



THE WEST BENGAL UNIVERSITY OF HEALTH SCIENCES

REGULATION, CURRICULUM AND SYLLABUS FOR MASTER OF SCIENCE DEGREE IN MEDICAL LABORATORY TECHNOLOGY (M.Sc MLT) IN BIOCHEMISTRY

1. TITLE OF THE COURSES:

Master of Science degree in Medical Laboratory Technology courses (M.Sc. MLT) is proposing in the **M.Sc. MLT in Microbiology**

2. GOAL/OBJECTIVES:

Post Graduate programme in Medical Laboratory Technology Gives to provide an extensive and advance technological training in the fields on Microbiology, Biochemistry, Pathology and Haematology & Blood Transfusion to the student to enable them to supervise and operate the entire laboratory.

Candidates who successfully complete M.Sc. (MLT) courses shall be able to

- a. Practice as Specialized Laboratory Technologist in the concerned subject.
- b. Setup and manage specialized clinical Laboratory and to deliver better health care system to the public.
- c. Function as effective educators in the field of Medical Laboratory Technology.
- d. Conduct independent research works and utilize the research findings in Laboratory Practice and education.
- e. Establish collaborative relationship with clinicians and member of other disciplines.

3. DURATION OF THE COURSE:

The duration of the master's degree in Medical Laboratory Technology including submission of Thesis work on the topic registered shall be for a period of two years from the commencement of the academic term on full time basis

1st year - 0 - 12 Months

2nd year -13 - 24 Months

4. ELIGIBILITY FOR ADMISSION:

The minimum qualification for admission to the master's courses In Medical Laboratory Technology shall be -

- a) Students who have passed in B.Sc. MLT course/BMLT course from any recognised University (With 50% Marks).
- b) Students who have passed in B.Sc. Honours in Microbiology.
- c) Students who have passed in B.Sc. in biological science along with DMLT (from State Medical Faculty or its equivalent).

1. SELECTION CRITERIA:

The selection of students for the post graduate course shall be made based strictly on merit in the qualifying entrance examination conducted by institution / University.

2. REGISTRATION / ADMISSION

A candidate on admission to the Msc. MLT shall apply to the institution/ University for registration.

- Formal application in the prescribe format
- Fill up the registration University form
- Original degree certificate/ mark sheet (3 Xerox copies)
- Migration certificate (If applicable)
- Reservation certificate (Caste Certificate) if applicable
- Physically Challenged certificate, if applicable
- NOC from employer, if applicable
- 6 copies colour passport size photo.

3. ATTENDENCE

Candidates should have 75% attendance to appear the University examination. A condition of 10% maximum of attendance shortage shall be done once during the whole post graduate programme by the Principal/ Head of the Institution.

4. MEDIUM OF INSTRUCTION:

English is the medium of instruction for the subjects of study as well as for the examination.

5. TEACHING METHODS & CURRICULUM:

- (1) The 2 years curriculum includes theoretical lectures, practical, seminars, and project in addition to practical training and educational trips/tour.
- (2) The students will also take co-curricular and extra-curricular activities such as NSS, Sports and Cultural etc.
- (3) The students also take part in journal club for 1 Hr. (including discussion) weekly.
- (4) Tutorials/group discussion/review club.

- (5) M.Sc. MLT trainees present seminars under the moderation of faculty members. Each trainee presents a minimum of 6 seminars and present at least 6 journal clubs in two years.
- (6) M.Sc. MLT trainee's students should regularly visit for practical training in Hospital/Diagnostic centre/College own laboratory.

10. INTAKE OF STUDENTS (GUIDE - STUDENT RATIO):

The guide student ratio shall be a maximum of 1:3 including co-guide

Experience of Guide: - Guide should have master degree in related field and minimum 3(three) years of teaching experience in the same institute or any other institute.

Experience of Co-Guide:-co-guide should have master degree in related field and minimum 1(one) year of teaching experience.

Change of Guide:-It can be changed only on unavoidable situations with prior permission on from University.

11. COMMENCE OF COURSE

The course will commence from the 1st week of October of every year.

12. DISSERTATION/THESIS EVALUATION:

- 1) The topic of the dissertation along with synopsis should be submitted at the end of the first 6 months and obtain the ethical clearance of the same. The candidate should also inform the name of the guide & co-guide (if any) for the dissertation.
- 2) If there are changes in the dissertation topic, the student has to be informed University 2 months prior to the 1st year examination.
- 3) The dissertation should be submitted duly signed by the Guide & Co-Guide (if any) and Head of the institution and has to be forwarded to the university through the Head of the institution 2 months prior to the University Final/2nd year Examination.
- 4) If the dissertation is not approved (Failed) by the majority of the examiners, the results shall be withheld till the resubmitted dissertation is approved (passed).
- 5) If the candidate fails in the written/practical Examination, but his/her dissertation is approved (passed), approval of the shall be carried over to the subsequent examination.
- 6) The dissertation should be written under the following headings - Introduction, Aims or objectives of study, Review of literature, Material of methods, Results, Discussion, conclusion, Summary, References, Tables, Annexure.
- 7) The written text of dissertation shall not be less than 75 pages and shall not exceed 100 pages including introduction to annexure. It should be neatly typed in double line spacing on one side of paper (A4 size) and found properly.

13. COMPLETION OF THE COURSE OF STUDY:

The duration for completion of the course is double the duration of the course i.e. 4 years to the pass the examination, from the date of joining the course. Otherwise he/she has to be discharged from the course.

14. THEORY & PRACTICAL HOURS DISTRIBUTION

• FIRST YEAR

Subject	Theory	Practical Hours	Total Hours
1. Basic Science	100 hrs	1200 hrs	1600 hrs
2. Basic Medical Laboratory Science - I	100 hrs		
3. Basic Microbiology	100 hrs		
4. Basic Medical Laboratory Science - II	100 hrs		

SECOND YEAR

Subject	Theory	Practical Hours	Total Hours
1. Bacteriology & Virology	100 hrs	1200 hrs	1600 hrs
2. Mycology & Parasitology	100 hrs		
3. Molecular Microbiology & Genetics	100 hrs		
4. Diagnostic & Applied Microbiology	100 hrs		

15. SCHEME & SCHEDULE OF EXAMINATION

There are four specialties in M.Sc. MLT course. First year shall be common to all the three specialities. In the second year the student will study subject of his/her specialization.

