any of the State/ Medical council or candidate should register the same within one month from the date of admission, failing which the admission of the candidate shall be cancelled. Provided that in the case of a foreign national, the MCI may on the payment of prescribed fee for the registration, grant temporary registration for the duration of post graduate training restricted to the medical college/ institute to which the applicant is admitted for the time being exclusively for post graduate studies; provided further, that temporary registration to such foreign national shall be subjected to the condition that such person is duly registered with appropriate registering authority in his /her country wherefrom he has obtained his basic medical qualification ,and is duly recognized by the corresponding Medical Council or concerned authority.

If the candidate fails to fulfill the relevant eligibility requirements as mentioned above he/she will not be considered eligible for admission for Medical Postgraduate Degree Courses even if he/she is placed in the merit list of statutory authority and BLDE (Deemed to be University).

Obtaining Eligibility Certificate by the University before making Admission

Candidate shall not be admitted for any postgraduate degree course unless he/she has obtained and produced the eligibility certificate used 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.
5. Completion of internship certificate.
6. In case internship was done in a non-teaching hospital, a certificate from the Medical Council of India that the hospital has been recognized for internship.
7. Registration by any State Medical council and
8. Proof of SC/ST or OBC or physically handicapped status, as the case may be.

In addition to the above mentioned documents, candidate applying for admission to superspeciality courses has to produce degree/pass certificate of MD/MS/DNB degree with prescribed fee.

Intake of Students

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

Course Duration

- a. M.D. / M.S. Degree Courses:

The course of study shall be for a period of 3 completed years including examinations. (MCI PG REG 2000 10:1)

- b. D.M/M Ch Degree Courses; (MCI PG REG 2000, 10:2)

The duration of these courses shall be for a period of 3 completed years including examinations.

Training Method

The postgraduate training for degree shall be of residency pattern. The post graduate shall be trained 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 should be required to participate in the teaching and training program 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. Exposure to applied aspects of their learning should be addressed. Similarly, clinical subjects' students should be posted to basic medical sciences and allied specialty departments or institutions.

Training of superspeciality [M.Ch] should follow similar pattern. In addition, they have to be trained in advanced techniques of diagnosis and treatment pertaining to their specialty, participate actively in surgical operations as well.

Attendance, Progress and Conduct

A candidate pursuing degree course 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

Each year shall be taken as a unit for the purpose of calculating attendance. 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. Every Candidate is required to attend a minimum of 80% of the training during each academic year of the post graduate course. This shall include assignments, assessment of full time responsibilities and participation in all facets of educational process. 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. Leave benefits shall be as per university rules.

A post graduate student pursuing degree course in broad specialties, MD, MS and superspeciality courses DM, M.Ch would be required to present one poster presentation, read one paper in 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/her to be eligible to appear at the university degree examinations. (MCI, PG 2000, 13.9)

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

Monitoring Progress of Studies

The learning process of students should be monitored through continuous appraisal and regular assessment. It not only helps teachers to evaluate students, but also students to evaluate themselves. The monitoring is done by the staff of the department based on participation of students in various teaching / learning activities. It may be structured and assessment done by using checklists that assess various aspects.

The learning outcomes to be assessed include:

- Personal Attitudes,
- Acquisition of Knowledge,
- Clinical and operative skills, skills of performing necessary tests/experiments
- Teaching skills.
- Documentation skills

Personal Attitudes:

The essential items are:

- Caring attitude, empathy
- Initiative in work and accepting responsibilities
- Organizational ability
- Potential to cope with stressful situations and undertake graded 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. Any appropriate methods can be used to assess these. It is appreciated that these items require a degree of subjective assessment by the guide, supervisors and peers. However every attempt should be made to minimize subjectivity.

Acquisition of Knowledge:

Lectures: Lectures/theory classes as necessary may be conducted. It is preferable to have one class per week if possible. They may, be employed for teaching certain topics. Lectures may be didactic or integrated.

The following selected common topics for post graduate students of all specialties to be covered are suggested here. These topics can be addressed in general with appropriate teaching-learning methods centrally or at departmental level.

- History of medicine with special reference to ancient Indian medicine
- Basics of health economics and health insurance
- Medical sociology, Doctor –Patient relationship, role of family in disease
- Professionalism & Medical code of Conduct and Medical Ethics
- Research Methods, Bio-statistics
- Use of library, literature search ,use of various software and databases

- Responsible conduct of research
- How to write an article, publication ethics and Plagiarism
- Journal review and evidence based medicine
- Use of computers & Appropriate use of AV aids
- Rational drug therapy
- National Health and Disease Control Programmes
- Roles of specialist in system based practice
- Communication skills.
- Bio medical waste management
- Patient safety, medical errors and health hazards
- Patient's rights for health information and patient charter.

