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MAHATMA GANDHI UNIVERSITY
of
MEDICAL SCIENCES & TECHNOLOGY
JAIPUR

Syllabus

MD – LABORATORY MEDICINE (MD24)

(3 Years Post Graduate Degree Course)

NO CHANGE FOR 2023-24

Edition 2022-23

Principal & Controller
Mahatma Gandhi Medical College & Hospital
Sitapura, JAIPUR

Dr. Mohit Agrawal
Professor & Head
Department of Laboratory Medicine
Mahatma Gandhi Medical College & Hospital

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Notice

1. Amendment made by the National Medical Commission (NMC) of India in Rules/Regulations of Post Graduate Medical Courses shall automatically apply to the Rules/Regulations of the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST), Jaipur.
2. The University reserves the right to make changes in the syllabus/books/guidelines, fees-structure or any other information at any time without prior notice. The decision of the University shall be binding on all.
3. The Jurisdiction of all court cases shall be Jaipur Bench of Hon'ble Rajasthan High Court only.

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RULES & REGULATIONS
MD LABORATORY MEDICINE (MD24)
(3 Years Post Graduate degree course)

TITLE OF THE COURSE:
It shall be called Doctor of Medicine.

ELIGIBILITY FOR ADMISSION:
No candidate of any category (including NRI quota) shall be eligible for admission to MD/MS courses, if he or she has not qualified NEET PG (MD/MS) conducted by National Board of Examinations or any other Authority appointed by the Government of India for the purpose.

(1) General Seats

(a) Every student, selected for admission to postgraduate medical course shall possess recognized MBBS degree or equivalent qualification and should have obtained permanent Registration with the Medical Council of India, or any of the State Medical Councils or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled;

(b) Completed satisfactorily one year's rotatory internship or would be completing the same before the date announced by the University for that specific year as per NMC rules after passing 3rd professional MBBS Part II Examination satisfactorily.

(c) In the case of a foreign national, the Medical Council of India may, on payment of the prescribed fee for registration, grant temporary registration for the duration of the postgraduate training restricted to the medical college/institution to which he/she is admitted for the time being exclusively for postgraduate studies; however temporary registration to such foreign national shall be subject to the condition that such person is duly registered as medical practitioner in his/her own country from which he has obtained his basic medical qualification and that his degree is recognized by the corresponding Medical Council or concerned authority.

(2) NRI Seats

(a) Students from other countries should possess passport, visa and exchange permits valid for the period of their course of study in this Institution and should also observe the regulations of both central and state governments regarding residential permits and obtain no-objection certificate from the same.

(b) The candidate should have a provisional "Student Visa". If he comes on any other visa and is selected for admission, he will have to first obtain a student visa from his country and then only he will be allowed to join the course. Therefore it is imperative to obtain provisional student visa before coming for Counseling.

(c) This clause is applicable to NRI/Foreign Students only.

CRITERIA FOR SELECTION FOR ADMISSION:

(1) NRI Quota

15% of the total seats are earmarked for Foreign National / PIO / OCI/ NRI / Ward of NRI/NRI sponsored candidates who would be admitted on the basis of merit obtained in NEET PG or any other criteria laid down by Central Government/NMC.

(2) Remaining Seats (Other than NRI Quota Seats)

(a) Admissions to the remaining 85% of the seats shall be made on the basis of the merit obtained at

the NEET conducted by the National Board of Examinations or any other Authority appointed by the Government of India for the purpose.

(b) The admission policy may be changed according to the law prevailing at the time of admission.

COUNSELING/INTERVIEW:

(1) Candidates in order of merit will be called for Counseling/Interview and for verification of original documents and identity by personal appearance.

(2) Counseling will be performed and the placement will be done on merit-cum-choice basis by the Admission Board appointed by the Government of Rajasthan.

RESERVATION:

Reservation shall be applicable as per policy of the State Government in terms of scheduled caste, scheduled tribe, back ward class, special back ward class, women and handicapped persons.

ELIGIBILITY AND ENROLMENT:

Every candidate who is admitted to MD/MS course in Mahatma Gandhi Medical College & Hospital shall be required to get himself/herself enrolled and registered with the Mahatma Gandhi University of Medical Sciences & Technology (MGUMST) after paying the prescribed eligibility and enrolment fees.

The candidate shall have to submit an application to the MGUMST through Principal of College for the enrolment/eligibility along with the following original documents and the prescribed fees within the prescribed period without late fees. Then after, students will have to pay applicable late fees as per prevailing University Rules –

(a) MBBS pass Marks sheet/Degree certificate issued by the University (Ist MBBS to Final MBBS)
(b) Certificate regarding the recognition of medical college by the Medical Council of India.
(c) Completion of the Rotatory Internship certificate from a recognized college.
(d) Migration certificate issued by the concerned University.
(e) Date of Birth Certificate
(f) Certificate regarding registration with Rajasthan Medical Council / Medical Council of India / Other State Medical Council.

REGISTRATION

Every candidate who is admitted to MD/MS course in Mahatma Gandhi Medical College & Hospital shall be required to get himself/herself registered with the Mahatma Gandhi University of Medical Sciences & Technology after paying the prescribed registration fees.

The candidate shall have to submit application to the MGUMST through Principal of College for registration with the prescribed fees within the prescribed period without late fees. Then after, students will have to pay applicable late fees as per prevailing University Rules.

DURATION OF COURSE:

The course shall be of 3 years duration from the date of commencement of academic session.

PERIOD OF TRAINING:

The period of training for obtaining Post graduate degrees (MD/MS) shall be three completed years including the period of examination.

MIGRATION:

No application for migration to other Medical Colleges will be entertained from the students already

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admitted to the MD/MS course at this Institute.

METHODS OF TRAINING FOR MD/MS:

Method of training for MD/MS courses shall be as laid down by the Medical Council of India.

ONLINE COURSE IN RESEARCH METHODS

i. All postgraduate students shall complete an online course in Research Methods to be conducted by an Institute(s) that may be designated by the Medical Council of India by way of public notice, including on its website and by Circular to all Medical Colleges. The students shall have to register on the portal of the designated institution or any other institute as indicated in the public notice.
ii. The students have to complete the course by the end of their 2nd semester.
iii. The online certificate generated on successful completion of the course and examination thereafter, will be taken as proof of completion of this course
iv. The successful completion of the online research methods course with proof of its completion shall be essential before the candidate is allowed to appear for the final examination of the respective postgraduate course.
v. This requirement will be applicable for all postgraduate students admitted from the academic year 2019-20 onwards

ATTENDANCE, PROGRESS AND CONDUCT:

(1) Attendance:

(a) 80% attendance in each course is compulsory. Any one failing to achieve this, shall not be allowed to appear in the University examination.
(b) A candidate pursuing MD/MS course shall reside in the campus and work in the respective department of the institution for the full period as a full time student. No candidate is permitted to run a clinic/work in clinic/laboratory/ nursing home while studying postgraduate course. No candidate shall join any other course of study or appear for any other examination conducted by this university or any other university in India or abroad during the period of registration. Each year shall be taken as a unit for the purpose of calculating attendance.
(c) Every candidate shall attend symposia, seminars, conferences, journal review meetings, grand rounds, CPC, CCR, case presentation, clinics and lectures during each year as prescribed by the department and not absent himself / herself from work without valid reasons. Candidates should not be absent continuously as the course is a full time one.

(2) Monitoring Progress of Studies- Work diary/Log Book:

(a) Every candidate shall maintain a work diary in which his/her participation in the entire training program conducted by the department such as reviews, seminars, etc. has to be chronologically entered.
(b) The work scrutinized and certified by the Head of the Department and Head of the Institution is to be presented in the University practical/clinical examination.

(3) Periodic tests:

There shall be periodic tests as prescribed by the Medical Council of India and/ or the Board of Management of the University, tests shall include written papers, practical/clinical and viva voce.

(4) Records:

Records and marks obtained in tests will be maintained by the Head of the Department and will be made available to the University when called for.