A) INTERNAL ASSESSMENT

- Internal Assessment marks shall be awarded to the candidates in each paper as detailed in the Scheme of examination. The marks secured by the candidates in each subject shall be forwarded to the University 15 days before the University Examinations.
- The marks of the internal assessment must be published on the notice board of the respective colleges.
- If a candidate is absent from the test due to genuine and satisfactory reasons, such a candidate may be given a re-test within a fortnight.

There shall be minimum of two internal assessment examinations in 1st year & subject of specialty in 2nd year conducted by the colleges at regular intervals both in theory & practical which includes seminars. The average of best two examination Marks shall be taken into consideration by calculating marks for the internal assessment.

B) THEORY EXAMINATION

Theory main examination will be conducted yearly basis i.e. end of 1st year and 2nd year. Supplementary examination will conduct after 3 -4 months from publication of main examination.

C) PRACTICAL & VIVA

After theory examination practical & viva examination in respected subject shall be conducted by the University appointed Internal & External examiner.

D) DISSERTATION

The evaluation of the dissertation work will be on the basis of project contact, presentation, defense viva and valuation by the Internal & External examiners together, appointed by the University.

E) PATTERN OF QUESTION PAPER

Essay	4X10 = 40 Marks
Short Notes	8 X 5 = 40 Marks
	Total = 80 Marks

F) CRITERIA FOR PASS

- 40% of Marks in the University Theory Examination
- 50% of Marks in the University Practical Examination

MSc. MLT Regulation

- 40% of Marks in the Internal Assessment Marks
- 50% of the Marks in aggregate in theory, practical, IA and Oral.

G) CRITERIA FOR PROMOTION

Candidate, who fails in any subject, shall be permitted to continue the studies into the second year. However the candidate shall not be allowed to appear for the second year examination till such time that he/she passes all subjects of the first year M.Sc. MLT examination.

H) RULES FOR SUPPLEMENTARY EXAMINATION

No supplementary batch will be conducted for M.Sc. (MLT) course but supplementary examination will be conducted within six months after each regular examination. Candidate failing to secure minimum pass mark in any theory paper shall reappear for that paper only. Candidates who fail in the practical examination shall reappear for both practical and Viva voce in the supplementary examination.

I) DECLARATION OF CLASS

- (1). Distinction - 75 % and above.
- (2) First Class - 60 % and above, less than 75 %
- (3). Second Class - 50 % and above, less than 60%.

Candidate who fail in the first attempt in any subject and pass in subsequent examination shall not be ranked in distinction or first class. Maximum number of attempts per subject is three inclusive of first attempt. The maximum period to complete the course successfully should not exceed 4 years.

J) SCHEME OF EXAMINATION

- **FIRST YEAR:- [Compulsory For All 4 Specialization]**

Subject	Theory	IA (Th)	Total	Practical + Oral	IA (Pr)	Total	Grand Total
1. Basic Science	80	20	100	-	-	-	100
2. Basic Medical Laboratory Science - I	80	20	100	80	20	100	200
3. Basic Microbiology	80	20	100	80	20	100	200
4. Basic Medical Laboratory Science - II	80	20	100	80	20	100	200
Grand Total	320	80	400	240	60	300	700

Microbiology

Subject	Theory	IA (Th)	Total	Practical + Oral	IA (Pr)	Total	Grand Total
1. Bacteriology & Mycology	80	20	100	80	20	100	200
2. Virology & Parasitology	80	20	100	80	20	100	200
3. Molecular Microbiology & Genetics	80	20	100	--	--		100
4. Diagnostic & Applied Microbiology	80	20	100	--	--		100
5. Deseration	-	-	-	100	-	100	100
Grand Total	320	80	400	260	40	300	700

MINIMUM REQUIREMENT OF INFRASTRUCTURE, STAFF & FACULTY & LABORATORY FACILITIES FOR M.Sc. MLT COURSE

(Basis of 15 students each course)

6. Basic Infrastructure Applicable To All Four Specialities :-

- I. Institute should have its own Hospital with full fledged Clinical Laboratory or its own diagnostic centre or own independent Clinical laboratory provided the above mentioned facilities fulfill the minimum work load criteria for each of the subject speciality mentioned here under.
- II. One class room with capacity for 60 students measuring 500 sq. ft.
- III. Four class room with capacity for 15 students measuring 300 sq. ft.
- IV. Library:- Should be 800 sq. ft. and having more than 1000 books in related course.
- V. Seminar Hall: - One seminar room measuring 500 sq. ft. with avoids - OHP, Slide Projector and computer, LCD Projector (optional).
- VI. Other Infrastructure :- Principal room, Students common room, Teaching & non - teaching staff room, Office room, Store room, Boys & Girls separate toilet, Boys and Girls Hostel with canteen facilities and Playground etc.
- VII.
 7. Basic Laboratories :-
Four labs with area of 500 sq. ft. each one lab for each subject infrastructure & instrument subject wise-

A. MICROBIOLOGY:-

a. Laboratory equipments

1. Autoclave
2. Hot air oven
3. Incubator
4. Centrifuge
5. Water distillation/Purification unit
6. PHmeter
7. Physical Balance
8. Digital Balance
9. Refrigerator
10. Microscope - Monocular 10
 - Binocular - 5
 - Dark field Microscope - 1
 - Fluroscnt microscope - 1
12. ELISA reader
13. Anaerobic Jar
14. Micropipettes
15. Pressure cooker
16. Laminar air flow
17. Water bath

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18. VDRL shaker
19. Deep freezer - 1

Apart from the above mentioned equipments necessary glassware, kits, chemicals as per the syllabus requirements should be made available in adequate quantity.

b. Minimum work load criteria for conducting M.Sc MLT course in Microbiology

100 different types of samples per day including serological tests

B. BIOCHEMISTRY:-

a. Laboratory equipments

1. Chemical Balance/single Pan Balance
2. Colorimeter
3. Electrolyte analyser
4. pH meter
5. HPLC machine
7. Semi auto analyser
8. Auto analyser
10. Blood gas analyser
11. Refrigerator
12. Titration Apparatus
13. Electrophoresis equipments

Apart from the above mentioned equipments, necessary glass ware, kits, chemicals, as per the syllabus requirements should be made available in adequate quantity.

b. Minimum work load criteria for conducting M.Sc MLT in Clinical Biochemistry.

