

The members of the Syllabus Committee of Medical Laboratory Science & Technology has formally approved the final syllabus.

Members :-

1.

Debidas Ghosh
29/6/25

.....
Prof. (Dr.) Debidas Ghosh (Chairperson)

Department of Bio-Medical Laboratory Science & Management

Vidyasagar University

Email: debidas_ghosh@yahoo.co.in

2.

Syamal Roy
30/6/25

.....
Dr. Syamal Roy, FASc FNASc FNA

INSA Sr Scientist

Indian Association for the Cultivation of Sciences, Jadavpur, Kolkata-700032, India

Former Vice Chancellor,

Coochbehar Panchanan Barma University, Shankar Mandal Rd, Cooch Behar, WB- 736101

J.C. Bose Fellow, Department of Science and Technology, Govt. of India

Professor, National Institute of Pharmaceutical Education and Research, Kolkata

Former Chief Scientist,

Division of Cell Biology and Physiology,

CSIR-Indian Institute of Chemical Biology, Kolkata-700032, India

Email: drsyalmaroy@yahoo.com

3.

Chiranjib Pal
30/6/25

.....
Prof. Chiranjib Pal,

Professor, Department of Zoology,

Room 504 (Research Lab 3), New Academic Building #1,

West Bengal State University, Barasat, North 24 Parganas,

Berunanpukuria, PO: Malikapur, Pin - 700126, West Bengal, India.

E-mail: chiranjibpal.zoology@wbsu.ac.in, cpcu.immunology@gmail.com

4.

Payel Bhattacharjee
29/6/25

.....
Dr. Payel Bhattacharjee (Co-Ordinator)

Assistant Professor,

Department of Zoology,

Rabindra Mahavidyalaya,

Champadanga, Hooghly, WB-712401

Email: payel.iicb@gmail.com

RANI RASHMONI GREEN UNIVERSITY TARAKESWAR, HOOGHLY



Syllabus
of
Master of Science (M.Sc.)
in
Medical Laboratory Science & Technology

Under Semester System
Course Duration: 2 years, 4 Semesters
[W.e.f. : 2025-2026]

Subject: Medical Laboratory Science & Technology (MLT) Programme Structure

Semester	Course Code	Course Title	Full Marks	Credit (L+T+P)	Lecture hours
I	EVS	Environmental Science	40+10*	4 (2-0-2)	40
	MLT-101	Clinical Laboratory Biosafety, Ethics and Quality Control	40+10	4 (4-0-0)	40
	MLT-102	Human Anatomy and Physiology	40+10	4 (4-0-0)	40
	MLT-103	Clinical Biochemistry and Fundamental Laboratory Pathology	40+10	4 (4-0-0)	40
	MLT-194	Survey on Clinical Laboratory Biosafety, Ethics and Quality Control (P)	50	4 (0-0-4)	80
	MLT-195	Clinical Biochemistry and Fundamental Laboratory Pathology (P) / Short-term training at pathological laboratory	50	4 (0-0-4)	80
	Total		300	24	320
II	MLT-201	CBCS-I Nutrition and Public Health	40+10	4 (4-0-0)	40
	MLT-202	Clinical Immunology, Serology, Hematology, Blood Transfusion and Blood Bank	40+10	4 (4-0-0)	40
	MLT-203	Cytotechnology and Histotechnology	40+10	4 (4-0-0)	40
	MLT-204	Research Methodology, Epidemiology and Health Statistics	40+10	4 (4-0-0)	40
	MLT-295	Hematology and serology (P)/ Short-term training at diagnostic laboratory	50	4 (0-0-4)	80
	MLT-296	Cytotechnology and Histotechnology (P)/ Short-term training at diagnostic laboratory	50	4 (0-0-4)	80
	Total		300	24	320
III	MLT-301	CBCS-II First Aid and Cardiopulmonary resuscitation Emergency Handling	40+10	4 (2-2-0)	40
	MLT-302	Clinical Endocrinology and Reproductive Technology	40+10	4 (4-0-0)	40
	MLT-303	Clinical Entomology and Parasitology	40+10	4 (4-0-0)	40
	MLT-304	Clinical Bacteriology, Virology and Mycology	40+10	4 (4-0-0)	40
	MLT-395	Clinical Endocrinology, Spermiology (P)	50	4 (0-0-4)	80
	MLT-396	Clinical Microbiology, Entomology and Parasitology (P)	50	4 (0-0-4)	80
	Total		300	24	320