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THESIS:

(1) Every candidate pursuing MD/MS degree course is required to carry out work on research project under the guidance of a recognized post graduate teacher. Then such a work shall be submitted in the form of a Thesis.
(2) The Thesis is aimed to train a postgraduate student in research methods & techniques.
(3) It includes identification of a problem, formulation of a hypothesis, designing of a study, getting acquainted with recent advances, review of literature, collection of data, critical analysis, comparison of results and drawing conclusions.
(4) Every candidate shall submit to the Registrar of the University in the prescribed format a Plan of Thesis containing particulars of proposed Thesis work within six months of the date of commencement of the course on or before the dates notified by the University.
(5) The Plan of Thesis shall be sent through proper channel.
(6) Thesis topic and plan shall be approved by the Institutional Ethics Committee before sending the same to the University for Registration.
(7) Synopsis will be reviewed and the Thesis topic will be registered by the University.
(8) No change in the thesis topic or guide shall be made without prior notice and permission from the University.
(9) The Guide, Head of the Department and head of the institution shall certify the thesis. Three printed copies and one soft copy of the thesis thus prepared shall be submitted by the candidate to the Principal. While retaining the soft copy in his office, the Principal shall send the three printed copies of the thesis to the Registrar six months before MD/MS University Examinations. Examiners appointed by the University shall evaluate the thesis. Approval of Thesis at least by two examiners is an essential pre-condition for a candidate to appear in the University Examination.
(10) Guide: The academic qualification and teaching experience required for recognition by this University as a guide for thesis work is as laid down by Medical Council of India/Mahatma Gandhi University of Medical Sciences & Technology, Jaipur.
(11) Co-guide: A co-guide may be included provided the work requires substantial contribution from a sister department or from another institution recognized for teaching/training by Mahatma Gandhi University of Medical Sciences & Technology, Jaipur/Medical Council of India. The co-guide shall be a recognized postgraduate teacher.
(12) 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.

ELIGIBILITY TO APPEAR FOR UNIVERSITY EXAMINATION:

The following requirements shall be fulfilled by every candidate to become eligible to appear for the final examination:

(1) Attendance: Every candidate shall have fulfilled the requirement of 80% attendance prescribed by the University during each academic year of the postgraduate course. (as per NMC rules)
(2) Progress and Conduct: Every candidate shall have participated in seminars, journal review meetings, symposia, conferences, case presentations, clinics and didactic lectures during each year as designed by the department.
(3) Work diary and Logbook: Every candidate shall maintain a work diary for recording his/her participation in the training program conducted in the department. The work diary and logbook shall be verified and certified by the Department Head and Head of the Institution.
(4) Every student would be required to present one poster presentation, to read one paper at a National/State Conference and to have one research paper which should be published/accepted

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for publication/ sent for publication to an indexed journal during the period of his/her post graduate studies so as to make him/her eligible to appear at the Post Graduate Degree Examination.

(5) Every student would be required to appear in and qualify the Pre-University Post graduate degree Mock examination. Post graduate students who fail to appear in or do not qualify the Pre-University Post graduate degree Mock examination shall not be permitted to appear in the final examination of the University.

The certification of satisfactory progress by the Head of the Department/ Institution shall be based on (1), (2), (3), (4) and (5) criteria mentioned above.

ASSESSMENT:

(1) The progress of work of the candidates shall be assessed periodically by the respective guides and report submitted to the Head of the Institution through the Head of the Department at the end of every six months. The assessment report may also be conveyed in writing to the candidate who may also be advised of his/her shortcomings, if any.

(2) In case the report indicate that a candidate is incapable of continuing to do the work of the desired standard and complete it within the prescribed period, the Head of the Institution may recommend cancellation of his/her registration at any time to the University.

(3) Formative Assessment:

(a) General Principles

i. The assessment is valid, objective, constructive and reliable.
ii. It covers cognitive, psychomotor and affective domains.
iii. Formative, continuing and summative (final) assessment is also conducted.
iv. Thesis is also assessed separately.

(b) Internal Assessment

i. The internal assessment is continuous as well as periodical. The former is based on the feedback from the senior residents and the consultants concerned. Assessment is held periodically.
ii. Internal assessment will not count towards pass/fail at the end of the program, but will provide feedback to the candidate.
iii. The performance of the Postgraduate student during the training period should be monitored throughout the course and duly recorded in the log books as evidence of the ability and daily work of the student.
iv. Marks should be allotted out of 100 as under

1) Personal Attributes - 20 marks

a. Behavior and Emotional Stability: Dependable, disciplined, dedicated, stable in emergency situations, shows positive approach.
b. Motivation and Initiative: Takes on responsibility, innovative, enterprising, does not shirk duties or leave any work pending.
c. Honesty and Integrity: Truthful, admits mistakes, does not cook up information, has ethical conduct, exhibits good moral values, loyal to the institution.

2) Clinical Work - 20 marks

a Availability: Punctual, available continuously on duty, responds promptly on calls and takes proper permission for leave.
b Diligence: Dedicated, hardworking, does not shirk duties, leaves no work pending, does not sit idle, competent in clinical case work up and management.

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c Academic Ability: Intelligent, shows sound knowledge and skills, participates adequately in academic activities and performs well in oral presentation and departmental tests.

d Clinical Performance: Proficient in clinical presentations and case discussion during rounds and OPD work up. Preparing Documents of the case history/examination and progress notes in the file (daily notes, round discussion, investigations and management) Skill of performing bed side procedures and handling emergencies.

3) Academic Activities - 20 marks
   a. Performance during presentation at Journal club/ Seminar/Case discussion/Stat meeting and other academic sessions. Proficiency in skills as mentioned in job responsibilities.
4) End of term theory examination - 20 marks
   a. End of term theory examination conducted at end of 1st, 2nd year and after 2 years 9 months.
5) End of term practical examination - 20 marks
   a. End of term practical/oral examinations after 2 years 9 months.
   b. Marks for personal attributes and clinical work should be given annually by all the consultants under whom the resident was posted during the year. Average of the three years should be put as the final marks out of 20.
   c. Marks for academic activity should be given by the all consultants who have attended the session presented by the resident.
   d. The Internal assessment should be presented to the Board of examiners for due consideration at the time of Final Examinations.
   e. Yearly (end of 1st, 2nd & 3rd year) theory and practical examination will be conducted by internal examiners and each candidate will enter details of theory paper, cases allotted (2 long & 2 short) and viva.
   f. Log book to be brought at the time of final practical examination.

APPOINTMENT OF EXAMINERS:

Appointment of paper setters, thesis evaluators, answer books evaluators and practical & viva voce examiners shall be made as per regulations of the Medical Council of India.

SCHEME OF EXAMINATION:

Scheme of examination in respect of all the subjects of MD/MS shall be as under:

(1) The examination for MD/MS shall be held at the end of three Academic Years.
(2) Examinations shall be organized on the basis of marking system.
(3) The period of training for obtaining MD/MS degrees shall be three completed years including the period of examination.
(4) The University shall conduct not more than two examinations in a year for any subject with an interval of not less than 4 months and not more than 6 months between the two examinations.
(5) The examinations shall consist of:
   (a) Thesis:
      i. Thesis shall be submitted at least six months before the main Theory examinations.
      ii. 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/Practical.
      iii. In departments where besides the two earmarked practical/clinical examiners no one else is a qualified P.G. teacher, in that case the Thesis shall be sent to the third external

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examiner who shall actually be in place of the internal examiner.

iv. Only on the acceptance of the thesis by any two examiners, the candidate shall be eligible to appear for the final examination.

v. A candidate whose thesis has been once approved by the examiners will not be required to submit the Thesis afresh, even if he/she fails in theory and/or practical of the examination of the same branch.

vi. In case the Thesis submitted by a candidate is rejected, he/she should be required to submit a fresh Thesis.

(b) Theory papers:

i. There shall be four theory papers.

ii. Out of these, one shall be of Basic Medical Sciences and one shall be of Recent Advances.

iii. Each theory paper examination shall be of three hours duration.

iv. Each theory paper shall carry maximum 100 marks.

v. The question papers shall be set by the External Examiners.

vi. There will be a set pattern of question papers.
Every question paper shall contain three questions. All the questions shall be compulsory, having no choice.
Question No. 1 shall be of long answer type carrying 20 marks.
Question No. 2 shall have two parts of 15 marks each. Each part will be required to be answered in detail.
Question No. 3 shall be of five short notes carrying 10 marks each.

vii. The answer books of theory paper examination shall be evaluated by two External and two internal examiners. Out of the four paper setters, the two paper setters will be given answer books pertaining to their papers and the answer books of the remaining two papers will be evaluated by two Internal Examiners. It will be decided by the President as to which paper is to be assigned to which Internal Examiner for evaluation.

viii. A candidate will be required to pass theory and practical examinations separately in terms of the governing provisions pertaining to the scheme of examination in the post graduate regulations. The examinee should obtain minimum 40% marks in each theory paper and not less than 50% marks cumulatively in all the four papers for degree examination to be cleared as "passed" at the said Degree examination.

(c) Clinical/ Practical & Oral examinations:

i. Clinical/Practical and Oral Examination of 400 marks will be conducted by at least four examiners, out of which two (50%) shall be External Examiners.

ii. A candidate will be required to secure at least 50% (viz. 200/400) marks in the Practical including clinical and viva voce examinations.