100 different bio-chemical tests per day [Routine and special tests]

C. PATHOLOGY:-

a) Laboratory Equipments

1. Refrigerator
2. Micro oven
3. Microtome
4. Hot Air Oven
5. Water Bath
6. Coil Stone
7. Cooker - 5 lit.
8. Digital flame
9. Binocular Microscope
10. Monocular Microscope
11. Centrifuge
12. Autoclave
13. Automatic Tissue Processer
14. Ryle's tube
15. Urinometer
16. PH meter
17. Albuminometer
18. Specific gravity meter

19. FNAC Aspiration

b. Minimum work load criteria for conducting M.Sc MLT in Pathology.

100 different pathological tests per day [Routine and special tests]

D. HAEMATOLOGY & BLOOD TRANSFUSION

a. List of Equipments [Haematology]

Name of the Equipment

1. Blood cell counter - 1
2. Coagulometer 1
3. Spectrophotometer 1
4. Refrigerator - 165 lit 2
5. Hot air oven 1
6. Electronic Balance (Libror) 1
7. Water bath 1
8. Distilled water unit 1
8. Centrifuges 1
9. Hb Electrophoresis Machine 1(Tank, Scanner, monitor, Printer, CPU)
10. ELISA reader 1
11. pH meter 1
12. Autoclave 1
13. Microscope - Binocular 10
14. Haemocytometer One per student
15. Westergren pipette one per student
16. D C counters one per student
17. Calorimeter 1
18. Urinometer 1
19. Albuminometer 1
20. Blood Bank Refrigerator 2
21. Domestic Refrigerator 1
22. Centrifuge - 16 tube capacity 1
23. tube capacity 1
24. Water bath 1
25. Thawing bath 1
26. Microscope 1
27. Photoelectric Colorimeter 1
28. view box 1
29. Weighing Machine 1
30. Hot air Oven 1
31. Elisa Reader with washer 1
32. VDRL Rotator 1
- 33 .Donor cots with mattress and pillows 2 (ICU cots)
34. Blood collection Monitor 1
35. Spring Balance 2
36. Deep Freezer - 300C Horizontal 1
37. Deep Freezer - 700C Horizontal / Vertical 1
38. Platelet Agitator with Incubator 1
39. Refrigerated Centrifuge 1
40. Laminar Flow 1
41. Tube sealer 2
42. Cobe Spectra Cell Separator 1

- 43. Couch 1 Optional
- 44. Automatic component extractor 1
- 45. Component weighing scale 1
- 46. Rough Balance 1
- 47. Oxygen cylinder

Apart from the above mentioned equipments necessary glassware, chemicals, kits, should be made available in adequate quantity.

b. Minimum work load criteria for conducting M.Sc MLT course- Haematology

100 samples per day Haematology Including Clinical Pathology samples Haematology samples should include following Special type of investigations

- 1. Haemolytic work up
- 2. Coagulation work up
- 3. Thrombotic work up1

1st Year SYLLABUS

(Common to all streams)

1. BASIC SCIENCE (Paper - I) [Marks - 80]

A. HUMAN ANATOMY [Marks - 20]

Theory

Introduction of anatomy and Histology, Elementary Histology of cell, Tissues of the body organs and system, Elementary Anatomy and Histology of:-

1. **Skeletal System** - Development of bones, types of bones, Micro-anatomical and gross structure of bones, Osteology of human skeleton and various movement of joints.
2. **Muscular System**, Structure and type of muscles in human body, important muscles and their group action.
3. **Circulation System** - Structure of heart and blood vessels, Systemic circulation, pulmonary circulation, Portal circulation, and coronary Circulation.
4. **Lymphatic System** - orientation & origin of lymph, Lymph vessels, Lymph nodes and lymphoid organs, their structure and functions.
5. **Digestive System** - Gastrointestinal tract and associated glands (Salivary Glands, Liver, Pancreas etc).
6. **Respiratory System** - Respiratory tract,& various structure of the tract-Trachea, Lungs including other air passages.
7. **Urinary System** - Kidney, ureter and urinary bladder etc.
8. **Endocrine System** - Thyroid glands, Parathyroid glands, Adrenal glands and Pituitary glands.
9. Female and Male reproductive organs System.
10. Skin and its appendages,
11. Special sense organs: Eye, Ear, Nose Taste buds, subcutaneous sense organs.
12. Nervous system: brain, Spinal cord, Peripheral nerves.

B. HUMAN PHYSIOLOGY [Marks -25]

Theory

1. **Blood:** - Blood volume, composition and function of blood, haemopoiesis, blood coagulation, blood groups, and body fluids.
2. **Cardiovascular System :-** General plan of circulatory system, function of heart and blood vessels (arteries, arterioles, capillaries and veins) heart sound and E.C.G. nervous control of heart and blood vessels, regular of blood pressure.

3. **Respiratory System:** - Functional anatomy of respiratory system, mechanism of breathing and exchange of gases in the lungs. Regulation of respiration, Oxygen and. carbondioxide carriage, anoxia, dysproes, cyanisis, artificial respiration and pulmonary function test.
4. **Gastrointestinal System:** - Alimentary canal and its various glands, digestion of food in mouth, stomach and small intestines, gastro-intestinal tract movements and absorption. Function of liver and metabolism.
5. **Excretory System:** - Structure and function of kidney and Urinary bladder, Structure and function of skin & lungs.
6. **Reproductive System:** Physiology of male and female reproductive System, Spermatogenesis, Sperm morphology, Menstrual cycle, ovulation,
7. Endocrine glands and their function. Regulation of endocrine secretion positive & negative feedback.
8. **Muscular System:-** Types of muscles, innervation of muscles, neuromuscular transmission, mechanism of muscular contraction.
9. **Nervous System:** - Neurone and its function, spinal cord and reflex action, sensory end organs and sensory path ways, cerebral cortex and motor path ways. Maintenance of posture and locomotion, automatic nervous system, Physiology of vision, hearing test and olfaction.