IV	MLT-401	Biomedical Instrumentation and Molecular Diagnostic Techniques	40+10	4 (4-0-0)	40
	MLT-402	Advanced Laboratory Pathology	40+10	4 (4-0-0)	40
	MLT-403	Advanced Diagnostic Bacteriology, Virology and Mycology	40 +10	4 (4-0-0)	40
	MLT-494	Advanced Laboratory Pathology (P)	50	4 (0-0-4)	80
	MLT - 495	Advanced Diagnostic Bacteriology, Virology (P)	50	4 (0-0-4)	80
	MLT-496	Internship (2 months internship at hospitals)	50	4 (0-0-4)	160
	Total			300	24
Grand Total			1200	96	1400

Theory -50 Marks, Written - 40 Marks, Internal Assessment -10 Marks

Theory - ... Marks, Written - Marks, Internal Assessment -... Marks Practical - 100 Marks

For Theory :- X-0-X

For Practical/Project:- X-9-X

For Practical/Project, lecture hours would be twice of the theory

*Each student will obtain marks based on the plantation and growing up of a sapling that would produce fruits and attract the birds/animals.

Overview

Semester	Paper	No of Papers	Full Marks of Each Paper	Credit Point of Each Paper	Total Marks	Credit Points	Total Credit Point
1 st	Theoretical		40+10 = 50		300		24
2 nd	Theoretical		40+10 = 50		300		24

3 rd	Theoretical		40+10 = 50		300		24
4 th	Theoretical	4	40+10 = 50		300		24
	Project Internsh ip	2	50				
Grand Total 96 Credit Points							

Question Pattern :

- Question of 2 marks (4 questions out of 6 questions, should be attended by the students) = 8 marks
- Questions of 4 marks (4 questions out of 6 questions, should be attended by the students) = 16 marks
- Questions of 8 marks (2 questions out of 4 questions, should be attended by the students) = 16 marks

Total = 40 marks

Program outcome (P.O):

The purpose of the postgraduate Medical Laboratory Science & Technology(MLT) course at Rani Rashmoni Green University is to provide the key knowledge base /and laboratory resources on the laboratory aspects of medical care with a good scientific foundation to prepare students for careers as professionals in the field of laboratory technology.

On completion of the course, the student should be able to gain in-depth knowledge and skills which will be useful for entrepreneurship-based, research-based career development.

Knowledge based

- Demonstrate a strong understanding of the laboratory safety protocols, scientific principles and ethics, and various techniques involved in laboratory diagnostics.
- Ability to interpret laboratory results accurately, understand their significance in the context of patient health, and correlate findings with clinical presentations.
- Students should possess a solid understanding of medical terminology related to laboratory science and be able to use it effectively when communicating with other healthcare professionals.
- Compare and explain the choice of advanced diagnostic methods and biomarkers in the modern pathology laboratory.
- Understand the concept of epidemiology and statistics and their clinical relevance.
- Theorise and reflect on how machine learning and artificial intelligence can be used in current and future diagnosis and care applications.

Skills and abilities

- Independently search, analyse, and evaluate the choice of advanced methods in pathological

diagnostics for profession-relevant human diseases.

- Students will gain practical skills for analyzing body fluids and tissues to aid in disease diagnosis and treatment.
- These skills include specimen handling, laboratory equipment operation, quality control, and effective communication within a healthcare team.
- Apply different applications for machine learning for advanced image analysis, present results, and formulate conclusions based on the results.
- Problematising over ethical issues around digital pathology

Entrepreneurship-based

- Students would learn to analyze the needs of healthcare providers and patients, identifying gaps in existing diagnostic services that they could address with their technical expertise.
- The core knowledge and skills in laboratory procedures, quality control, and instrument operation would be crucial in establishing and running a successful laboratory-based business.
- Offering a range of laboratory services to patients and hospitals.
- Advising hospitals and clinics on laboratory operations, quality control, and technology selection.