These topics may preferably taken up in the first few weeks of the 1st year commonly for all new postgraduates and later in 2nd year or 3rd year as required during their progression of the programme. The specialty wise topics can be planned and conducted at departmental level.

- a) Integrated teaching: These are recommended to be taken by multidisciplinary teams for selected topics, eg. Jaundice, Diabetes mellitus, thyroid diseases etc. They should be planned well in advance and conducted.

Journal Review Meeting (Journal club):

The ability to do literature search, in depth study, presentation skills, use of audio – visual aids, understanding and applying evidence based medicine are to be focused and assessed. The assessment is made by faculty members and peers attending the meeting using a checklist

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.

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 check list 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.

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

Clinical Meetings:

Candidates should periodically present cases to his peers and faculty members. This should be assessed using a check list.

Group discussions: Group discussions are one of the means to train and assess the student's ability to analyse the given problem or situation, apply the knowledge and make appropriate decisions. This method can be adopted to train and assess the competency of students in analyzing and applying knowledge.

Death review meetings/Mortality meetings: Death review meetings is important method for reflective learning. A well conducted morbidity and mortality meetings bring about significant reduction in complications, improve patient care and hospital services. They also address system related issues. Monthly meetings should be conducted with active participation of faculty and students. Combined death review meetings may be required wherever necessary.

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.

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

Attitude and Communication skills:

Candidates should be trained in proper communication skills towards interaction and communication with patients, attendees and society in general. There should be appropriate training in obtaining proper written informed consent, discussion and documentation of the proceedings. Structured training in various areas like consent, briefing regarding progress and breaking bad news are essential in developing competencies.

Variety of teaching –learning methods like Role play, video based training, standardized patient scenarios, reflective learning and assisting the team leader in all these areas will improve the skills. Assessment can be done using OSCE simulated scenarios and narratives or any appropriate means. Training to work as team member, lead the team whenever situation demands is essential. Mock drills to train and assess the readiness are very helpful.

Work diary / Log Book:

Every candidate shall maintain a Work Diary/Log Book and record his/her participation in the training programs 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, conducted by the candidate. A well written and validated Log Book reflects the competencies attained by the learner and points to the gap which needs address. This Log Book shall be scrutinized by concerned teachers periodically and certified, by the Head of Department and Head of the Institution, and presented during University Practical / Clinical examination.

Periodic tests:

In case of degree courses of three years duration (MD/MS, DM, M.Ch), the concerned departments 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. The tests may include written papers, practical / clinical and viva voce. One of these practical/clinical tests should be conducted by OSPE (objective structured practical examination or OSCE (objective structured clinical examination) method. Records and marks obtained in such tests will be maintained by the Head of Department and sent to the University, when called for,

Assessment

Assessment should be comprehensive & objective. It should address the stated competencies of the course. The assessment needs to be spread over the duration of the course.

FORMATIVE ASSESSMENT, ie., assessment during the training would include:

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.

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 clinical examination.

Quarterly assessment during the Postgraduate training course should be based on following educational activities:

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

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

Procedure for defaulter:

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 requirements in spite of being given adequate chances to set himself or herself right.

Dissertation: Every candidate pursuing MD/MS degree course is required to carry out work on a selected research project under the guidance of a recognized post graduate teacher. The results of such a work shall be submitted in the form of a dissertation.

The dissertation is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of 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.

Every candidate shall submit to the Registrar (Academic) 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 the proper channel.

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.

The dissertation shall be written under the following headings:

1. Introduction
2. Aims or Objectives of study
3. Review of Literature
4. Material and Methods
5. Results

6. Discussion
7. Conclusion
8. Summary
9. References
10. Tables
11. Annexure

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.

Adequate number of copies as per norms and a soft copy of dissertation thus prepared shall be submitted to the Controller of Examinations six months before final examination or before the dates notified by the University.

The dissertation shall be valued by examiners appointed by the university. Acceptance of dissertation work is an essential precondition for a candidate to appear in the University examination.

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 Minimum Qualifications for Teachers in Medical Institutions Regulations, 1998 and its amendments thereof. Teachers in a medical college/institution having a total of eight years teaching experience out of which at least five years teaching experience as Lecturer or Assistant Professor gained after obtaining post graduate degree shall be recognized 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 recognized for teaching/training by this University / Medical Council of India. The co-guide shall be a recognized post graduate teacher of BLDE (Deemed to be University).