C. EPIDEMIOLOGY & PUBLIC HEALTH [Marks - 15]

1. Epidemiology - definition, concept and role in health and disease.
2. Definition of the terms used in describing disease transmission and control.
3. Modes of transmission and natural history of a disease
4. Measures for prevention and control of communicable and non-communicable disease.
5. Principal sources of epidemiological data.
6. Definition, calculation and interpretation of the measures of frequency of diseases and mortality.
7. Need and uses of screening tests.
8. Accuracy and clinical value of diagnostic and screening tests (sensitivity, specificity, & predictive values).
9. Causal Association & Various types of epidemiological study designs
10. Critical evaluation of published research.
11. Measures of Disease Frequency
12. Cross sectional studies
13. Case control studies
14. Cohort studies
15. Randomized controlled trial
16. Association and Causation

17. Bias and Confounding
18. History of Public Health
19. Organization of Health services
20. Health Care Delivery system
21. Health Economics
22. Health Planning
23. Concept of public health.
24. Principles of primary, secondary and tertiary care.
25. Planning of health services.
26. Health economics
27. Health manpower development-
 - a) Basic O.T Practices
 - b) Familiarity with use of Operating Microscope
28. NPCB and refractive blindness - optometrist's role as primary health care provides.
29. Health care's insurance including role of TPA.

D. BIOSTATISTICS & RESEARCH METHODOLOGY: [Marks - 20]

A) RESEARCH METHODOLOGY

Theory

1. **Introduction to Research methodology:** Meaning of research, objectives of research, Motivation in research, Types of research & research approaches, Research methods vs methodology, Criteria for good research, Problems encountered by researchers in India.
2. **Research problem:** Statement of research problem. Statement of purpose and objectives of Research problem, Necessity of defining the problem
3. **Research design:** Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design
4. **Sampling Design:** Criteria for selecting sampling procedure, Implications for sample design, steps in sampling design, characteristics of good sample design, Different types of sample design
5. **Measurement & scaling techniques:** Measurement in research- Measurement scales, sources of error in measurement, Technique of developing measurement tools, Meaning of scaling, its classification, Important scaling techniques.
6. **Methods of data collection:** collection of primary data, collection data through questionnaires & schedules, Difference between questionnaires & schedules.
7. **Sampling fundamentals,** need for sampling & some fundamental definitions, Important sampling distributions
8. **Processing & analysis of data:** Processing operations, problems in processing , Types of analysis, Statistics in research, Measures of central tendency, Dispersion, Asymmetry, relationship.
9. **Testing of hypothesis:** What is hypothesis? Basic concepts concerning testing of hypothesis, Procedure of hypothesis testing, measuring the power of hypothesis test, Tests of hypothesis, limitations of the tests of hypothesis.
10. **Computer technology:** Introduction to Computers, computer application in research, Computers & researcher.

BIOSTATISTICS :

Theory

1. **Introduction:** Meaning, definition, characteristics of statistics, Importance of the study of statistics, Branches of statistics, Statistics and health science including physiotherapy, Parameters and Estimates, Descriptive and inferential statistics, Variables and their types, Measurement scales.
2. **Tabulation of Data:** Basic principles of graphical representation, Types of diagrams – histograms, frequency polygons, smooth frequency polygon, cumulative frequency curve, Normal probability curve.
3. **Measure of Central Tendency:** Need for measures of central Tendency, Definition and calculation of mean – ungrouped and grouped, Meaning, interpretation and calculation of median ungrouped and grouped., Meaning and calculation of mode, Comparison of the mean, median and mode, Guidelines for the use of various measures of central tendency.
4. **Probability and Standard Distributions:** Meaning of probability of standard distribution, The binominal distribution, The normal distribution, Divergence from normality – skew ness, kurtosis.
5. **Sampling techniques:** Need for sampling - Criteria for good samples, Application of sampling in community, Procedures of sampling and sampling designs errors, Sampling variation and tests of significance.
6. **Analysis of variance & covariance:** Analysis of variance (ANOVA), what is ANOVA? Basic principle of ANOVA, ANOVA technique, Analysis of Co variance(ANACOVA).

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2. BASIC MEDICAL LABORATORY SCIENCE - I (Paper – II)

[Marks – 80]

A. LABORATORY MANAGEMENT AND QUALITY CONTROL [Marks - 20]

THEORY

1. Quality control of product, chemical reagents, good reliable and authentic report, Total quality management framework of laboratory.
2. Essential elements of quality assurance programme, internal quality control, control of pre-analytical variable, laboratory precision, accuracy and sensitivity validation method.
3. Reference material and calibrating definitive method, source of variation in laboratory test result, systemic and random error in the laboratory.
4. Quality control chart—IJ chart, Culsum chart, Glossial curve
5. Internal and external factor for quality control assurance.
6. Standard Bio-medical Laboratory set up, management through the client, patient, physician, administrative authority,
7. Marketing, management and economics related to bio medical laboratory science, management objective, cost benefit analysis, cost effective analysis, and cost accounting input output analysis.
8. System analysis, network analysis including programme evolution and review techniques ad critical path method, planning to pro work sampling, decision monitoring, cost of conformance and non- conformance.

B. ADVANCED SERODIAGNOSTIC TECHNIQUE [Marks - 30]

Theory

1. Collection and preparation of specimen used in serological laboratory.
2. Principle of sero-diagnostic tests, precipitation, flocculation, agglutination, neutralization and coagulation.
3. Serological test for syphilis (STS) and VDRL, CRP, RPR test.
4. WIDAL test for Salmonella types.
5. Serodiagnosis test for AIDS, Rubella, Toxoplasmosis, Leishmaniasis, Trypanosomiasis. TORCH panel test.
6. Immunological test for pregnancy.(direct and indirect)
7. Intradermal hypersensitivity test - Montoux test.
8. ASO test.
9. Complement Fixation Technique - working principle & application technique,
10. Haemagglutination Technique - working principle & application technique
11. Fluorescent/ immunofluorescent technique - working principle & application technique
12. Chemiluminescence Immune Assay (CLIA) - working principle & application technique
13. PCR - working principle & application technique
14. Western blot - working principle & application technique
15. Immuno-blot - working principle & application technique
16. ELISA: Types, Working Principle, and its application
17. Electrophoresis: Types, Working Principle, and its application
18. Counter immune electrophoresis- Electrophoresis: Types, Working Principle, and its application
19. HPLC: Types, Working Principle, and its application

Practical

1. Study of precipitation, agglutination and coagulation test.
2. VDRL test, WIDAL test, RPR, ASO test.
3. CRP test, RA test, AIDS test, STS test.
4. Immunological test for pregnancy.(direct and indirect)
5. Montoux test.