(6) If a candidate fails in one or more theory paper(s) or practical, he/she shall have to reappear in the whole examination i.e. in all theory papers as well as practical.

GRACE MARKS

No grace marks will be provided in MD/MS examinations.

REVALUATION / SCRUTINY:

No Revaluation shall be permitted in the MD/MS examinations. However, the student can apply for scrutiny of the answer books as per University Rules.

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GUIDELINES FOR COMPETENCY BASED POSTGRADUATE TRAINING PROGRAMME FOR MD IN LABORATORY MEDICINE

Preamble

Clinical management of patients today is highly dependent on results of laboratory investigations which has seen rapid advances in technology and automation. The presence of a Central laboratory to handle majority of laboratory investigations, quick receipt of quality investigation reports and access and availability of laboratory physicians in the Laboratory Medicine Department to consult helps the consulting clinician in the rapid diagnosis, management and follow-up of patients. Further, the MD in Laboratory Medicine course would assist in bringing newer techniques from research to the diagnostic level.

The MD Laboratory Medicine course is consistent with the 3-tier laboratory concept of an ideal tertiary care hospital attached to a medical college/institute. Tier I is related to laboratory medicine department itself. Tier II encompasses specialty laboratories of Pathology, Microbiology, Biochemistry, Hematology, Endocrinology and Immunology departments while tier III is the high-end research facility laboratory in the medical college hospital. The creation of an MD laboratory Medicine course would help in the availability of Laboratory physicians of first contact for both clinicians and patients thus helping in the treatment and management of patients.

SUBJECT SPECIFIC LEARNING OBJECTIVES

A post graduate student upon successfully qualifying for MD in Laboratory Medicine, should be able to demonstrate following clinical, teaching and research skills:

A. Clinical Skills:

1. Demonstrate competence in skills related to different sections of disciplines of Laboratory Medicine.
2. Interact effectively with allied departments by rendering services in basic and in advanced laboratory investigations.
3. Demonstrate application of laboratory medicine techniques in a variety of clinical settings to solve diagnostic and therapeutic problems.
4. Demonstrate understanding of instrumentation including automation and maintenance of various laboratory equipment.
5. Interact with clinical colleagues during ward round, clinical combined round and clinico-

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laboratory conference.

6. Contribute along with the clinical colleagues in the formulation of the panel of investigations, whenever the requirement arises.
7. Actively participate in interpretation of test results, further refer for other investigations, if necessary, and help in comprehensive decision making in patient's management and follow up.
8. Collect specimens by routinely performed procedures such as venipuncture, finger-prick, and bone-marrow aspiration. Whenever necessary must be able to provide appropriate help to colleagues performing an invasive procedure.

B. Teaching skills:

1. Sensitize the undergraduate students on the importance of diagnostic laboratory in patient management.
2. Guide the clinical post graduate students on test selection and its interpretation, rational use of laboratory facilities, and make them aware of pre-analytical, analytical and post-analytical sources of error in laboratory investigations.
3. Acquire the skill of guiding their junior colleagues and managing laboratory staff.
4. Present relevant topics in seminar and review published articles during Journal club
5. Participate in case discussions.
6. Learn the operational and quality management of the investigations in the Laboratory Medicine Department and guide the technical staff on the same.
7. Develop communication skills to interact with patients, relatives, peers and paramedical staff and present reports and opinions effectively.

C. Research:

1. Identify a research problem for conducting research in basic or applied aspects.
2. Clearly state the objectives in terms of what is expected to be achieved in the end.
3. Design study taking care of adequate no. of cases with age and gender-matched controls with full awareness of the statistical validity of the size of experimental material.
4. Carry out the technical procedures required to conduct the research topic.
5. Accurately, systematically and objectively record the results and observations made during the course of research.
6. Analyze the data with the aid of an appropriate statistical methodology.
7. Interpret the observations in the light of existing knowledge and highlight how the study

has advanced existing knowledge on the subject and what further remains to be done.

8. Prepare the data for publication in an indexed scientific journal.
9. Write the thesis or a scientific paper in accordance with prescribed instructions in a journal of international standards.
10. Present one poster, read one paper at national/state conference and 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.

D. Group Approach:

1. Participate in group discussion of cases by attending undergraduate multidisciplinary seminars, clinical rounds and contributing to the Journal Club.
2. Participate in instructing and guiding the technical staff of the laboratory, in operational aspects of the tests and quality management.
3. Acquire knowledge on Quality Assurance, Accreditation, Laboratory Audit, Laboratory safety, legal aspects of Laboratory Medicine, Laboratory Management, training of technicians and allocation of work.

SUBJECT SPECIFIC COMPETENCIES

A. Cognitive domain

At the end of the training in M.D. Laboratory Medicine, the post graduate student should acquire knowledge and competence in conducting relevant procedures in: i) Medical Biochemistry, ii) Pathology and Hematology, iii) Medical microbiology, iv) Endocrinology, v) Blood Banking, vi) Immunology, and vii) Molecular diagnostics as related to the discipline of Laboratory Medicine.

The student should be able to:

1. acquire knowledge about the normal body systems and pathological basis of disease.
2. understand and identify morphological disorders in tissues and cells from test results.
3. acquire knowledge about how and why the use of histological, cytological and biochemical and immune-histological techniques can be helpful in the diagnosis and

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management of diseases.

4. acquire knowledge about the rationality and relevance of choosing diagnostic investigations (biochemical / hematological / microbiological / immunological / molecular/ endocrinological) in the management of disorders.
5. understand the specific biochemical principles which are being used to measure or determine test substances.
6. acquire competence to perform the specified tests in medical biochemistry, microbiology, pathology, hematology, immunology, molecular biology and endocrinology at the *operational level* with a high order of accuracy.
7. interpret the test results in the context of clinical setting and with knowledge of reference intervals/ abnormal values/ critical Alert values.
8. co-ordinate Laboratory and Hospital Information System (LIS & HIS) with validation of test results on time.
10. evaluate the medical validity of the results of the test, i.e. quality of analysis in comparison to the medical problem.
11. Ensure routine conduct of External Quality Assurance Program & Internal Quality Control Programs and take corrective steps, when needed. The post graduate student should be aware of the principles and the need for quality control of tests performed at the bedside of the patients as Point-of-Care (POC) investigations e.g., ABG in Emergency room or a glucometer in a ward.
9. acquire knowledge on medical auditing of individual and panel of Laboratory Investigations.
12. acquire knowledge of various kinds of Laboratory Auditing methods and is required to attend the course of ISO 15189.
13. acquire knowledge of infection control policies and procedures to the extent of action to be taken in case a MRSA (Methicillin resistant Staph aureus), MDR (multi drug resistant) TB, XDR (extensively drug resistant) TB, VRE (Vancomycin resistant enterococci) is isolated in the Laboratory.
14. give priority status to different tests in case of emergency.
15. design and conduct research in the discipline of Laboratory Medicine.
16. acquire knowledge on Biostatistics for conducting research, writing thesis and

publication of scientific papers.

18. acquire knowledge and conduct budgeting and costing of all laboratory tests.
19. acquire knowledge of the underlying principle/s and design of important laboratory instruments, their use and annual maintenance (AMC).
20. acquire knowledge on different kinds of safety measures in the laboratory.
21. acquire knowledge on infection control programs including antimicrobial stewardship and response to epidemics.
22. supervise and train technical staff of the department.
23. acquire knowledge about management of a large multidisciplinary laboratory services program.

B. Affective Domain:

The post graduate student should be able to:

1. function as a part of a team, develop an attitude of cooperation with colleagues, and interact with patients, clinicians or other colleagues to provide the best possible opinion.
2. adopt ethical principles and maintain proper etiquette in dealings with patients, relatives and other health personnel and to respect the rights of the patient including the right to information and second opinion.
3. develop communication skills to word reports and professional opinion as well as to interact with patients, relatives, peers and paramedical staff, and for effective teaching.
4. work as an effective team member and leader. The student should also demonstrate attitude and communication skills while handling clinical material, reports and with patients or their relatives.

C. Psychomotor domain

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

I. Management Skills

1. General Management

The student should be able to:

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(i) manage a multidisciplinary central hospital laboratory of the medical college/institute a) with patient-centric view, one window solution of their problems b) with minimum Turn-Around-Time (TAT)) of investigations and c) assurance of quality d) covering Total Testing (Pre-analytical, Analytical and Post-Analytical) phases of investigation.

(ii) actively participate in test selection (ward-round, consultation with clinicians), test operation and test interpretation (acting as laboratory consultant for clinicians) and referral to laboratory super-specialist, when felt necessary.