Research-based

- Students may be involved in designing and executing research studies related to laboratory techniques, sample handling, or the impact of new technologies on diagnostic accuracy.
- Working in research and development to create innovative laboratory tools and techniques.
- Focusing on specific areas of expertise, such as genetic testing or molecular diagnostics.
- Ultimately, the research-based outcome aims to equip students with the skills to contribute to the advancement of knowledge and improve the quality of laboratory services.

Innovation and creativity-based

- Students could be tasked with identifying areas for improvement in laboratory workflows, suggesting automation or streamlining to increase efficiency and reduce errors.
- Students would be encouraged to develop innovative solutions to existing diagnostic challenges, potentially leading to new laboratory techniques or technologies.

1st Semester				
Paper	Course	Marks	Lecture hours	Credit Point
EVS	Environmental Science	40+10	40	4
MLT-101	Clinical Laboratory Biosafety, Ethics and Quality Control	40+10	40	4
Unit 1	Laboratory Biosafety			
Unit 2	Ethics and Quality Control (Clinical Research, Medical Law)			
Unit 3	Record Keeping and Health Informatics			
Unit 4	Preparation of Operating Budget			
MLT-102	Human Anatomy and Physiology	40+10	40	4
Unit 1	Overview of Human Body and Nervous System			
Unit 2	Skeletal and Muscular System			
Unit 3	Cardiovascular and Respiratory System			
Unit 4	Digestive and Endocrine System			
Unit 5	Excretory and Reproductive System			
MLT-103	Clinical Biochemistry and Fundamental Laboratory Pathology	40+10	40	4
Unit 1	Laboratory Practice in Clinical Biochemistry			
Unit 2	Biomolecules			
Unit 3	Metabolic and Genetic Disorders			
Unit 4	Introduction to Laboratory Pathology			
MLT-194	Survey on Clinical Laboratory Biosafety, Ethics and Quality Control (P)	50	80	4
MLT-195	Clinical Biochemistry and Fundamental Laboratory Pathology (P)/ Short-term training at pathological laboratory	50	80	4
	Total Marks	300		
	Total Credit			24

Text Books/References

CC-101, Unit -01-04 and CC- 194: Clinical Laboratory Biosafety, Ethics and Quality Control

1. Laboratory biosafety manual, 4th edition, by World Health Organization, 2020, ISBN: 978-92-9-49001131-1.
2. Biosafety in Microbiological and Biomedical Laboratories, by Health and Human Services department; 5th edition, 2010, ISBN: 978-0160850424
3. Textbook of Bioethics, Medical Ethics and Health Law by Russell D'souza, Vedprakash Mishra, Mary Mathew. Paras Medical Books Pvt Ltd; 1st Edition, 2023, Paras Medical Books Pvt Ltd, India, ISBN : 978-8195409723.
4. The Ethics of Artificial Intelligence in Healthcare: From Hands-on Practice to Policy-making. In The International Library of Ethics, Law and Technology by Eike-Henner W. Kluge. Springer Cham, 1st edition, 2024, ISBN:978-3-031-72836-5.
5. Electronic Medical Records: A Practical Guide for Primary Care. In Current Clinical Practice. Neil S. Skolnik (Editor), Springer Science, Humana Totowa, NJ, 1st Edition, 2010, ISBN: 978-1-60761-605-4.
6. Health Information Management: Principles and Organization for Health Information Services. By Margaret A. Skurka. Jossey-Bass Public Health, 6th Edition, 2017, ISBN: 9781119151203.
7. Medical Laboratories Management: Cost Effective Methods. By: Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi, Rajeev Thakur. Viva Books Originals, India, 2018, ISBN: 9789386105417.