C. LABORATORY ETHICS [Marks - 15]

Theory

1. Co-operation and working relationship with other health professionals
2. Principle of laboratory ethics, laboratory ethical committee, institutional ethical committee and its role, Introduction, techniques and Social ethics of pathology, ethics of pathological clinic.
3. ISO rules for laboratory medicine, NABL guidelines and its implication.
4. Confidentiality of patients information and test result and guidelines for laboratory reports, dignity and privacy of patients.
5. Responsibility from acquisition of the specimen to the production of data.
6. NACO guidelines for laboratory medicine.
7. CLSI guidelines clinical laboratory.

D. COMPUTER APPLICATION [Marks -15]

Theory

1. Study on various components of a personal computer, hardware and software.
2. Computer Applications in pathological laboratory to recording and data presentation.
3. Basic knowledge and utility in multimedia in laboratories.
4. Application of the digital computer in patient maintaining, Basic knowledge on MS-office, Floppy recording, Storage of data in pathological laboratory.

Practical

- a. Operation of personal computer.
- b. Data storage, reporting, data presentation in computer.
- c. Application of MS-office in pathological laboratories.

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3. BASIC MICROBIOLOGY (Paper - III) [Marks - 80]

a) GENERAL MICROBIOLOGY

Theory

1. An introduction to microbiology, Classification of microorganisms,
2. Infection - Types, source, portals of entry, spread.
3. Prevention and control of infection, Disinfection and antiseptics Sterilization
4. Bacterial anatomy and nutrition.
5. Idea about different culture media and culture method, different staining - its procedure.
6. Introduction of Bacteriology, Virology and mycology.

b) SYSTEMIC MICROBIOLOGY

Theory

1. Diagnostic bacteriology, grouping, characteristics of common pathogen.
2. Laboratory diagnosis of mycotic infection.
3. Laboratory diagnosis of different parasitic infection of protozoa, helminth and arthropods.
4. Laboratory diagnosis of viral infection.

Practical

1. Sterilization techniques and cleaning of glassware.
2. Preparation of culture media, biochemical test for bacterial differentiation.
3. Examination of skin scapper fungi and Acid fast bacilli and examination of sputum for Acid fast bacilli.
4. Biochemical test for bacterial differentiation.
5. Gram staining: (gram positive and gram negative)
6. Collection, Presentation & Identification of different disease causing Arthropods (Housefly, Mosquito etc.)
7. Whole mount preparation of slide of different disease causing arthropods for their detailed anatomical studies.
8. Identification of different disease causing Helminth and Protozoan parasites.

9. Identification of different phases of life cycle of arthropods protozoa, helminth, having medical importance for causing disease.
 10. Examination of stool for OPC (Ova parasite Cyst).
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4. **BASIC MEDICAL LABORATORY SCIENCE - II (Paper - IV)** [Marks - 80]

A. BIOCHEMISTRY [Marks - 20]

Theory

1. **Carbohydrate** - Definition, Source, Classification, Functions and Importance, Physiological importance of major type of carbohydrates.
2. **Protein** - Definition, Source, Classification, Function and Importance of major type of proteins.
3. **Lipids** - Definition, Source, Classification, Function of major type of lipids. Saturated and Unsaturated type of fatty acids, Essential fatty acids and their importance. Phospholipids and their importance.
4. **Nucleic acid** - Structure and function of DNA & RNA. Nucleosides and Nucleotides, Genetic code, biologically important nucleotides.
5. **Vitamins** - Fat-soluble and water-soluble vitamins, Daily requirements, Physiological functions and diseases of vitamin deficiency.
6. **Bioenergetics** - Energy rich compounds. Respiratory chain and biological oxidation.
7. **Enzymes** - Definition, Classification, Mode of action, Factors affecting enzyme action, Chemical importance of enzyme.
8. Concept of P^H and buffers, Acid-base equilibrium, Osmotic pressure and physiological importance.
9. **Electrolytes** - Sodium and potassium metabolism.
10. **Isotopes** - Isotopes and their role in treatment and diagnosis of diseases.

PRACTICAL

1. Qualitative identification of Glucose, Fructose, Lactose, Maltose, Sucrose, Starch, Peptone, Glycerol, Cholesterol, Acetone, Bile salt in sample by biochemical tests.
2. P^H determination of a solution by titration.
3. Quantification of Glucose, Lactose and Sucrose in a specific sample.
4. Preparation of different buffers used in pathological laboratory and their P^H determination.
5. Sodium and Potassium estimation in Serum.

B. HEAMATOLOGY [Marks - 20]

THEORY

1. Cleaning of laboratory glassware in Haematology.
2. Blood sample collection by pricking method and brachial vein in adult and children.
3. Anticoagulants used for collection of blood samples with merits and demerits.
4. Separation of plasma and serum from blood.
5. Routine of haematological tests like Haemoglobin concentration, haematocrit, TC, DC of leukocytes, total count of Erythrocytes, determination of erythrocyte indices-MCV, MCH, MCHC, Reticulocyte count, platelets count, ESR.
6. Bleeding disorder—Determination of Clotting time, bleeding time and Prothrombin time.
7. Idea about Thalassaemia and Sickle cell anaemia, Importance of blood tests before marriage. Laboratory reports preparation and made interpretation of laboratory finding in haematology.
8. Haemostasis: Definition, types, clotting factors, Extrinsic and Intrinsic pathway, disorders.

PRACTICAL

1. Collection of blood sample from vein, Blood film preparation and it's staining.(Leishman Giemsa method)
2. Experiments on TC & DC, PCV, MCV, MCH, MCHC and ESR.(Wintrob method)
3. Determination of haemoglobin by haemoglobinometer and by colorimetric method.
4. Quantification of reticulocyte, thrombocyte and erythrocyte count.
5. Determination of Bleeding time and clotting time, PT.
6. Screening test for sickle cell anemia and slide identification of thalassaemia.