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.

Schedule of Examination:

The examination for M.D. /M.S and DM/M.Ch courses shall be held at the end of three academic years. 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.

Scheme of Examination

M.D. /M.S. Degree

M.D. / M.S. Degree examinations in any subject shall consist of dissertation, written papers (Theory), Practical/Clinical and Viva Voce.

Dissertation:

Every candidate shall carryout work and submit a Dissertation as indicated above. Acceptance of dissertation shall be a precondition for the candidate to appear for the final examination.

Written Examination (Theory):

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 and 4th paper on Recent advances, which may be asked in any or all the papers. In basic medical subjects and para-clinical -subjects, questions on applied clinical aspects should also be asked.

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 students ability to make relevant and valid observations, interpretations and inference of laboratory or experimental work relating to his/her subject.

In case of clinical examination, it should aim at examining clinical skills and competence of candidates for undertaking independent work as a specialist. Each candidate should examine at least one long case and two short cases minimum. However additional assessment methods can be adopted which will test the necessary competencies reasonably well.

The total marks for Practical / Clinical examination shall be 300.

Viva Voce:

Examination shall aim at assessing depth of knowledge, logical reasoning, confidence and oral communication skills.

The total marks shall be 100:

- 80 Marks, for examination of all components of syllabus
- 20 Marks for Pedagogy

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.

Criteria for pass & distinction: 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/clinical and (3) viva voce examination. The candidate should pass independently in practical/clinical examination and Viva Voce: vide MCI pg 2000 Reg no 14(4) (Ciii)

Obtaining a minimum of 40% marks in each theory paper and not less than 50% cumulatively in all the four papers for degree examinations. Obtaining of 50% marks in Practical examination shall be mandatory for passing the examination as a whole in the said degree examination as the case may be.[amendment of MCI PG Regulations clause 14 dated 5.4.2018]

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 Controller of Examinations.

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 of marks is 75 percent and above.

Distinction will not be awarded for candidates passing the examination in more than one attempt.

D.M/M.Ch Degree

DM/M.Ch Degree examinations in any subject shall consist of written theory papers (theory), practical/clinical and Viva voce.

Written Examination (Theory):

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 should also be asked.

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 students ability to make relevant and valid observations, interpretations and inference of laboratory or experimental work relating to his/her subject.

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

The total marks for Practical / clinical examination shall be 300.

Viva Voce:

Examination shall aim at assessing depth of knowledge, logical reasoning, confidence and oral communication skills.

The total marks shall be 100:

- 80 Marks, for examination of all components of syllabus
- 20 Marks for Pedagogy

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.

Criteria for passing and distinction: 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 (3) viva voce examination. The candidate should pass independently in practical/clinical examination vide: MCI pg 2000 Reg no 144-c (iii).

Obtaining a minimum of 40% marks in each theory paper and not less than 50% cumulatively in all the four papers for degree examinations. Obtaining of 50% marks in Practical examination shall be mandatory for passing the examination as a whole in the said degree examination as the case may be.[amendment of MCI PG Regulations clause 14 dated 5.4.2018]

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Distinction will not be awarded for candidates passing the examination in more than one attempt.

Number of candidates per day: The maximum number of candidates for practical / clinical and viva-voce examination shall be as under:

- MD / MS Courses: Maximum of 8 per day
- DM/M.Ch Maximum of 3 per day

Additional annexure to be included in all curricula

Postgraduate Students Appraisal Form
Pre/Para/Clinical Disciplines

Name of Department/Unit :
Name of the PG Student :
Period of Training : FROM..... TO.....

Sr. No	PARTICULARS	Not Satisfactory	Satisfactory	More Than Satisfactory	Remarks
		1 2 3	4 5 6	7 8 9	
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				
6	Thesis/Research work				
7	Log Book 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 GUIDE

SIGNATURE OF HOD

SIGNATURE OF UNIT CHIEF

SECTION - II

MD BIOCHEMISTRY

a) GOALS:

1. 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.
2. The student 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.
3. 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.

b) GENERAL COMPETENCY STATEMENTS:

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.

3. Diagnostic services

The student should 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 should be able to provide clinicians with consultation services for diagnostic tests in biochemistry and in interpretation of laboratory results.

4. Research

The student should 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.

c) SUBJECT SPECIFIC COMPETENCIES:

The student during the training programme should acquire the following competencies:

A. Cognitive domain

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.