CC-102, Unit -01-04: Human Anatomy and Physiology

1. Ross and Wilson Anatomy and Physiology in Health and Illness. By Anne Waugh and Allison Grant, International Edition, 14th Edition, Elsevier, 2022.
2. Neuroanatomy. Alan R. Crossman, David Neary. Elsevier Health Sciences, 2014.
3. Student Workbook for Essentials of Anatomy and Physiology. By Valerie C Scanlon, Tina Sanders. F.A. Davis, 2018.
4. Textbook of Anatomy & Physiology for Nursing. By Indu Khurana, Arushi Khurana. CBS Publishers & Distributors Pvt Ltd, India, 2018.

CC-103, Unit -01-04 and CC-195: Clinical Biochemistry and Fundamental Laboratory Pathology

1. Biochemistry and Clinical Pathology. By Devika K. Tilekar, Nileema S. Modhave, Manisha Y. Chaudhari. Technical Publications, India, 2023.
2. Introduction to Clinical Biochemistry: Interpreting Blood Results. By Dr. Graham Basten.
3. A Textbook Fundamental Book Of Biochemistry & Clinical Pathology. By Dr. Keshav K. Gupta, Dr. S.R. Sahu, Dr. Arun Kumar Singh, Dr. Shambaditya Goswami. Adhyayan Books, 2023, ISBN: 978-9358473896.
4. Clinical Biochemistry:Metabolic and Clinical Aspects. By William J. Marshall, Marta Lapsey, Andrew Day, Ruth Ayling. Churchill Livingstone, Elsevier, 3rd Edition, 2014, ISBN : 9780702051401
5. Practical Clinical Biochemistry: Methods & Interpretations by Ranjna Chawla. Jaypee Brothers Medical Publishers, 5th Edition, 2023. ISBN: 9789389188769.
6. Principles and Interpretation of Laboratory Techniques in Pathology. By Shameem Sharif. Jaypee Publisher, 1st Edition, 2024.
7. Textbook of Medical Laboratory Science & Technology- Vol 1 and 2. by Praful B. Godkar; Darshan P. Godkar. Book Bundle, 3rd Edition, 2024, Bhalani Publishing House.
8. Fundamentals of Urine and Body Fluid Analysis. By Nancy A. Brunzel. Elsevier Science Health Science; 5th edition, 2022.

2 nd Semester				
Paper	Course	Marks	Lecture hours	Credit Point
MLT-201	CBCS-I Nutrition and Public Health	40 + 10	40	4
Unit 1	Fundamentals of food and nutrition			
Unit 2	Principles of diet in diseases			
Unit 3	Diet Planning			
Unit 4	Food safety			
MLT-202	Clinical Immunology, Hematology and Serology	40 + 10	40	4
Unit 1	Clinical Immunology			
Unit 2	Serology			
Unit 3	Hematology			
Unit 4	Blood Bank and Blood Transfusion			
MLT-203	Diagnostic Cytotechnology and Histotechnology	40 + 10	40	4
Unit 1	Introduction to Histopathology			
Unit 2	Cytology			
Unit 3	Staining and Immunochemistry			
Unit 4	Cytology Laboratory and Cryopreservation Techniques			
MLT-204	Research Methodology and Health Statistics	40 + 10	40	4
Unit 1	Research in Medical Laboratory Technology			
Unit 2	Epidemiology and Public Health			
Unit 3	Basic statistics			
Unit 4	Statistics in Clinical Application			
MLT-295	Serology and Hematology (P)/ Short-term training at diagnostic laboratory	50	80	4
MLT-296	Cytotechnology and Histotechnology (P)/ Short-term training at diagnostic laboratory	50	80	4
	Total Marks	300		
	Total Credit			24

Text Books/References:

CC 201: Unit 01-04: CBCS-I Nutrition and Public Health

1. Textbook of Human Nutrition. By (Late) Anjana Agarwal and Shobha A Udipi. Jaypee Brothers Medical Publishers, 2nd Edition, 2022.
2. Advanced Human Nutrition. By Medeiros, Denis M., Wildman, Robert E. C. Jones & Bartlett Learning; 4th edition, 2018.
3. Biochemical, Physiological, and Molecular Aspects of Human Nutrition. By Martha H. Stipanuk, Marie A. Caudill. Saunders, 4th Edition, 2018.
4. Williams' Basic Nutrition & Diet Therapy. By Staci Nix McIntosh. Mosby 15th Edition, 2016.