C. PATHOLOGY [Marks -20]

a)GENERAL PATHOLOGY

Theory

1. Aims and objectives of the study of pathology. Meaning of terms, etiology, pathogenesis and lesions
2. Causes of disease and cell injury – features of cell injury, mechanism of cell injury – hypoxia, free radical injury. Necrosis and gangrene
3. INFLAMMATION- definition, events of acute inflammation, chemical mediator of inflammation, morphological types of acute inflammation, chronic inflammation, difference between acute and chronic inflammation
4. REPAIR –primary healing, secondary healing, factors affecting healing and repair healing of skin, muscle and bone.
5. Fluid and hemodynamic derangements – oedema, hyperemia, Haemorrhage, shock, embolism, thrombosis, infarction
6. IMMUNITY – Classification of imunity, natural and acquired immunological mechanisms of tissue injury, hypersensitivity reactions, general features of autoimmune diseases and immunodeficiency diseases.

7. **NEOPLASIA:** characteristic of benign and malignant tumors, grading and staging of malignant tumors, a brief outline of the carcinogenic agents and methods of diagnosis of malignancy and general effects of malignancy on the host
8. **Nutritional disorders:** deficiency disorders (protein deficiency, vitamin deficiency (A,B,C,D,E,) causes , features , a brief outline of the methods of diagnosis.

b) SYSTEMIC PATHOLOGY

Theory

A brief outline of etiology, pathogenesis and general features of disease of the following systems.

(The morphology, microscopic details and details of diagnostic procedures are not required).

1. **Blood:** Disorders of RBC, WBC and platelets
2. **Blood Vessels:** Atherosclerosis, thromboangitis obliterans, varicose vein, DVT, thrombophlebitis, lymphoedema
3. **Disease of Heart:** Congestive cardiac failure, ischemic heart disease, rheumatic heart disease, infective heart disease (pericarditis, myocarditis, endocarditis)
4. **Respiratory System:** Pneumonias, Bronchiectasis, Emphysema, Chronic bronchitis, Asthma, Tuberculosis etc.
5. **Joints Disorders:** Arthritis- types and their features.
6. **Bone Disorders:** Osteoporosis, Paget's disease, Osteogenesis Imperfecta, Osteomyelitis, tumors-Osteosarcoma, Chondrosarcoma, Ewing's sarcoma, Multiple myeloma (a brief outline only)
7. **Muscles:** Muscular dystrophy, Myasthenia gravis
8. **Nervous System:** Meningitis, encephalitis, vascular diseases of brain, poliomyelitis, nerve injuries

c) Clinical Pathology:

1. Collection of urine and stool specimen, types of urine and stool specimen and preservation of urine and stool.
2. Routine examination of urine - physical and Microscopic examination.
3. Chemical test of urine for glucose, protein, Ketone bodies, bilirubin, urobilinogen & blood.
4. Laboratory investigation, Serous fluid and Gastric juice.
5. Collection and processing of CSF and its laboratory investigation.
6. Routine test for stool and occult blood test.
7. Examination of Sputum - routine and special test.
8. Semen Examination - routine and special test.
9. Various methods of detecting HCG level.

Practical

1. Physical and Microscopic examination of Urine.
2. Bio-chemical estimation of glucose in urine.
3. Bio-chemical estimation of protein and ketone bodies in urine, bile salt, bile pigment, urobilinogen and blood in urine.
4. Laboratory testing of CSF, Serous fluid, Gastric juice, and Synovial fluid.
5. Collection and processing of CSF and its laboratory investigation.
6. Routine test and microscopical test for stool and occult blood test.
7. Examination of Sputum - routine and special test.
8. Semen Examination - routine and special test.

9. Various methods of detecting HCG level.

D. IMMUNOLOGY [Marks - 20]

Theory

1. Basic concept of Immune system. Types of immunity, cellular, humoral, active, passive, natural, and acquired immunity. Primary immune organs
2. Basic Concept of Antigen , Antibody & its components .
3. Immunity & Hypersensitivity reactions
4. Principles & practice of antigen - antibody reactions (Agglutination, Precipitation, complement , fixation , gel diffusion, toxin reaction, haemagglutination)
5. Basic Concept & techniques of studying cell mediated immune response.
6. Basic concept of immunization. Primary and secondary response of immunization. Vaccination and Booster dose.
7. Immunoglobins—type, structure and their specific importance.
8. Immunodeficiency diseases.
9. Immunosuppression - role of organ transplantation.
10. Auto immune disease: Hasimotor disease, myasthenia gravis, RA and Lupus erythromatosus.
11. Erthoblastosis foetslis

Practical

1. Determination of 'ABO' blood grouping and 'Rh' typing.
2. Antibody measurement by Radial immuno-diffusion (RID) technique.
3. Antigen-Antibody reaction testing by precipiting ring. Ouchterlony test.
4. Quantitative assay of Immunoglobins in plasma.(IgG,IgM)

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2nd YEAR (SPECIALIZATION)

❖ MICROBIOLOGY (Specialization - 1)

1. BACTERIOLOGY AND MYCOLOGY [Paper - I]

a) Bacteriology

- a. Isolation and identification of bacteria.
 - b. Gram positive cocci of medical importance including Staphylococcus, Micrococcus,
- 2) Streptococcus, Enterococcus, Mycobacteria: general characters and classification. Gram negative cocci of medical importance including Neisseria, Branhamella, Moraxella, Veillonella
 - 3) Gram positive bacilli of medical importance including Laciobacillus, coryneform organisms, Gardnerella, Bacillus, Actinomyces, Nocardia, Actinobacillus and other Actinomycetales, Propionibacterium, Bifidobacterium, Eubacterium, Erysipelothrix, Listeria, Clostridium and other spore-bearing anaerobic bacilli.
 - 4) Gram negative bacilli of medical importance including Enterobacteriaceae, Vibrio, Aeromonas, Plesiomonas, Haemophilus, Bordetella, Brucella, Pasteurella, Francisella, Legionella, Pseudomonas, Burkholderia, Chromobacterium, Flavobacterium, Acinetobacter, Achromobacter, Cardiobacterium and other non-fermenters, Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Leptotrichia, Mobiluncus and other anaerobic Gram negative bacilli, Helicobacter, Campylobacter and Spirillum, Spirochaetes, Mycoplasmas and chlamydiae, Rickettsiae including Bartonella Coxiella, etc.
 - 5) Knowledge of the above family/ genus/ species should include definition, historical perspectives, classification, morphology, cultural characteristics, metabolism, and antigenic structure, laboratory isolation and identification, tests for virulence and pathogenicity, susceptibility.
 - 6) Bacterial metabolism- Role of metabolism in Biosynthesis and growth, focal metabolites and their interconversion, assimilatory and biosynthetic pathway, regulation of metabolic pathway.
 - 7) Urinary tract infection (UTI)
 - 8) Antibiotic sensitivity test.