(iii) ensure laboratory safety by ensuring standard universal and special precautions for managing fire, poisonous/corrosive chemicals, infectious specimens and by post-exposure management and prophylaxis.

(iv) ensure management of biomedical waste, starting from segregation to disposal.

(v) conduct inventory management of equipment (Log book) and reagents (stock, shelf-life) and proper storage.

2. Management of Automation

The student should be able to:

a) Pre-analytical automation

handle the pre-phlebotomy (e.g., LIS, bar coding) and post-phlebotomy automation for collection and transport (e.g., conveyer belt) of samples.

b) Analytical automation

(i) handle laboratory automation / robotics of all types including tract-based analyzers, and converting the automated laboratory into a smart laboratory.
(ii) check calibration of the equipment and to maintain daily quality control record.
(iii) trouble shoot, recalibrate the equipment and take corrective measures for errors detected.
(iv) read "flags" in the result and take appropriate action.
(v) validate laboratory reports.

c) Post-analytical automation

(i) dispatch of reports through Laboratory Information System (LIS), if available.

(ii) ensure preservation of patient samples as and when necessary.

3. Management of Quality

(i) detect laboratory errors, its source, types, and take remedial measures and finally document it in the record book.

(ii) maintain calibration of pipettes, dispensers, refrigerators, centrifuges and allied equipment.

(iii) identify pre-analytical variables, perform preventive maintenance of equipment and testing and verification of reagents.

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(iv) run and interpret results of high, medium and low controls on daily basis in laboratory .
(v) perform internal quality control and statistical analysis on daily basis for precision check.
(vi) plot and interpret Levy Jennings chart for analytes and follow Westgard rules to take corrective action for errors identified before running patient samples.
(vii) participate in an external quality assurance program and proficiency testing organized by national or international agencies.
(viii) read and interpret EQAS reports and take corrective action accordingly.

4. Point-of-Care Management

(i) calibrate, maintain and perform quality checks of Point-of-Care devices.
(ii) validate the device against a gold standard test.
(iii) validate results of point-of-care investigations.

5. Managing to prepare and get the Laboratory accredited by National and International Accreditation body (NABL, CAP)

(i) prepare Quality Manual, Sample collection Manual, Lab Safety Manual.
(ii) design Standard Operating Procedures (SOPs) of investigations and Quality System Procedure (QSP) for different clauses of ISO 15189 along with routine forms and formats.
(iii) conduct Internal Audit of the lab and prepare report.
(iv) correct non-conformities raised during audits and assessment of the laboratory.
(v) monitor Complaint Register; documentation of complaints, response from the laboratory, remedial and precautionary measures taken.
(vi) write Minutes of Management Review Meetings (MRM).

6. Management of onsite training of staff, MBBS and nursing students & clinical residents

(i) Participate in motivating, periodic training and competency assessment of the Technical staff.
(ii) Sensitize undergraduate and nursing students about laboratory tests during their laboratory visits.
(iii) Sensitize post graduates from clinical departments on the scope and limitations of the laboratory investigations during their laboratory rounds and laboratory postings.

II. Skills in Basic Technology

(i) check water quality of laboratory
(ii) handle equipment including:
different types of microscopes, pipettes, dispensers, balance, different types of centrifuges, vortex mixer, pH meter, oven, incubators, BOD incubator, refractometer, colorimeter, spectrophotometer, nephelometer, blood gas analyzer, electrolyte analyzer, different types of electrophoresis equipment, different types of chromatography (e.g., HPLC, TLC, GLC) equipment, autoclaves, sterilizers, ELISA equipment etc.
(iii) prepare buffers, standard solutions, normal solutions and molar solutions.
(iv) handle sterilization and disinfection methods.

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III. Operational and Investigation Skills

1. Investigations on Body Fluids

(i) conduct physical, chemical and microscopic examination of:
Urine, CSF, peritoneal, pleural, pericardial and synovial fluids, semen, sputum, feces, amniotic fluids, lavage fluids (e.g., BAL, gastric lavage) and, if necessary, conduct microbiological examinations, to arrive at possible diagnosis.

(ii) interpret urinary findings.

(iii) perform and interpret pregnancy test in urine.

(iv) interpret CSF findings in the context of meningitis caused by different organisms and differentiate from encephalitis, brain abscess and Guillain Barre syndrome.

(v) interpret exfoliative cytology in the peritoneal, pleural and pericardial fluids.

2. a} Blood/Serum:

The student should be able to take corrective steps while testing hemolysed, hyperlipidemic and hyperbilirubinimic serum.

b) **The student should b*e able to carry out biochemical investigations of :***

(i) sugar, urea, creatinine, uric acid, bilirubin (total, direct, indirect) total protein, Albumin, Globulin (both manual & automated methods)

(ii) serum enzymes

(iii) serum electrolytes

(iv) Lipid profile: total cholesterol (manual and automated method), LDL-cholesterol, HDL-cholesterol, VLDL and triglycerides

(v) Blood gas parameters and pH

(vi) hormones: TSH, T_4, T_3, ACTH, Cortisol, FSH, LH, GH, Prolactin, Testosterone, Estradiol, ADH

(vii) vitamins (e.g. Vit D, B_{12}, Folic acid) and trace elements

(viii) cardiac markers: Troponin-I Troponin-T, CK-MB, myoglobin. LDH 1 & II

(ix) tumor markers: Colonic cancer (CEA, CA19-9), pancreatic cancer (CA19-9), ovarian cancer (CA125), hepatic cancer (alpha-fetoprotein), trophoblastic tumor (BHCG).

(x) drugs and toxins, when necessary.

b) Urine:

The student should be able to analyse:

(i) urinary Na^+, Ca^{++}, PO_4^-, creatinine, albumin, uric acid

(ii) tumor markers

(iii) substances excreted for inborn errors of metabolism

(iv) porphyrins and related metabolites

c) CSF:

sugar, total protein, albumin, globulin and enzymes.

(i) Fecal fat estimation for diagnosis of malabsorption,
(ii) Conduct (a) Plasma electrophoresis for investigation of cause of hypoproteinemia, (b) serum electrophoresis for 'M' spike, (c) hemoglobin electrophoresis for investigation of hemoglobinopathies, (d) urine electrophoresis for specific protein.
(iii) evaluate liver functions, renal functions, endocrine functions, GI functions.
(iv) select and perform investigations for laboratory diagnosis of diabetes mellitus, metabolic syndrome, metabolic bone disease, hepatitis and other diseases of liver, inborn Errors of metabolism, prenatal fetal defects.
(v) Diagnose metabolic/respiratory/mixed acidosis and alkalosis (uncompensated /compensated).
(vi) identify the cause/s of hypo- and hypernatremia, hypo- and hyperkalemia, hypo- and hypercalcemia.
(vii) guide clinical post gradates on progress and regress of cancer from tumor markers.

3. *Investigations on Blood for hematological disorders*

(i) collect, transport and processing of blood samples for different hematological investigations in specified vial with adequate amount of specific anticoagulant.
(ii) perform manual methods of blood cell count, make peripheral blood smear and its staining.
(iii) perform Hematocrit, Reticulocyte count, measure ESR (Westergren and Wintrobe methods) and prepare Buffy coat.
(iv) read and interpret hemogram, histogram from automated blood cell counter.
(v) examine and interpret stained peripheral blood smear and to arrive at possible diagnosis of disorder of red cells, white cells and platelets, sepsis and drug effects.
(v) demonstrate Hemo-parasites; malaria, babesia, microfilaria etc.
(vii) investigate in detail the etiology of Anemia: nutritional deficiency, hemolytic, hypoplastic and other causes.
(viii) select investigations and perform tests for nutritional Anemia.
(ix) select investigations and perform tests for hemolytic Anemia
(x) demonstrate sickle cell, G6PD deficiency and identify cold agglutinin.
(xi) diagnose Thalassemia and conduct further study to classify it.
(xii) investigate for Leukocyte disorders (quantitative and functional disorders).
(xiii) investigate for, and diagnose different types of Leukemia with cytochemistry, immune-phenotyping and genetic analysis.
(xiv) investigate and diagnose bleeding disorders by screening coagulation tests (BT, CT, PT, APTT, TT, Platelet count, Clot retraction), DIC work up including estimation of D-Dimer, diagnose specific Factor deficiency by Mixing study, Adsorption study, Factor Assay.
(xv) investigate platelet functions (platelet adhesion, aggregation and release defect).
(xvi) investigate prothrombotic state: Assay of anti-thrombin III, factor V-leiden, protein C, protein S.