CC-202: Unit 01-04, CC-295: Clinical Immunology, Hematology and Serology

1. Clinical Haematology, Illustrated – Colour Atlas Victor Hoffbrand, John E Peth't.
2. Practical Hematology –Dacie, Lewis.
3. Haematology – Williams
4. Wintrobe clinical haematology Vol- I. 5. Wintrobe clinical haematology Vol- II.
5. Lynch's Medical Lab – Technology Latest edition
6. Clinical Diagnosis & Management – Todd & Sanford.
7. Medical Laboratory Science & Technologyby Sood, Jaypee Brothers.
8. Clinical Haematology in Medical Practice – G.C. Degruchy.
9. Immunology & Serology in Laboratory Medicine. By Mary Louise Turgeon. Mosby; 7th edition, 2021.
10. Clinical Immunology And Serology A Laboratory Perspective. By Stevens, Christine Dorresteyn. F. A. Davis Company, 2005.
11. Clinical Immunology & Serology: A Laboratory Perspective. By: Linda E. Miller, Christine Dorresteyn Stevens, Linda E Miller. F. A. Davis Company, 5th Edition, 2021.
12. Kuby Immunology. By Jenni Punt, Sharon Stranford, Patricia Jones, Judith A Owen.WH Freeman; 8th edition, 2018.
13. Basic Serological Testing. In: Techniques in Life Science and Biomedicine for the Non-Expert By Rowa Yousef Alhabbab. Springer, 2018.

CC-203: Unit 01-04, CC-296: Diagnostic Cytotechnology and Histotechnology

1. Manual of immunohistotechnology, histotechnology and cytotechnology. By Romanik Sood, Tejaswini Srikhande. CBS Publishers and Distributors Pvt. Ltd., 2022.
2. Diagnostic Cytology. By Pranab Dey. Jaypee Brothers Medical Publishers, New Delhi, 3rd Edition, 2022.
3. Techniques in Histopathology and Cytopathology. By Sadhana Vishwakarma. Jaypee Brothers Medical Publishers (P) Ltd., 2017.
4. Basic and Advanced Laboratory Techniques in Histopathology and Cytology. By Pranab Dey. Springer, 1st edition, 2018.

CC-203: Unit 01-03, Research Methodology, Epidemiology and Health Statistics

1. Research Methodology: Methods and Techniques. By C.R. Kothari. New Age International Publishers; 5th edition, 2023, New Age International Private Limited.
2. Research Methodology and Biostatistics. By Vinod Kumar Bais. Pee Vee Publishers.
3. Biomedical Research Methodology. By Ranjan Das, PN Das. Jaypee Brothers Medical Publishers, New

Delhi, 2011.

4. Modern Epidemiology. By Timothy L. Lash (Author), Tyler J. VanderWeele (Author), Sebastien Haneuse (Author), Kenneth J. Rothman. Wolters Kluwer Publishers, 4th Edition, 2021.
5. Statistics for Epidemiology. By Nicholas P. Jewell. CRCPress, 1st Edition, 2004.
6. Epidemiology Principles and Practice. By Susmita Bhattacharya. Jaypee Brothers Medical Publishers, 1st Edition, 2010.
7. Applied Statistics in Health Sciences. By NSN Rao, NS Murthy. Jaypee Brothers Medical Publishers, New Delhi, 2010.
8. Mahajan's Methods in Biostatistics for Medical Students and Research Workers. By Bratati Banerjee. Jaypee Brothers Medical Publishers, New Delhi, 9th Edition. 2018.
9. Medical Statistics: A Textbook for the Health Sciences. By Stephen J. Walters, Michael J. Campbell, David Machin. Wiley-Blackwell, 5th Edition, 2021. ISBN: 978-1-119-42364-5.