Practical

1. Study of morphological, cultural and biochemical characters of common bacterial pathogens. Diagnostic Bacteriology
2. Epidemiology of bacterial infections, Guidelines for the collection, Transport, Processing analysis, isolation of bacterial pathogens and reporting of cultures from specimens for bacterial infections
3. Bacterial infections of respiratory tract.
4. Bacterial infections of gastro intestinal tract and food poisoning.
5. Bacterial urinary tract infections.
6. Bacterial infections of genital tract and reproductive organs.

7. Bacterial infections of central nervous system.
8. Skin and soft tissue infections.
9. Bone and joint infections
10. Eye ear and sinus infections
11. Cardiovascular infections
12. Tissue samples for culture
13. Anaerobic infections
14. Zoonotic infections.
15. Infections associated with immunodeficiency and immune suppression
16. Pyrexia of unknown origin.
17. Enteric fever
18. Streptococcal infections
19. Syphilis
20. Rickettsial infections
21. Brucellosis
22. Primary atypical pneumonia
23. New rapid serological diagnostic methods for bacterial infections.
24. Antibiotics in clinical laboratory, Study of antibiotic sensitivity of common pathogens, Antibiotics and mechanism of action MIC&MBC Invitro susceptibility tests-Different methods Rapid methods of antibiotic susceptibility tests Antibiotic resistance mechanisms
25. Detection of methicillin resistant staphylo coci
26. Isolation, Characterization and identification of pathogens from various clinical Specimens.
27. Common serological tests for the diagnosis of bacterial infections.

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2. VIROLOGY AND PARASITOLOGY [Paper – II]

a) VIROLOGY

Theory

1. **General morphology and ultra structure of Viruses:** Capsids- Helical Symmetry, icosahedral symmetry and complex symmetry
2. **Bacteriophages:** Classification, Morphology and ultrastructure One step growth curve (Latent period, eclipse period and burst size).
3. **Life cycles and other details of DNA viruses:** herpes, adeno and SV40
4. **Life cycle and other details of RNA viruses:** Retroviruses, oncogenic viruses and lentiviruses (HIV), picorna, orthomyxo and paramyxo.
5. **Systematic Virology-** Parvo viruses, Adeno viruses, Papova virus, Herpes virus, Pox virus, orthomyxovirus, paramyxovirus , Rubella virus, Arbovirus, Rhabdo virus, Hepatitis viruses, Retro viruses, Human enteric viruses, Oncogenic viruses, Prions of humans.
6. **Diagnostic virology-**
 - i) Laboratory diagnosis of viral infections.
 - ii) Collection, Preservation, transportation, Processing, and reporting of various clinical specimens for viral infections.
 - iii) Pathogenesis of viral infections

- iv) Immune response to viral infections
- v) Epidemiology of viral infections, Antiviral agents
- vi) Viral infections in immunocompromised patients.

Practical

1. Diagnostic tests in virology, Animal-cell cultures, Media, Sterilization, Demonstration of cell lines, CPE, embryonated egg inoculation, immuno fluorescent techniques, Viral neutralization tests, Viral haemagglutination tests and haemagglutination inhibition tests, serological tests for viral infections, Western blot technique.
2. Serological methods: haemagglutination, haemagglutinationinhibition, complement fixation, immunofluorescence assays(IFA), ELISA, RIA.
3. Assays of viruses: physical and chemical methods of assays (protein nuclei acid, radioactivity traces, electrons microscopy, plaque method, pock counting method, end point method and infectivity of plant viruses).

b) PARASITOLOGY

Theory

1. General Principles of host parasite interactions and definitions of terms in this connection
2. Morphology, life cycle and pathogenesis of the parasites listed below. The students should know the medical importance, laboratory diagnostic methods, drugs used for therapy and Epidemiology.
3. PROTOZOA
 - i. Intestinal amoebae.
 - ii. Free living pathogenic amoebae
 - iii. Intestinal and genital flagellates
 - iv. Haemoflagellates
 - v. Ciliates of medical importance
 - vi. Malarial parasite
4. HELMINTHS
 - i. Nematodes
 - (a) Intestinal
 - (b) Tissue
 - ii. Trematodes infection in man.
 - iii. Cestodes infecting man
 - iv. Larval infections in man.

Practical

1. Collection, Presentation & Identification of different disease causing Arthropods (Housefly, Mosquito etc.)
2. Whole mount preparation of slide of different disease causing arthropods for their detailed anatomical studies.
3. Identification of different disease causing Helminth and Protozoan parasites.
4. Identification of different phases of life cycle of arthropods protozoa, helminth, having medical importance for causing disease.

5. Slide identification of microfilaria, Taenia solium, ascaris, and deferent stages of malaria.
6. Examination of stool for OPV(Ova parasite Cyst)
7. Trematodes infection in man.
8. Cestodes infecting man
9. Larval infections in man

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3. MOLECULAR MICROBIOLOGY & GENETICS [Paper - III]

Theory

1. DNA as genetic material, structure of DNA, structure of RNA, DNA replication, genetic code, gene structure, transcription, translation.
2. Gene as a unit of mutation & recombination.
3. Mutagenesis, mutations & mutants- biochemical basis of mutations, Genetic mechanism of drug resistance. spontaneous & induced mutations, isolations of mutants, mutagenesis, reversion, suppression, genetic analysis of mutants.
4. Transformation- competence cells, regulation, general process
5. Transduction- general & specialized;
6. Recombination Mechanism: Introduction & models Extra chromosomal heredity
7. Recombination Mechanism: Introduction & models- Extra chromosomal heredity partitioning, incompatibility & gene transfer, transposable genetic elements & gene mapping
8. Regulation & expression of gene activity lac Operons.
9. Bacterial genome, Extra chromosomal genome, phenotypic and genotypic variations, regulation and expression of gene activity, genetic transfer in bacteria, Hfr strains, R factor, bacteria in genetic engineering.
10. Viral genome, types and their symmetry, cultivation of virus in embryonated eggs, primary culture and secondary culture.