1. Explain energy transactions in a living system, and describe importance of biomolecules in sustaining the life process.
2. Describe pathways of the intermediary metabolism along with their individual and integrated regulation and apply that in understanding the functioning of the body.
3. 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.
4. Apply and integrate knowledge of molecular and metabolic conditions in normal and disease states for clinical problem solving and research
5. Acquire knowledge on application of various aspects of genetic engineering medicine
6. Acquire knowledge and apply the principle of statistics, biostatistics and epidemiology to the evaluation and interpretation of molecular and metabolic disease states.
7. Evaluate, analyze and monitor disease states by applying relevant biochemical investigations and interpreting the clinical and laboratory data.
8. Able to integrate principles of immunology in biochemistry.
9. 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.
10. 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
11. Demonstrate knowledge of principles of Instrumentation.
12. 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 emphasize 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.

D. SYLLABUS:

The course contents are outlined below:

THEORY

1) 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, protein folding and denaturation, structure and functions of hemoglobin, myoglobin, collagen, Plasma proteins, and immunoglobulins.
- Classification, functions, properties and 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, structure 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.

2) 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.

3) Analytical techniques in biochemistry

- 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, electrophoresis (principle, types, applications), mass spectrometry, automation, point of care testing, Chromatography (principle, types and applications), 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.
- Nanotechnology and microfabrication
- Techniques to study in vivo metabolism - NMR, SPECT, PET scans, etc
- Radioisotope-based techniques and its applications

4) 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.

5) 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.

6) Environmental Biochemistry: Health and pollution.

7) **Enzymes:** Properties, classification, mechanism of action, coenzymes and cofactors, factors affecting enzyme activity, kinetics of enzyme activity, regulation of enzyme activity, isoenzymes, diagnostic and therapeutic enzymes, principles of assays of enzymes, enzymes as therapeutic targets of drugs, enzymes as analytical tool.

8) **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.

9) 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, Metabolism of fructose and galactose, Pentose phosphate and uronic acid pathways and their significance, Polyol pathway, Regulation of blood glucose levels, Diabetes mellitus classification, pathogenesis, metabolic abnormalities, diagnostic criteria, principles of treatment, pathogenesis, complications, laboratory tests, Metabolism of ethanol.
- **Metabolism of lipids :** Digestion and absorption, 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.
- **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.
- **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, disorders associated with nucleotides and nucleosides used as therapeutic agents.
- **Metabolism of heme:** 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.

10) 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.
- **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).

11) Metabolism of xenobiotics

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

13) Molecular Biology:

- **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 frame shift mutations, Relationship of mutations with specific diseases.
- **Translation :** Basic structure of prokaryotic and eukaryotic ribosomes, Structure of tRNA 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 medicolegal 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.

14) 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.

15) 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.

16) 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.

17) 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.

18) Clinical correlates and analytical procedures: Hormones and associated disorders, catecholamines and serotonin, bone and mineral metabolism, 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, body fluid analyses.

19) Regulation of fluid and electrolyte balance and associated disorders

20) Regulation of acid-base balance and associated disorders

21) Biochemistry of the endocrine system: Classification and general mechanism of action of hormones, Biosynthesis, secretion, regulation, transport and mode of action of hypothalamic peptides, adeno-hypophyseal 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.

22) 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.

23) Cardiovascular system: Atherosclerosis - pathogenesis, risk factors, prevention and treatment, Cardiac failure, acute coronary syndrome, cardiac biomarkers.

24) Respiratory system: Gaseous exchange in lungs - physiological features and disturbances, arterial blood gases, Pathogenesis of cystic emphysema, alpha-1 anti-trypsin deficiency.

25) 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.

26) 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.

27) 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.

28) 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.

29) 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.

PRACTICALS

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

- Performance of reactions of carbohydrates, amino acids and proteins, and lipids
- Experiments to demonstrate constituents of milk
- Experiments to demonstrate normal and abnormal constituents of urine
- Estimation of phosphorus by Fiske Subbarao method
- Estimation of proteins by Biuret method and dye binding method.
- Thin layer chromatography for separation of amino acids
- Preparation and estimation of starch
- Estimation of clinical analytes as detailed below:
 - blood glucose, glycated haemoglobin; performance of glucose tolerance test
 - electrolytes, arterial blood gas analysis
 - cholesterol, triglycerides, Lp (a),
 - urea, creatinine, uric acid, ammonia, microalbuminuria
 - parameters of liver function tests (bilirubin, hepato-biliary enzymes such as AST, ALT, ALP, GGT, serum proteins/albumin and prothrombin time)
 - Calcium, magnesium, copper (and ceruloplasmin), serum iron, TIBC and ferritin.