3rd Semester: Spl.				
Paper	Course	Marks	Lecture hours	Credit Point
MLT-301	CBCS-II First Aid and Cardiopulmonary Resuscitation Emergency Handling	40 + 10	40	4
Unit 1	Introduction to first aid			
Unit 2	Victim assessment and rescue methods			
Unit 3	Response to cardiac emergencies			
Unit 4	Primary home-based treatment to diarrhoea, burn and snake or insect-bite			
MLT-302	Clinical Endocrinology and Reproductive Technology	40 + 10	40	4
Unit 1	Endocrine glands and hormones			
Unit 2	Hormones of the gonads, adrenal gland and gastrointestinal tract			
Unit 3	Male and female reproductive system, stem cells and chromosomal disorders			
Unit 4	Reproductive Technology			
MLT-303	Clinical Entomology and Parasitology	40 + 10	40	4
Unit 1	Basic entomology			
Unit 2	Vector borne diseases			
Unit 3	Medical parasitology			
Unit 4	Applied parasitology			
MLT-304	Clinical Bacteriology, Virology and Mycology	40 + 10	40	4
Unit 1	General microbiology			
Unit 2	Medical bacteriology			

Unit 3	Medical virology			
Unit 4	Medical mycology			
MLT-395	Clinical Endocrinology, Spermiology (P)	50	80	4
MLT-396	Clinical Microbiology, Entomology and Parasitology (P)	50	80	4
	Total Marks	300		
	Total Credit			24

Text Books/References:

CC- 301, Units 01-04: CBCS-II First Aid and Cardiopulmonary Resuscitation Emergency Handling

1. First Aid, CPR, and AED Standard. By Alton L. Thygerson, Thygerson, Steven M., Guili, Benjamin, Mell, Howard L., Bob Elling. Jones & Bartlett Learning 7th Edition, 2016.
2. Introduction to First Aid and Cardiopulmonary Resuscitation by Moses Adrod. 2022. ISBN: 979-8356668173
3. First Aid Procedure Emergency Management. By Yogendra Garg, Hitendra Sharma. Saurabh Medical Publishers, 3rd Edition, 2022.

CC- 302, Units 01-04, CC-395: Clinical Endocrinology and Reproductive Technology

1. Williams Textbook of Endocrinology. By Shlomo Melmed, Ronald Koenig, Clifford J. Rosen, Richard J. Auchus, Allison B. Goldfine. Elsevier, 14th Edition, 2019.
2. Principles and Practice of Assisted Reproductive Technology. By Kamini A Rao, Deepika Krishna, Mir Jaffar, Mohammed Ashraf C. Volume 1-3, Jaypee Brothers Medical Publishers (P) Ltd., 2nd Edition, 2019.
3. Speroff's Clinical Gynecologic Endocrinology & Infertility. By Hugh S Taylor. Wolters Kluwer India, 9th Edition, 2019.
4. Manual of Assisted Reproductive Technologies and Laboratory Sciences (Volume 1-3). By Prof (Col) Pankaj Talwar VSM, M Gouri Devi, Jayant Mehta, Ashok Agarwal. Evangel Publishing, First Edition, 2022.
5. Manual of Assisted Reproductive Technologies & Clinical Embryology. By Pankaj Talwar VSM. Jaypee Brothers Medical Publishers (P) Ltd., 2nd Edition, 2012.

CC- 303, Units 01-04: Clinical Entomology and Parasitology

1. Handbook of Medical Entomology For Medical Undergraduates, Students of Community Medicine, Public Health and Healthcare Professionals. By Dr. K N Panicker, Dr. Navami S, Dr. Geme Urge Dori. Paras Medical Books, 2nd Edition, 2024.
2. Prakash's Notebook of Microbiology, including Parasitology and Entomology. By Prakash Modi. CBS Publishers & Distributors, 3rd Edition.
3. Basic Clinical Parasitology. By Penny Goodwin. Vinod Publication.
4. Handbook of Medical Entomology. By B. K. Tyagi. Scientific Publishers, 2nd Edition, 2022.
5. Medical Entomology: A Textbook on Public Health and Veterinary Problems Caused by Arthropods. Bruce F. Eldridge, John D. Edman (Editors). Springer Dordrecht, First Edition, 2000.
6. The Short Textbook of Medical Microbiology (Including Parasitology and Entomology). By Satish Gupta. Jaypee Brothers Medical Publishers, 11th Edition, 2020.
7. Paniker's Textbook of Medical Parasitology. By Sougata Ghosh. Jaypee Brothers Medical Publishers (P) Ltd., 7th Edition.