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4. DIAGNOSTICS AND APPLIED MICROBIOLOGY [Paper - IV]

Theory

1. Nosocomial infections

- Epidemiological aspects of control infections and diseases
- Typing methods in Bacteriology
- Hospital acquired infections
- Surgical and trauma related infections
- Microbial bio - film -prevention, control and removal
- Role of microbiology lab for infection control in hospital
- Emerging infectious diseases

2. Public health Microbiology

- Microbiology of air
- Bacteriology of water and water born infections
- Microbiology of milk and milk products
- Milk born infections
- Bacteriology of food and food born diseases

Vaccines for infectious diseases

Molecular diagnostic methods in microbiology

Automation in diagnostic microbiology

Microbiology Laboratory Physical design, Management and organization

Quality in the clinical Microbiology Laboratory

Genetically modified microorganisms

3. Opportunistic infection

4. Molecular Diagnostic methods Molecular diagnostic techniques relevant to medical microbiology.

PCR and its modifications including nested PCR, Multiplex PCR.

Special emphasis to Real-time PCR. Principles of different hybridization techniques

Principles of recombinant DNA technology

5. Principle, techniques and application of Fermentation, BACTEC, VIOTEC 2 & MGIT culture.

6. Clinical diagnosis serological techniques for identification of bacteria: TMV

Bacteriophages. HIV. SV 40, myxo & paramyxovirus.

DISSERTATION

Each candidate pursuing Msc. MLT course is required to carry out work on selected research to carry out work on selected research project/dissertation under the guidance of a recognised post graduate teacher in same field.

The dissertation/research project is aimed to train a graduate student in research methods and techniques. It includes identification of problem, formulation, formulation of hypothesis, search and review of the literature, design of the research study, collection of data, analysis of data, interpretation of results and finally frame conclusions.

The dissertation / research project should be written under following heading:

INTRODUCTION
AIMS OR OBJECTIVES OF STUDY
FORMULATION HYPOTHESIS
REVIEW OF LITERATURE
MATERIALS AND METHODS
RESULTS
DISCUSSION AND INTERPRETATION
CONCLUSION
SUMMARY
REFERENCES
TABLES
ANNEXURE

SYNOPSIS

Every candidate should submit a synopsis to the registrar of the university in the prescribed format containing particulars of proposed dissertation work after obtaining ethical clearance from the Institutional Ethical Committee comprising principal and other senior faculty of the college within 6 months from the date of admission on or before the date 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.

Synopsis should be written under following heading:-

Proposed research project topic

Introduction

Aim of Study

Objective of the study

Formulation hypothesis

Review of literature

Materials and methods

Statistics

References

The written text of synopsis shall not exceed 8(eight) pages including all the above mentioned topics.

DISSERTATION SUBMISSION

The candidate should submit their dissertation work at the end of 10 months of second year of the M.sc. MLT course.

The candidate should submit six (6) copies of dissertation (with hard binding) to the Principle/Head of the Institution. Institute shall be submitted four (4) copies of dissertation to the registrar on the 22nd month of the commencement of course on or before the date notified by the university.

EVALUATION OF DISSERTATION

Dissertation valuation of the candidates will be conducted by the Internal and External examiners together on the basis of work, presentation and defense viva at the time of second year M.sc. MLT practical examination.

STANDARD FORMAT OF DISSERTATION

The written text of dissertation shall not be less than 100 pages and shall not exceed 150 pages excluding references, tables, questionnaires and annexure. It should be neatly typed (font size 12 - Time New Roman or font size 123 Arial) in double line spacing on one side of the bond paper (A-4 Size) and bound properly. The Guide and the head of the Institution shall certify the dissertation.

CHANGE OF DISSERTATION TOPIC/ GUIDE

No change in the dissertation topic/guide shall be made without prior approval from the university.

ABSTRACT

Abstract provides a brief summary of the dissertation/thesis, summing up clearly the problem examined, the methods used, and the main findings. The abstract is a one-paragraph, self-contained summary of the most important elements of the paper. The abstract word limit is between 250 and 300 words. All numbers in the abstract (except those beginning a sentence) should be typed as digits rather than words. Key words (max.10) should be given, chosen from subject concerned headings. Each word should be separated by semicolon.

GENERAL PRINCIPLES

PAPER

Use only one side of high quality, plain white (unlined in any way) bond paper, minimum 20-lb weight, and "8 ½ x 11" in size. Erasable paper should not be used.

TYPE SIZE AND PRINT

The font size should be visible to the reader, preferably Times New Roman 12 pt .No italicization.68 Size of the title should be 14 and bold; the size of sub-title should be 12 and bold. Print should be letter quality or laser (not dot matrix) printing with dark black characters that are consistently clear and dense. Use the same type of print and print size throughout the document.

PAGINATION

Number all of the pages of your document, including not only the principal text, but also all Plates, tables, diagrams, maps and so on. Roman numerals are used on the preliminary pages

(Pages up to the first page of text) and Arabic numerals are used on the text pages. The numbers themselves can be placed anywhere on the page, however they should be consistent.

SPACING

Use double spacing except for long quotations and foot notes which are single spaced.

MARGINS

Margin size; “generous”- Use plenty of room on the top, bottom, left & right (1” minimum). To allow for binding, the left hand margin must be 1.5”. Other margin should be 1.0”. Diagrams or photographs in any form should be a standard page size, or if larger, folded so that a free left-hand margin of 1.5” remains and the folded sheet is not larger than the standard page.

PHOTOGRAPHS

Professional quality black-and-white photographs are necessary for clear reproduction. Colors are allowed, but you should be certain the colored figure will copy clearly and will not be confusing when printed in black and white.

FILE FORMAT

Dissertation format should be in Doc (Ms Word document) or PDF (portable document Format), Image file in JPG or TIFF format and audio visual in AVI (Audio Video Interleave), GIF, MPEG (moving picture expert) files format.

LABELING ON CD

CD-ROM labeling should be standard and should contain title, Name of the candidate, degree name ,subject name, Guide name, name of the department, College, place and year.