4. *Investigation of Bone Marrow*

(i) Collect, transport and processing of bone marrow samples for different investigations and diagnosis.

(ii) interpret normal and abnormal marrow.
(iii) diagnose hematological and systemic disease from bone marrow examination especially reactive marrow, megaloblastic anemia, all kinds of leukemia, myelodysplastic disorders, plasma cell dyscrasia, megakaryocytic and non-megakaryocytic thrombocytopenia, pure red cell aplasia, hypoplastic marrow, metastatic deposits, viscera leishmaniasis, Parvo virus infection.

5. *Investigation required for basic Transfusion Medicine*

(i) familiar with National and State legislation policies on blood banking.
(ii) screen blood donors.
(iii) perform phlebotomy on a healthy blood donor and collect blood in different specified bags
(iv) screen for transfusion transmitted diseases in a blood donor.
(v) perform cell grouping of major ABO & Rh blood groups and interpret findings by tube method.
(vi) perform serum cell grouping of major ABO blood groups and interpret findings by tube method.
(vii) perform cell grouping and serum cell grouping for minor blood groups.
(viii) identify secretory status of the donor and recipient.
(ix) perform cell and serum cross matching.
(x) perform antiglobulin (Coombs) test: direct and indirect.
(xi) investigate a case of blood transfusion reaction.
(xii) perform fractionation of whole blood into various components such as cryoprecipitate, platelet concentrate, fresh frozen plasma, single donor plasma, Red Blood Cell concentrates, Leucocyte-depleted component, store the components according to standard protocols and use those in appropriate clinical conditions.
(xiii) select subject for apheresis and conduct the procedure.

6. *Immunological Investigations*

(i) perform basic immunological techniques including Immunofluorescence microscopy & Immunoassays; immune-precipitation, immune-fixation, different kinds of ELISA, ELISPOT assays, chemi-luminescence analysis, Western blotting.

Serological techniques; CFT, different types of agglutination reactions, IHA.

(ii) perform immune-phenotyping by flowcytometry.
(iii) evaluate collagen vascular disorders, autoimmune disorders, immunodeficiency status (primary and secondary).
(iv) measure and interpret CRP, RF, ANF.
(v) evaluate cellular immune system including count B cell, T cell, T cell subsets; CD4 & CD8. Able to perform T cell function test; *in-vitro* demonstration of CMI, Blast transformation, *in vivo* test e.g., Intradermal inoculation.
(vi) evaluate humoral immune system including B cell function evaluation and immunoglobulin estimation.
(vii) estimate level of complements.
(viii) estimate cytokines in blood and fluids.
(ix) perform HLA-typing of cells and organs.
(x) evaluate collagen vascular disorders, autoimmune disorders, immunodeficiency status

(primary and secondary).

(xi) apply laboratory approach for investigation of various hypersensitivity and allergic disorders.

7. Investigations for Infective disorders: the student should be able to:

(i) take care of pre-analytical variables to increase the yield of infectious agents.
(ii) perform and interpret rapid diagnostic tests (e.g., Malaria, Leishmania and HIV)
(iii) demonstrate microorganisms by using common stains like Gram, Giemsa, Albert and AFB stains, and India ink preparation by means of appropriate microscopic procedures.
(iv) prepare culture media and inoculation of the sample specimen in the media and recording the outcome.
(v) conduct drug sensitivity tests in culture.
(vi) perform biochemical tests for microbial identification and their serotyping (including Widal test).
(vii) conduct cell culture studies for the diagnosis of viral & other microbial infections.
(viii) maintain specific strains of microbes in the laboratory, as required.
(ix) perform and interpret TORCH screening
(x) perform and interpret the markers of different kind of viral hepatitis.
(xi) diagnose Tuberculosis including drug-resistant tuberculosis.
(xii) investigate the infections and infestations in an immune-compromised host.
(xiii) examine body fluids and excreta (stool, urine) for parasites including protozoa, nematodes, cestodes and trematodes and their diagnosis by gross, microscopic (concentration method, when necessary), special staining, and serological & culture methods.
(xiv) diagnose amoebiasis, giardiasis, leishmaniasis, toxoplasmosis & malaria.
(xv) identify opportunistic parasites in the immune-compromised host.
(xvi) identify common mycotic organisms by microscopy and special stains.
(xvii) participate in Hospital Infection Surveillance program.

8. Molecular Diagnostics: the student should be able to:

(i) set up of a molecular diagnostic laboratory.
(ii) extract DNA from cell homogenate and use nanodrop spectrophotometer for DNA isolation.
(iii) perform Nucleic acid amplification techniques: PCR, RT-PCR (including Melting Curve analysis), LCR, LAMP, digital PCR, and Non-PCR based Isothermal amplification and probe amplification.
(iv) Post-translation analysis including electrophoresis, hybridization (solid phase and solution phase) assays, microarray, dot-blot, line probe assay.
(v) read gel electrophoresis in gel documentation unit.
(vi) perform investigations on chromosomal and genetic disorders
(vii) develop familiarity with New Generation Gene Sequencer (NGS), if available.

9. Skills on Histo- and Cyto-pathology: the student should be able to:

(i) diagnose from H/E-stained histopathology slides common lesions like acute appendicitis, fatty liver, secretory and proliferative endometrium, gestational products, amyloidosis (of kidney), colloid goiter, TB lymphadenitis, fibroadenoma breast, leiomyoma uterus,

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squamous cell carcinoma skin/lung, adenocarcinoma breast, mucin-secreting adenocarcinoma colon/stomach/ovary, metastatic carcinoma in lymph node and in bone marrow.

(ii) perform FNAC of cervical lymph node, thyroid, skin & oral lesions and breast lump and do liquid-based cytology and interpret the PAP smear.

IV Skill of reporting the result of investigations

(i) acquire the skills for integrative reporting taking consideration of (a) clinical context (b) results of all chemical, hematological and microbiological investigations of the patient sent to the lab, (c) reference interval of values, (d) the specificity and sensitivity of the methods, (e) prevalence of disease in defined populations and (f) Positive and negative predictive value (PPV and NPV) of the test.
(ii) develop the skill of communication of the result to the patient and to clinical colleagues.
(iii) advice further series of investigations.
(iv) maintain confidentiality of the report.
(v) counseling of patients.
(vi) develop the skill of Error-disclosure.

V Research Skills

(i) identify research problem, formulate research hypothesis/question, design appropriate study method with requisite no of cases & controls, select laboratory methods of analysis, tabulation and statistical analysis of the results and prepare report.
(ii) apply the available statistical tools for analysis of the result.
(iii) identify the strength and limitation of the study.

SYLLABUS

A. Cognitive Domain:

The post graduate student must acquire knowledge in the following:

1. ORGANIZATION OF THE LABORATORY

- Spatial organization: flooring, ventilation, air-conditioning, sanitation, drainage
- Disposal of waste in differently colored bags; from collection, segregation to disposal
- Laboratory Safety:
  - Prevention of physical, chemical & biological hazards
  - First Aid in laboratory accidents; management and post exposure prophylaxis
  - Understanding of different levels of biosafety; BSL I, BSL, II and BSL III.
- Financing, budgeting and cost accounting of investigations
- Management of laboratory stores
- Special reference to glassware, chemicals (AL, LR) & storage of dangerous poisonous

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chemicals

- Personal management and training of technical staff
- Streamlining of in-put and output of lab investigations, specimen collection and dispatch of report (TOT, One point solution to patients)
- Understanding of POC testing in the wards
- Computerization of laboratory services (LIS and its connection with HIS)
- Legal aspects of laboratory services.

2. QUALITY CONTROL & QUALITY ASSURANCE

- Sources of errors in laboratory results a) pre- analytical b) analytical c) post- analytical.
- Methods of detection of errors
- Types of error
- Corrective measures to minimize the errors
- Method of documentation of the whole procedures
- Onward transmission of the knowledge and skill to the other laboratory
- Preparation of internal `control'
- Proficiency testing program, participation in E.Q.A.P. & preparation of biological standards
- Procurements of 'Standards' and 'Control' for Hematology, Clinical Chemistry and immunoassays
- Quality assurance in microscopy
- To check the calibration of Pipettes, speed of centrifuge, temperature of freezer, incubator, oven etc.

3. INSTRUMENTATION

Acquire knowledge on i) principle, ii) parts, iii) working manual, and iv) preventive maintenance of the following instruments:

A. Major Instruments:

- Photoelectric Colorimeter
- Spectrophotometer
- Centrifuge machines (table top, high speed, cold centrifuge)
- Blood Cell Counter
- ELISA Reader & Washer
- Autoanalysers
- Flame-photometer & Electrolyte analyzer
- Blood Gas Analyzer
- Microscopes: Light, Fluorescent, Dark ground, Phase contrast
- Electrophoresis apparatus,

- Densitometer,
- Culture hood & Biosafety hood
- Thermocycler and Gel doc.
- Microbial culture system,
- TB culture system
- Urine analysis system
- BOD Incubator
- Immunoassay analyzer
- -20^0 C and -80^0 C deep freezer
- Refrigerated centrifuge machine.