CC- 304, Units 01-04: Clinical Bacteriology, Virology and Mycology

1. Medical Microbiology. By Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller. Elsevier, 9th Edition, 2020.
2. Textbook of Medical Virology. By Baijayantimala Mishra. CBS Publishers & Distributors, 2nd Edition.
3. Jawetz, Melnick & Adelberg's Medical Microbiology. By Geo Brooks, Karen C Carroll, Janet Butel, Stephen Morse. McGraw Hill, 26th Edition, 2013.
4. Textbook of Microbiology. By C.P. Baveja, V. Baveja. Professional Book House, 2nd Edition. 2019.
5. Textbook of Medical Mycology. By Jagdish Chander. Jaypee Brothers Medical Publishers (P) Ltd., 4th Edition, 2017.
6. Ryan, Kenneth J., ed. 2022. Sherris & Ryan's Medical Microbiology. 8th ed. New York: McGraw Hill.
7. Introduction to Bacteriology. By Haris Russell (Editor). Larsen and Keller Education. 2017.
8. Clinical Bacteriology. By J. Keith Struthers, Roger P. Westran. Amer Society for Microbiology, 2003.
9. Clinical Bacteriology. By Robert Jones (Editor). Murphy & Moore Publishing, 2022.
10. Principles and Practice of Clinical Virology. By Arie J. Zuckerman, Jangu E. Banatvala, John R. Pattison, Paul Griffiths, Barry Schoub (Editors). Wiley, 5th Edition. 2004. ISBN: 978-0-470-02096-8

CC-396: Clinical Microbiology, Entomology, Parasitology

1. Laboratory Manual in Medical Bacteriology; c.1. Hassell Street Press, 2021. ISBN: 9781014265098
2. Diagnostic Bacteriology Protocols. In: Methods in Molecular Biology, Louise O'Connor (Editor). Humana Totowa, NJ, Volume 345, 2006.
3. Diagnostic Bacteriology: Methods and Protocols. In Methods in Molecular Biology, Kimberly A. Bishop-Lilly (Editors), Humana New York, NY, 2017.
4. Practical Bacteriology. By Ameer Khusro, J. P. Preetam Raj, P. Agastian, S. Theoder. Alpha Science, 2017.
5. Practical Microbiology. By D.R. Arora, Bharti Arora. CBS Publishers & Distributors, 3rd Edition.
6. Principles and Practice of Clinical Virology. By Jangu E. Banatvala, Arie J. Zuckerman, John R. Pattison (Editors). Wiley Medical Publication. 2nd Edition.
7. Text and Practical Microbiology for MLT by Dr. CP Baveja, Dr. V. Baveja. Arya Publishing Company, 4th Edition.

4th Semester: Spl.				
Paper	Course	Marks	Lecture hours	Credit Point
MLT-401	Biomedical Instrumentation and Molecular Diagnostic Techniques	40 + 10	40	4
Unit 1	Concepts on instruments and techniques			
Unit 2	Methods of analysis of biomolecules			
Unit 3	Concepts on cellular energy and characterization			
Unit 4	Basic Bioinformatics			
MLT-402	Advanced Laboratory Pathology	40 + 10	40	4

Unit 1	Analysis of cerebrospinal fluid (CSF)			
Unit 2	Analysis of different body fluids			
Unit 3	Digital pathology and artificial Intelligence (AI)			
MLT-403	Advanced Diagnostic Bacteriology, Virology	40 + 10	40	4
Unit 1	Clinical Bacteriology			
Unit 2	Clinical virology			
Unit 3	Molecular diagnostic techniques relevant to medical microbiology			
MLT-494	Advanced Laboratory Pathology (P)	50	80	4
MLT - 495	Advanced Diagnostic Bacteriology, Virology	50	80	4
MLT-496	Internship (2 months internship at hospitals)	50	160	4
	Total Marks	300		
	Total Credit			24