- markers of myocardial damage (CK, CK MB, troponins, LDH)
- other enzymes of diagnostic relevance (eg. phosphatases, amylase etc)
- vitamins D and B12 and folate
- Electrophoresis of serum proteins
- Electrophoresis of Hemoglobin (*Optional*)
- Clearance tests (Demonstration)
- CSF analysis
- Thyroid function tests and other hormone assays by ELISA/RIA
- 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 FicollHypaque
- 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).

e) 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 and training of MD students.

- 1. Interactive lectures, tutorials, problem-based learning, case discussions, seminars, guest lectures, E-learning**
- 2. Journal club**
- 3. Practical exercises**
- 4. Thesis**
- 5. Presentation of work done on thesis to peers**

6. **Teaching of undergraduates**
7. **Horizontal and vertical integration of teaching of Biochemistry with other preclinical, para-clinical and clinical departments**
8. **Training in the basics of medical education and technology**
9. **Development of communication skills**
10. **Introduction to research methodology and Medical Biostatistics:**
11. **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 postgraduate 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 auto-analysers 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.

Students may be posted to institution where these facilities are available for molecular genetics and cytogenetics.

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

Later half of I year, II year and first half of third year (2 years) study and training in the department of Biochemistry.

Third year (later half) Clinical Biochemistry (Exclusively) – 6 months

Every postgraduate student in Biochemistry shall be posted to clinical biochemistry laboratory of the department where clinical investigations of the attached hospital are done. Student should be trained in collection of samples, carrying out investigations, interpretation, reporting of the results and maintenance in records of investigations, Quality assurance.

12. Rotation in clinical departments

It would be desirable for the post graduate students to be posted in clinical departments after their training period in the diagnostic laboratory, for up to 6 months of the course.

Suggested departments and durations of postings are as follows:

- I) Pathology - 15 days
- II) Blood bank – 15 days
- III) Microbiology -1month
- IV) Medicine & intensive care Unit - 1 month.
- V) Endocrinology – 15 days
- VI) Genetics – 15 days
- VII) Cardiology: 15 days.
- VIII) Gastroenterology – 15 days

- IX) Pediatrics – 10 days
- X) Neurology: 10 days.
- XI) Nephrology – 10 days

These postings will help post graduate students get a better perspective on diagnostic tests in clinical practice and will enable them to contribute more effectively to patient care.

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:
 - a) Determination of ESR, Hb, Hematocrit, 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 :
 - 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 etc

12. 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.

13. Department should encourage e-learning activities.

f) MONITORING AND ASSESSMENT METHODOLOGY:

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 student to be assessed periodically as per categories listed in postgraduate student appraisal form (Annexure I).

YEAR WISE PG ACTIVITIES:

First year of the course:

The P.G. student is required to

- a. To attend all UG Teaching sessions (Lectures, Tutorials and Practical's).
- b. To participate in seminars and journal club activities.
- c. To select and submit the topic of dissertation.
- d. To do reference work.
- e. To do self-study.
- f. Training in answering model questions.
- g. OSPE and MCQ's

Second year of the course:

The P.G. graduate student is required to

- a. To do work of dissertation.
- b. To do UG Teaching.
- c. To participate in activities like seminars, journal club, symposia, workshops and group discussions.
- d. To start writing the laboratory manuals.
- e. To attend rotation postings in other departments.
- f. To attend state and national level conferences.
- g. To do self-study.
- h. Training in answering model questions.
- i. OSPE and MCQ's

Third year of the course:

The P.G. student is required to

- a. To complete and submit dissertation 6 months before commencement of University examinations.
- b. To complete the writing of laboratory manuals.
- c. To do UG teaching.
- d. To participate in activities like seminars, journal club, symposia, workshop, panel discussion and group discussion.
- e. To attend conference at State and National level.
- f. To present a paper basing on his/her dissertation work in Institutional Scientific Research Society as well as at least one State / National conference before appearing for the examinations.
- g. To publish at least one Research paper or send it for publication in an indexed journal before University examinations.
- h. To do self-study.
- i. Training in answering model questions
- j. OSPE and MCQ's

g) SCHEME OF EXAMINATION:

SUMMATIVE ASSESSMENT at the end of training,

The summative examination will be carried out as per the Rules given in **POSTGRADUATE MEDICAL EDUCATION REGULATIONS, 2000.**

The postgraduate examination shall be in three 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 results of the work done shall be written up and submitted in the form of a thesis. The aim of doing a thesis is to contribute to development of a spirit of enquiry, to familiarize the post graduate students with research methodology, literature searches, laboratory techniques, analysis of data, interpretation of results and skills in scientific writing.