B. Minor Instruments:

- Different types of shakers, roller mixer, Cyclomixer etc.
- Thermometer
- Different kinds of refrigerators (4°, -20°c, -80°C)
- Incubators (including BOD incubator)
- Ovens
- Water-baths
- Distillation plant
- Deionizer plant
- RO System
- Auto pipettes
- pH meter
- Auto-dispensers
- Analytical balance
- Table top centrifuge.

C. The principles and working manual of following techniques:

- Chromatography of different kinds particularly HPLC, TLC and GLC,
- Flow Cytometry
- Chemi-luminesence analysis
- Scanning and Transmission Electron microscopy,
- Beta & Gamma Counting.

4. PHYSICAL CHEMISTRY & CLINICAL BIOCHEMISTRY

a) Physical Chemistry

- Molecular weight, Atomic weight, Equivalence weight, Log table, Periodic table
- Water of crystallization, colloid, crystalloid, osmolality, osmolarity, normality, specific gravity.

b) Clinical Biochemistry:

- Carbohydrate chemistry: identification, metabolism and disorders of metabolism; diabetes Mellitus, hypoglycemia
- Structure, function and physiological roles of different proteins, metabolism, hypo- and hyper-proteinemia
- Amino acids & related metabolites, aminoaciduria
- Glycoproteins, proteoglycans and collagen
- Porphyrins
- Lipids, lipoproteins, apoproteins
- Enzymology: diagnostic values of enzymes & isozymes in health and disease
- Acid-base and Electrolyte imbalance and regulation
- Tumor markers
- DNA-RNA chemistry
- Vitamins, & Trace elements and other important metals
- Biochemistry of various body fluids
- Functions of endocrine organs such as hypothalamus, pituitary, thyroid, parathyroid, adrenal, pancreas and gonads
- Bone and GI tract as endocrine organ
- Biochemistry of hormone synthesis, degradation and excretion, assay methods
- Neurochemistry: neurotransmitters, neuromodulators and neurohormones; their synthesis and functions

5. PHYSICAL, CHEMICAL AND MICROSCOPIC EXAMINATION OF BODY FLUIDS

Physical, chemical and microscopic examination of various excretory / secretary fluids e.g. (i) urine (ii) CSF (iii) peritoneal, pleural, pericardial, synovial, (v) amniotic (vi) semen (vii) sputum and (viii) feces.

6. HAEMATOLOGY & TRANSFUSION MEDICINE

A. Hematology

- Detection and typing of anemia
- Polycythemia
- Neutrophilia, eosinophilia, basophilia, lymphocytosis, neutropenia, Lymphopenia, Agranulocytosis
- Leukemia classification, cytochemistry immunophenotyping, cytogenetics, clinico-pathological correlation
- Thrombocytosis, thrombocytopenia, platelet functions
- Investigation of bleeding disorders
- Investigation of prothrombotic state
- Automation in hematology: difference with automation in clinical chemistry

- Bone marrow physiology and pathology

B. Transfusion Medicine

- Basic immunohematology
- ABO and Rh grouping
- Clinical significance of other blood groups
- Transfusion therapy including the use of whole blood, RBC concentrates and Blood component therapy
- Rationale of pre-transfusion testing
- Transfusion transmitted Infections
- Adverse reactions to transfusion of blood and blood components
- Quality control in blood bank

7. INVESTIGATIONS OF INFECTIOUS DISEASES

- Medically important microbes in general. Enterobacteriaceae and other gram negative bacilli like *Salmonella, Shigella, E coli*. Gram-positive cocci & bacilli and Mycobacteria, in particular, their general behavior, life history, metabolism, genetics and mode of infection
- Epidemiology of infectious diseases
- Hospital Acquired Infections/Nosocomial infections
- Medically important parasites
- Medically important viruses
- Medically important fungi
- Systemic Microbiology: Gastroenteritis and bacterial food poisoning, septicemia, wound infection, burn associate infections, U.T.I., R.T.I., C.N.S. infection including meningitis, encephalitis, STDs/ AIDS, opportunistic infections, congenital infections and infections in vulnerable groups e.g. AIDS patients, cancer patients, Geriatrics, premature babies, pregnancy & post-transplantation.
- Vaccines for infectious diseases
- Laboratory acquired infections
- Diagnosis & prevention of infection
- Lab. Safety: Blood borne diseases including-Viral Hepatitis & HIV, air borne infections, Universal standard precautions, Principles of bio-safety
- Medico-Legal aspects of infectious diseases including postmortem findings and evidence based opinion on criminal cases in regard to infections/vaccines.
- Notifiable disease

8 CLINICAL IMMUNOLOGY

- Physiology of Immune System

- Hypersensitivity reactions
- Autoimmune diseases
- Transplantation immunology
- Host-Parasite interaction

9. CLINICAL PHYSIOLOGY

ORGAN FUNCTION TESTS:

- Liver function tests
- Kidney function tests
- Gastric function tests
- Pancreatic function tests
- Splenic function tests
- Tests for malabsorption
- Respiratory function tests
- Cardiac function tests, and
- Endocrine function tests.

10. MOLECULAR BIOLOGY

- Structure of DNA & RNA
- Genetic configuration of commonly used genomic vectors/host and their uses in molecular biology
- Blotting technology (Southern, Northern, Western)
- DNA hybridization
- RNA hybridization
- Polymerase Chain Reaction (PCR) and its variants in various diseases
- LCR (Ligase Chain Reaction)
- NASBA (Nucleic acid sequence based amplification)
- Micro-array technology
- Chromosomal analysis
- HLA typing
- Principles of bioassays, Bio-chips
- Cell culture technology.

11. ANATOMIC PATHOLOGY

- Theory and methods of biopsy, processing of tissue
- Basic and general Pathology like degeneration, necrosis, inflammation, growth disorders, circulatory disturbance, hypersensitivity reaction, deficiency disease.
- Histopathology techniques, Cytopathology techniques, Histochemistry techniques, Immuno-histochemistry techniques, Electron Microscopy.

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- Study of common histo-pathological lesions such as:
  - Proliferative, secretory and menstruating endometrium
  - Gestational products
  - Common skin lesions such as psoriasis, lichen planus, pemphigus vulgaris, squamous cell carcinoma
  - TB lymph adenitis
  - Acute appendicitis
  - Fatty liver
  - Amyloidosis (of kidney)
  - Colloid goiter
  - Benign tumors, such as fibroadenoma breast, leiomyoma uterus
  - Malignant tumors such as squamous cell carcinoma of skin/lung, adenocarcinoma of breast, mucin secreting adenocarcinoma colon/stomach/ovary, metastatic carcinoma in lymph node and in bone marrow.

B. PSYCHOMOTOR DOMAIN

The post graduate student should acquire following skills:

1. GENERAL

- Preparation of standard, normal & molar solution
- Preparation of buffers
- Preparation of Laboratory reagents
- Handling of corrosives, poisonous chemicals.

2. CHEMISTRY

- Manual method of estimation of sugar, urea, bilirubin, protein (total and fractional), creatinine, cholesterol, uric acid, amylase, acid and alkaline phosphatases,
- Automated methods of estimation of: a) above substances b) SGOT, SGPT, LDH, CPK, Calcium, Phosphate.
- Measurement of blood pH & arterial blood gases,
- Electrolytes estimation (Na, K, Ca, Cl)
- Lipids, apo-proteins and lipoproteins,
- Tumor markers
- Chemical analysis of body fluids, (CSF, Peritoneal/pleural/synovial fluid)
- Practical exercises on quality assurance in a clinical biochemistry laboratory.
- Endocrine organ function tests.

3. HAEMATOLOGY & TRANSFUSION MEDICINE

Hematology

- Collection, transport and processing of blood samples for different hematological investigations

- Performance of routine hemogram: Hb, TLC, DLC, ESR.
- Preparation, staining and interpretation of peripheral blood smear, Reticulocyte count, buffy coat preparation, Hematocrit measurement
- Aspiration of bone marrow, preparation of touch smear and bone biopsy. Staining and interpretation of marrow
- Cytochemistry of blood smear and bone marrow smear and their interpretation,
- Nutritional Anemia Study: Serum iron, folate and vitamin B_{12} estimation
- Hemolytic studies e.g. osmotic frangibility, sickling test, estimation of HbF, HbA2, Comb's test vii) Leukocyte function test
- Screening coagulation and DIC studies. BT, CT, PT, APTT, clot stability
- Investigation of prothrombotic states. Protein C, Protein S, Antithrombin III, Lupus anticoagulant
- Demonstration of common blood parasites
- Understanding automation in hematology: advantage and limits.

B. Transfusion Medicine

- Selection and bleeding of donors
- ABO and Rh grouping
- Resolving ABO grouping problems by secretor status in saliva and expanded panel of minor blood groups
- Familiarity with antibody screening by; a) LISS (Low-ionic salt solution) b) Enzymes c) AHG (Anti-Human Globulin)
- Steps to be taken if the above are positive
- Demonstrate familiarity with cross-matching by; a) LISS (Low-ionic salt solution) b) Enzymes c) AHG (Anti-Human Globulin)
- Steps to be taken if there is incompatibility
- Preparation of blood components i.e. cryoprecipitate, platelet concentrate, fresh frozen plasma, single donor plasma, Red Blood Cell concentrates
- Demonstrate familiarity with antenatal and neonatal techniques a) Direct antiglobulin test b) Antibody screening and titer c) selection of blood for exchange transfusion
- Demonstrate familiarity with principle and procedures involved in, a) resolving ABO grouping problems, b) identification of RBC antibody, c) investigation of transfusion reaction d) testing of blood for presence of (i) HBV (Hepatitis B Virus Markers) (ii) HCV (Hepatitis C Virus Markers) (iii) HIV (Human Immunodeficiency Virus markers) (iv) VDRL, and xi) investigation of hemolytic jaundice of adult and new born.

4. INFECTIOUS DISEASE LABORATORY

- Methods of collection, transportation and techniques used for clinical samples: a) blood b) bone marrow, splenic, liver, lymph Node aspirates c) CSF, pus from closed cavities &

open wounds d) urine e) stool f) semen g) sputum h) saliva i) swabs (nasal, pharyngeal, rectal, conjunctival.)

- Demonstration of microorganisms by microscopy (bright field, dark ground, phase contrast, fluorescence.)
- Commonly used stains in microbiology: Grams, Giemsa, Romanowsky, A.F.B, Kinyouns', Albert's special stains for spores, capsules, inclusion bodies, parasites & fungi.
- Culture media: their preparation, inoculation, and uses
- Antibiotic sensitivity testing including automation in Microbiology and interpretation of antibiograms vi) Serological techniques e.g. Widal, VDRL, CFT, ID, ELISA, IFA, RIA etc. In-vitro demonstration of CMI (cell mediated immunity), Complement cycles, Blast transformation, Monoclonal antibodies, and skin test
- Biochemical tests for microbial identification
- Serotyping of microbes
- Bed side tests: FNA, intradermal tests, cord blood, lumber puncture etc.
- Animal inoculation studies
- Egg inoculation, cell culture studied for the diagnosis of viral & other microbial infection
- Human parasites including Protozoa, Nematodes, Cestodes and Trematodes and their diagnosis by gross, microscopic and serological & culture techniques. Diagnosis of amoebiasis, giardiasis, Leishmaniasis, Toxoplasmosis & Malaria
- fungal infections in human and their diagnosis
- Hospital infection surveillance
- Maintenance of strains.

5. CLINICAL IMMUNOLOGY

- Demonstration of T and B cell.
- Functional evaluation of T and B cell. CD4 & CD8 counting
- Immunoglobin estimation
- Serological techniques like (a) CFT (b) Agglutination test (c) IHA & (d) ELISA with particular, reference to microbial serology, interleukin, ANF, RF, CRP
- Radioimmunoassay
- Immunoglobulins in health and disease
- Complements level determination.

6. ANATOMIC PATHOLOGY

- FNAC procedure, processing, staining and microscopy
- Biopsy and gross specimens handling
- Processing of tissue: manual, automated
- Common histo-pathological staining
- Microscopy of common lesions

THESIS

The post graduate student must submit their research protocol within 04 months of joining the MD course. The thesis should be submitted at least 6 months before the date of commencement of the theory 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 practical; on the acceptance of the thesis by two examiners, the candidate shall appear for the final examination.

TEACHING AND LEARNING METHODS

Postgraduate teaching program

Teaching methodology

Learning in a PG program is primarily self-directed. MD course in Laboratory Medicine consists of laboratory and academic work. The formal sessions are merely meant to supplement this core value. The acquisition of practical competencies is the cornerstone of post graduate medical education in Laboratory Medicine so that they become the Laboratory physician of first contact for the clinicians and the patients in test selection, test operation and test interpretation.

Formal teaching sessions

In addition to laboratory work, at least 06 hrs of formal teaching per week is necessary. The department may select a mix of the following departmental sessions and interdepartmental sessions (see below):

Journal club	Once a week
Seminar	Once a week
Practical exercise	Once a week
Case discussions	Once a week

Note: These sessions may be organized as an institutional activity for all postgraduates.

- Sessions on basic sciences, biostatistics, research methodology, teaching methodology, hospital waste management, health economics, medical ethics and legal issues related to experimentation are suggested.
- The post graduate students shall be required to participate in the teaching and training program of undergraduate students and interns.

  Log book: During the training period, the post graduate student should maintain a Log Book giving details of experimentation done and skills acquired. The Log book shall be used to aid the internal evaluation of the student. The Log book shall be checked and assessed periodically by the faculty members imparting the training.
- Department should encourage e-learning activities.

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Formal interactive Teaching with other Departments

1. Weekly Combined seminar with residents of Pathology/ Microbiology / Biochemistry/ Immunology/ Endocrinology departments.
2. Interaction with clinical colleagues

   During the course of 03 years, the students are expected to interact with each other and with faculty of clinical disciplines continuously regarding in-patients as well as out-patients. They are advised to participate actively in pre-test and post-test counselling of the patients. The post graduate students are encouraged to take ward round at least once a week with respective Head of the Department of Pediatrics and Medicine, Surgery, Gynecology & Obstetrics.

3. Weekly Interdepartmental Case discussion

   There will be weekly interdepartmental rounds and case discussion on selected cases whose investigations have been done over the week in different sections of the laboratory,

   particularly with the following departments viz., Medicine, Pediatrics, Surgery, Gastroenterology, Endocrinology, Gynecology and Obstetrics, Neurology, Casualty and I.C.U.

4. Weekly participation in combined round and grand round of the Institution

   During the weekly combined round and grand round, the post graduate students of Laboratory Medicine will actively participate for discussion on the investigative aspects of the case presented.

Attending and Participating in Workshop. Symposia, CME

- Attend accredited scientific meetings (CME, symposia, and conferences).
- A postgraduate student of a post graduate degree course in broad specialties would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his post graduate studies so as to make him eligible to appear at the postgraduate degree examination.

RECOMMENDED POSTING SCHEDULE FOR THREE YEAR TRAINING

Posting	Ist year	2nd year	3rd year
Fluid and Excretion Laboratory	2 months	----------	2 months
Hematology Laboratory	4 months	2 months	2 months
Chemistry laboratory	3 months	2 months	3 months
Infectious disease laboratory	3 months	2 months	2 months
Dept. of Pathology	-	3 months	-
Dept. of Microbiology	-	2 months	-
Dept. of Transfusion Medicine	-	1 month	1 month
Other special lab, as required (e.g. Chromosomal and genetic lab, HLA Lab, Stem cell Lab etc.)		-	2 months

ASSESSMENT

FORMATIVE ASSESSMENT i.e., Assessment during the training

Formative assessment should be continual and should assess medical knowledge, patient care, procedural and 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 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)

SUMMATIVE ASSESSMENT, ie., assessment at the end of training

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

The postgraduate examination shall be in three parts:

1. **Thesis**

   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 examination. A post graduate student shall be allowed to appear for the Theory and Practical/Clinical examination only after the acceptance of the Thesis by the examiners.

2. **Theory examination**

   The examinations shall be organized on the basis of 'Grading'or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical'

separately shall be mandatory for passing examination as a whole. The examination for M.D./ MS shall be held at the end of 3rd academic year.

There shall be four theory papers.

Paper I. Basic Sciences as applied to laboratory medicine including management, equipment, automation, quality assurance and accreditation, General Pathology, Cytology and Histology

Paper II. Hematology, Transfusion Medicine, Immunology, Endocrinology and Molecular diagnostics

Paper III. Biochemical Investigations of systemic diseases on blood and body fluids; investigation of infectious diseases

Paper IV. Recent advances in laboratory medicine: diagnostics, emerging problems, new techniques and procedures, innovations.