The thesis shall be submitted at least six months before the theory and clinical / practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for theory and clinical examinations. 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.

2. Theory examination

The examinations shall be organized on the basis of a 'Grading' or 'Marking' system to evaluate and certify a post graduate student's level of knowledge, skills and competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' and 'Practical' examinations separately shall be mandatory for passing the examination as a whole. The examination for MD/MS shall be held at the end of the 3rd academic year.

There shall be 4 theory papers each of three hours duration: 400 Marks

Paper I: Biomolecules, cell biology, biochemical techniques, biostatistics and research methodology, basics of medical education in teaching and assessment of biochemistry

Paper II: Enzymes, bioenergetics, biological oxidation, metabolism of bio-molecules, 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.**

Each theory paper will consist of: Long Essay type questions - 2 x 20 marks = 40

Short Essay type questions - 6 x 10 marks = 60

3 Practical and oral/viva voce examination: 400 Marks

This should be held over two days.

1. Practicals: 300 Marks Duration: Two Days

The assignments of work under Part I and Part II should begin on day 1 and the candidate is expected to complete the work by forenoon on second day, so that viva-voce and pedagogy examinations are held on the second day afternoon.

Part I: 150 Marks

Major Experiment: 100 Marks

A blood sample from a patient to be given with clinical history and probable diagnosis. Student has to estimate relevant parameters and interpret the result. Suitable standard with standard graph should be done.

Minor Experiment: 50 Marks

Qualitative analysis of any biological / body fluid (Urine, CSF, Pleural Fluid etc.) and interpretation.

Part II: 150 Marks

Major Experiment: 100 Marks

Experiment 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 (LDH or CPK) by electrophoresis to be given.

Minor Experiment: 50 Marks

Screening test for inborn errors in metabolism – such as Porphyrrias, Phenylketonuria, Galactosemia, Alkaptonuria etc.

2. Viva Voce : 100 marks

- I. The Viva-Voce Examination 80 marks
Viva-voce examination would be on all components of syllabus including discussion on dissertation.
- II. Pedagogy Exercise 10 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.
- III. Log Book 10 marks
Candidate is asked to make a presentation for 8-10 minutes on the dissertation topic and the review of Log Book.

Maximum marks for	Theory	Practical's	Viva-Voce	Total
M.D. BIOCHEMISTRY Examination	400	300	100	800

h) LIST OF BOOKS RECOMMENDED:

- Murray RK, Grannar DK, Mayes PA, Rodwell VW, Harper's Illustrated Biochemistry, McGraw – Hill, 31st edition , 2018
- Champe PC, Harvey RA, Ferrier DR, Lippincotts Illustrated reviews: Biochemistry, Wolter Kluwer (India) Pvt Ltd, New Delhi, 6th edition, 2013
- Devlin TM, Textbook of Biochemistry with Clinical Correlations – Wiley-Liss, NewYork, 8th edition, 2015.
- Berg JM, Tymoczko JL, Stryer L. Biochemistry – WH Freeman and Company, New York, 8th edition, 2015
- Lehninger AL, Nelson DL, and Cox MM. Lehninger's Principles of Biochemistry, WH Freeman and company, New York, 6th edition, 2012
- Voet D and Voet J, Biochemistry –John Wiley and Sons, New York, 4th edition, 2011
- Marshall WJ, and Bangert SK, Clinical Chemistry: Metabolic and Clinical aspects, Mosby Elsevier, New York, 2nd edition, 2008.
- Bhagavan NV and Ha Chung-Eun, Essentials of Medical Biochemistry with clinical cases, Elsevier, New York, 1st edition, 2011
- Smith CM, Marks AD, Lieberman M. Marks Basic Medical Biochemistry: A clinical Approach, Lippincotts Williams and Wilkins, Philadelphia 2nd edition, 2005.
- Chhabra Namrata, A case oriented approach towards Biochemistry, Jaypee Brothers Medical Publishers (P) Ltd. New Delhi, 1st edition, 2013
- Bruce Alberts. Molecular Biology of the Cell, Taylor and Francis, New York, 5th edition, 2008

12. Scriver CR., et al. Metabolic and Molecular basis of Inherited diseases, McGraw Hill International edition, New York, 8th edition, 2001.
13. Burtis CA and Ashwood ER, Tietz Fundamentals of Clinical Chemistry, Harcourt (India) Ltd., 7th edition , 2014
14. Burtis CA, Ashwood ER, Burns DE. Tietz textbook of Clinical Chemistry and Molecular Diagnostics, Elsevier, Philadelphia, 5th edition, 2012
15. Kaplan LA and Pesee AG, Clinical Chemistry: Theory, analysis and Correlation – CV Mosby and Co. St Louisis , MO, 5 th edition , 2010
16. Gowenlock and Bell, Varley’s Practical Clinical Biochemistry – CBS, New Delhi, 6th edition, 1988
17. Bishop ML, Fody EP, Schoeff LE, Clinical Chemistry; Techniques, Principles,Correlations,Wolter Kluwer (India) Pvt Ltd, New Delhi, 6th edition, 2010
18. Wilson Keith and Walker John, Principles and Techniques of Biochemistry and Molecular Biology,Cambridge University Press, 7th edition, 2010
19. Williamson MA, Snyder LM. Wallachs Interpretation of Diagnostic tests, Wolter Kluwer (India) Pvt Ltd, New Delhi, 9th edition, 2011
20. Watson JD, Molecular Biology of gene, Pearsons education, Singapore Pvt Ltd, 5th edition, 2004
21. Hawks Physiological Chemistry- updated & revised version –edited by P S Kalsi, 4th edition , Medtech , 6 July 2015

i) LIST OF JOURNALS RECOMMENDED:

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. Journal of Clinical Endocrinology and Metabolism
13. Diabetes care

SECTION – III**M D BIOCHEMISTRY****ANNEXURES****MODEL CHECK-LIST – I****FOR EVALUATION OF JOURNAL****REVIEW PRESENTATIONS**

Name of the Student:

Name of the Faculty/Observer:

Date:

Sl. No	Items for observation during presentation	Poor 1	Average 2	Good 3	Excellent 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 defend the paper				
8.	Clarity of presentation				
9.	Any other observation				
	Total Score				

Check List – II**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	Below Average 1	Average 2	Good 3	Very Good 4
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.	Any other observation				
	Total Score				

Check List – III**MODEL CHECK LIST FOR EVALUATION OF DAY TO DAY LEARNING, TEACHING AND RESEARCH ACTIVITIES**

(To be completed once a month by Guide and to be counter signed by HOD)

Name of the Student:

Name of the Guide:

Month:

Sl. No.	Points to be considered	Below Average 1	Average 2	Good 3	Very Good 4
1.	Regularity of attendance				
2.	Punctuality				
3.	Interaction with Teachers, colleagues and supportive staff				
4.	Maintenance of Notes.				
5.	Ability to conduct Theory & Tutorial Classes				
6.	Ability to demonstrate Laboratory Procedure.				
7.	Completeness Preparation for Classes				
8.	Rapport with students.				
9.	Commitment to Research and Departmental Activities.				
10.	Over all quality of day to day work.				
	Total Score				

Signature of Guide

Signature of HOD

Check List – IV

EVALUATION FORM FOR PRACTICAL PROCEDURE

Name of the Student:

Name of the Faculty:

Date:

Sl. No	Points to be considered	Below Average 1	Average 2	Good 3	Very Good 4
1.	Psychomotor skills				
2.	Logical order				
3.	Mentioned all positive and negative points of importance				
4.	Accuracy in performing the procedure.				
5.	Ability to interpret result				
6.	Clinical Correlation.				
7.	Ability to elicit the signs.				
	Total Score				

Check List – V

MODEL CHECK LIST FOR EVALUATION OF TEACHING SKILL PRACTICE

Sl. No		Strong Point	Weak Point
1.	Communication of the purpose of the talk		
2.	Evokes audience interest in the subject		
3.	The introduction		
4.	The sequences 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		

Check List – VI

MODEL CHECK LIST FOR DISSERTATION SYNOPSIS PRESENTATION

Name of the Student:

Name of the Faculty:

Date:

Sl. No	Points to be considered	Poor	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					
	Total Score					

Check List – VII**CONTINUOUS EVALUATION OF DISSERTATION WORK BY GUIDE / CO-GUIDE**

Name of the Student:

Name of the Faculty:

Date:

Sl. No	Items for observation during presentation	Below Average 1	Average 2	Good 3	Very Good 4
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				
	Total Score				

Annexure: VIII

Postgraduate Students Appraisal Form

Pre / Para /Clinical Disciplines

Name of the Department/Unit :

Name of the PG Student :

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

Sr. No.	PARTICULARS	Not	Satisfactory	More Than	Remarks
		Satisfactory		Satisfactory	
		1 2 3	4 5 6	7 8 9	
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				
6	Thesis / Research work				
7	Log Book 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 CONSULTANT

SIGNATURE OF HOD

LOG BOOK

Table 1: Academic activities attended

Name:

Admission year:

College:

Date	Type of Activity Specify Seminar, Journal Club, Presentation, UG teaching	Particulars

LOG BOOK

Table 2: Academic presentations made by the student

Name:

Admission Year:

College:

Date	Topic	Type of Presentation Specify Seminar, Journal Club, Presentation, UG teaching Etc.