C. Practical Examination including viva voce: to be conducted over two days:

A guideline for 2-day examination is given below.
Total 14 hours: Three hours each on Fluids & Excretions, Chemical Analysis, Infectious Disease and Hematology, followed by 2 hours grand viva. Every exercise could be objectively structured.

Date & Time	Exercise
First day	
09-10 AM	Theoretical clinical case discussion
10-11 AM	Infectious lab: slide spotting & sample processing
11-01 PM	urine & stool examination & Viva
1.00-1.30 Lunch	
1.30-2.30 PM	Transfusion Medicine Practical and Viva Chemical lab
2.30-3.15 PM	Ex.1 & Viva (on manual estimation)
3.15-4.00 PM	Chemical lab Ex.2 & Viva (on electrolytes estimation)
4.00-4.45 PM	Chemical lab Ex.3 & Viva (on blood gas estimation)
4.45-5.30 PM	Chemical lab Ex.4 & Viva (on automated analysis including Chemiluminescence, ELISA interpretation & quality assurance)
	Continued Infectious sample Processing

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Second Day 8.00-9.00 AM 09.00-10.00 AM 10.00-10.15 AM 10.15-10.45 AM 10.45-11.00 PM 11.00-12.00 PM 12.00- 01.30 PM **1.30-2.00 Lunch** 2.00-3.00 PM 3.00-5.00 PM	Hematology (10 cases) & Path. Slide (2 cases) drill Viva on those cases Bleeding disorder: Theoretical case Exercise followed by practical exercise: PT/APTT/TT/Platelet count/ D-dimer estimation/others CSF/other fluid analysis exercise Viva on bleeding disorder & CSF Serology exercise and viva Infectious sample processing follow up, viva **Grand viva**

VIVA VOCE:

Viva voce will include selection, operational and interpretative aspects of tests performed. Grand viva will be on day 2 at the end for 2 hours for overall assessment.

RECOMMENDED READING MATERIALS - Books (latest edition)

1. Clinical Diagnosis and Management by Laboratory Methods, Henry JB, WB Saunders. (Indian Edition, Eastern Press, Bangalore).
2. Clinical Laboratory Medicine, Editor Kenneth D. McClatchey, Lippincott Williams & Wilkins.
3. Laboratory Medicine Test Selection and Interpretation, Ed. Joan H. Howanitz & Peter J. Howanitz. Churchill Livingstone.
4. An Introduction to Clinical Laboratory Science, Clerc.
5. Widmann's Clinical Interpretation of Laboratory Tests, Sacher.
6. Clinical Laboratory Science Education & Management, Wallace.
7. Most Commons in Pathology and Laboratory Medicine, Goljan.
8. Advances in Pathology and Laboratory Medicine, Graham.
9. Interpretation of Diagnostic Tests, Wallace.
10. Delmar's Guide to Laboratory & Diagnostic Test, Deniels.
11. A Manual of Laboratory & Diagnostic Tests, Fischbach.
12. General Pathology JB Walter, MS Israel. Churchill Livingstone, Edinburgh.
13. Robin's Pathologic Basis of Disease Ramzi S. Cotran, Vinay Kumar, Stanley L Robbins WB Saunders Co., Philadelphia.
14. William's Hematology Beutler E, Lichtmann MA, Coller BS, Kipps TJ, McGraw Hill, New York.
15. Postgraduate Hematolog, Hoffbrand AV, Lewis SM, Tuddenham EGD, Butterworth Heinemann, Oxford.
16. Wintrobe's Clinical Hematology, Lee GR, Foerster J, Lupeus J, Paraskevas F, Gveer JP, Rodgers GN, Williams & Wilkins, Baltimore.

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17. Practical Hematology, Dacie JV, Lewis SM, Churchill Livingstone, Edinburgh.
18. Bone Marrow Pathology, Bain BJ, Clark DM, Lampert IA, Blackwell Science, Oxford.
19. WHO Classification of Hematolymphoid Neoplasm
20. Fundamental of Clinical Chemistry, N. W. Teitz WB Saunders Company, Philadelphia.
21. Varley's Practical Clinical Biochemistry, JR Mc Murray, DM McLaunchlan, Heinemann Professional publishing, Oxford.
22. Glossary of Biochemistry and Molecular Biology, Glick.
23. Diagnostic Microbiology, Bailey & Scott's.
24. Koneman's color atlas and text book of Diagnostic Microbiology
25. Medical Microbiology, Mackie and McCartney.
26. Immunology, Roitt, Brostoff, Male, Bailliere Tindall, Churchill Livingstone, Mosby, W.B. Saunders.
27. Harrison's Principles of Internal Medicine, McGraw Hill
28. Mandell's Principle & Practice of Infectious Disease.

Journals

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

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Annexure 1

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	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 CONSULTANT** **SIGNATURE OF HOD**

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MODEL PAPER

MD24301 **Basic.Sc.-I**

MD Examination Month, Year
LABORATORY MEDICINE

Paper I

Basic Sciences as applied to laboratory medicine including management, equipment, automation, quality assurance and accreditation, General Pathology, Cytology and Histology

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q1. Write briefly on quality control in laboratory. What are the variables that affect quality of the test reports? 20 marks

Q2. Write on: 2x15 =30 marks

a. What is Liquid based cytology? Describe the two common systems used for Liquid based cytology. Enumerate the advantages of Liquid based cytology when compared to conventional cytology?

b. Discuss vesiculobullours lesion of skin. Give a detailed account on value of immnofluorescence techniques in diagnosis of skin disorders

Q3. Write short notes: 5x10 =50 marks

a. Flame photometer

b. Endometriosis.

c. Medullary carcinoma breast.

d. IHC in peritonial effusion cytology and small biopsy

e. Blood gas analysis

Mohit

MODEL PAPER

MD24302 **Hematology-II**

MD Examination Month, Year
LABORATORY MEDICINE

Paper – II

Hematology, Transfusion Medicine, Immunology, Endocrinology and Molecular diagnostics

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q1. Write about Major Histocompatibility Complex (MHC)? Role of HLA testing in transplantation. Add a note on ABO-Incompatible (ABO-I) transplantation in solid organ and hemotopoietic stem cell transplantation. 20 marks

Q2. Write on: 2x15 =30 marks

a. Write in detail the Biochemistry, mechanism of actions, function and clinical significance of Anti-Diuretic Hormone. Add a note on laboratory evaluation of Diabetes Insipidus.

b. Define and Classify Auto Immune Diseases. Write in detail about the Mechanism of Autoimmunity. Add a note on the laboratory Diagnosis

Q3. Write short notes: 5x10 =50 marks

a. Column agglutination technology in transfusion medicine

b. Automated DNA sequencing

c. Role of potentiators in immunohematology lab

d. Flow Cytometry

e. Gene amplification

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MODEL PAPER

MD24303 **Biochemical-III**

MD Examination Month, Year
LABORATORY MEDICINE

Paper – III

Biochemical Investigations of systemic diseases on blood and body fluids; investigation of infectious diseases

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q1. Describe the structure and types of Collagen. Add a note on the relationship of function to the three dimensional structure. 20 marks

Q2. Write on: 2x15 =30 marks

a. Enumerate the pathogenic Free Living Amoebae. Write in detail on the Pathogenesis, Clinical manifestations & Lab diagnosis of Primary Amoebic Meingo Encephalitis

b. Describe in brief the pathogenesis, clinical manifestations and lab diagnosis of Leptospirosis

Q3. Write short notes: 5x10 =50 marks

a. Inborn errors of fructose metabolism

b. Keratomycosis

c. Adipose tissues as an endocrine organ

d. Selenium and its applications.

e. Piedra

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MODEL PAPER

MD24304 **Recent.Adv-IV**

MD Examination Month, Year
LABORATORY MEDICINE

Paper – IV

Recent advances in laboratory medicine: diagnostics, emerging problems, new techniques and procedures, innovations

Time: Three Hours
Maximum Marks: 100

Attempt all questions
All the parts of one question should be answered at one place in sequential order.
Draw diagrams wherever necessary

Q1. Discuss automation in the Immunohaematology and infectious disease testing labs of a blood centre. 20 marks

Q2. Write on: 2x15 =30 marks

a. Write the WHO classification, molecular markers and recent advances of non Hodgkin's lymphoma.

b. Define the term outbreak. Write in detail the steps involved in the investigation and management of an outbreak.

Q3. Write short notes: 5x10 =50 marks

a.CRISPAR-Cas system in Transfusion Medicine.

b. Cytospin

c. Rapid molecular antimicrobial resistance detection

d. Blood pharming

e. Diagnostic stewardship

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