LOG BOOK

Table 3: Diagnostic and Operative procedures performed

Name:

Academic Year:

College:

Date	Name	ID No.	Procedure	Category O, A, PA, PI*

- * 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

SECTION - IV**MEDICAL ETHICS & MEDICAL EDUCATION****Sensitization 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 patient, 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 (i), General Objectives (ii) stated in Chapter II (pages 2.1 to 2.3), and develop human values it is urged that **ethical sensitization** be achieved by lectures or discussion on ethical issues, clinical case discussion of cases with an important ethical component and by including ethical aspects in discussion in all case presentations, bedside rounds and academic postgraduate programs.

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 0

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 Behavior 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 cares
 - Malpractice and Negligence

8. Research Ethics
 - Animal and experimental research / humanness
 - Human experimentation
 - Human volunteer research – Informed Consent
 - Drug trials\
 - ICMR Guidelines for Ethical Conduct of Research – Human and Animal
 - ICH / GCP Guidelines
 - Schedule Y of the Drugs and Cosmetics Act.
9. Ethical work -up of cases
 - Gathering all scientific factors
 - Gathering all human factors
 - Gathering value factors
 - Identifying areas of value – conflict, setting of priorities,
 - Working our criteria towards decisions

Recommended Reading

1. Francis C. M., **Medical Ethics**, 2nd Ed, 2004 Jaypee Brothers, Bangalore/-
2. Ethical guidelines for biomedical research on human participants, ICMR publication 2017
3. Santosh Kumar: the elements of research, writing and editing 1994, Dept of Urology, JIPMER, Pondicherry
4. Srinivas D.K et al, Medical Education Principles and Practice, 1995, National Teacher Training Centre, JIPMER, Pondicherry
5. Indian National Science Academy, Guidelines for care and use of animals in scientific Research, New Delhi, 1994
6. International committee of Medical Journal Editors, Uniform requirements for manuscripts submitted to biomedical journals, N Engl J Med 1991
7. Kirkwood B.R, Essentials of Medical Statistics, 1st Ed., Oxford: Blackwell Scientific Publications 1998
8. Mahajan B.K. Methods in bio statistics for medical students, 5th Ed, New Delhi, Jaypee, Brothers Medical Publishers, 1989
9. Raveendran, B. Gitanjali: A Practical approach to PG dissertation, New Delhi, Jaypee Publications, 1998.
10. John A Dent. Ronald M Harden, A Practical guide for medical teacher, 4th Edition, Churchill Livingstone, 2009.
11. Tejinder Singh Anshu, Principles of Assessment in Medical Education, Jaypee brothers
12. Dr. K.Lakshman, A Hand Book on Patient Safety, RGUHS & Association of Medical Consultants, 2012

13. Bernard Mogs, Communication skills in health & social care, 3rd Edition, (S) SAGE, 2015
14. Manoj Sharma, R. Lingyak Petosa, Measurement and Evaluation for Health Educators, Jones & Bartlett Learning.
15. David E. Kern, Patricia A, Thomas Mark T, Hughes, Curriculum Development for Medical Education. A six-step approach, The Johns Hopkins University press/Baltimore.
16. Tejinder Singh Piyush Gupta Daljit Singh, Principles of Medical Education (Indian Academy of Paediatrics), 4th Edition, Jaypee Brothers, 2013.
17. Robert Reid, Torri Ortiz Linenemann, Jessica L.Hagaman, Strategy Instruction for Students with learning disabilities, 2nd Edition, The Guilford Press London.
18. Lucinda Becker Pan Demicolo, Teaching in higher education, (S) SAGE, 2013.
19. C.N. Prabhakara, Essential Medical Education (Teachers Training), Mehta publishers.
20. Tejinder Singh Piyush Gupta, Principles of Evaluation & Research for health care programmes, 4th Edition, IAP National Publication House (Jaypee Brothers).
21. R.L.Bijlani, Medical Research, Jaypee Brothers, 2008
22. Stephen Polgar Shane A Thomas, Introduction to Research in the Health Sciences, Churchill Livingstone Elsevier, 2013.
23. Amar A,Sholapurkar. Publish & Flourish -A practical guide for effective scientific writing, Jaypee Brothers, 2011
24. Charles R.K.Hind, Communication Skills in Medicine, BMJ, 1997.