Text Books/References:

CC- 401, Units 01-04: Biomedical Instrumentation and Molecular Diagnostic Techniques

1. Principles and Applications of Molecular Diagnostics. By Nader Rifai, A. Rita Horvath, Carl T. Wittwer, Jason Park (Editors). Elsevier Science Publishing Co Inc, 2018.
2. Molecular Diagnostics: Fundamental Methods and Clinical Applications. By Lela Buckingham, F A Davis Co, 3rd Edition, 2019.
3. Advances in Cell and Molecular Diagnostics. By P. B. Raghavendra, T. Pullaiah. Academic Press, 1st edition, 2018.
4. Fundamentals of Molecular Diagnostics. By David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Elsevier, First Edition, 2007, ISBN-9781416037378.
5. Hofmann A, Clokie S, eds. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology. 8th ed. Cambridge University Press; 2018.
6. Flow Cytometry in Neoplastic Hematology Morphologic-Immunophenotypic-Genetic Correlation. By Wojciech Gorczyca. CRC Press, 4th Edition, 2023.

CC- 402, Units 01-04, CC-494: Advanced Laboratory Pathology

1. Fischbach, F.T. and M.B. Dunning, 2009. A Manual of laboratory and Diagnostic Tests, Lippincott Williams Wilkins, New York.
2. Sonnenwirth, A. C. and L. Jarret, 2000. Gradwohl's Clinical laboratory methods and diagnosis. M.D.B.I., New Delhi.
3. Godkar, P.B. and B. Godkar, 2003. Medical Laboratory Technology, Bhalani Book Depot, New Delhi.
4. Marks, V., T. Cantor, D.Mesko, R. Pullman and G. Nosalova, 2003. Differential Diagnosis in Lab Medicine, Springer, India.
5. Ochei, J. and A. Kolhatkar, 2000. Medical Laboratory Science, Theory and Practice, McGraw Hill, New

Delhi.

6. WHO laboratory manual for the processing of human semen, 2010, Geneva.
7. Comprehensive Workbook of Practical Pathology. By ML Gupta. Jaypee Brothers Medical Publishers (P) Ltd., First Edition, 2021.
8. Fundamentals of Urine and Body Fluid Analysis. By Nancy A. Brunzel. Elsevier, 4th Edition.
9. Graff's Textbook Of Urinalysis And Body Fluids. By Lillian Mundt. Jones and Bartlett Publishers, Inc, 3rd Edition, 2020.
10. Kjeldsberg's Body Fluid Analysis. Edited by: Jerry W Hussong; Carl R Kjeldsberg. ISBN: 978-0-89189-5824.
11. Artificial Intelligence and Deep Learning in Pathology. By Stanley Cohen. Elsevier; 1st edition, 2020.
12. Artificial Intelligence in Pathology: Principles and Applications. By Chhavi Chauhan, Stanley Cohen (Editors). Elsevier, 2nd Edition, 2024.

CC- 403, Units 01-04, CC-495: Advanced Diagnostic Bacteriology, Virology

1. Advanced Technique in Diagnostic Microbiology, Volume 2: Applications. Edited by Yi-Wei Tang, Charles W. Stratton. Springer, 3rd Edition, 2018.
2. Guide to Clinical and Diagnostic Virology. By Reeti Khare. ASM Press, 2019. ISBN: 978-1-683-67292-0.
3. Practical Medical Microbiology for Clinicians. By Frank E. Berkowitz, Robert C. Jerris. Wiley-Blackwell, 2015. ISBN: 978-1-119-06711-5.
4. Diagnostic Virology Protocols: In Methods in Molecular Biology by John R. Stephenson, Alan Warnes (Editors). Humana Press Inc., 2nd Edition, 2016.
5. Bailey & Scott's Diagnostic Microbiology. Elsevier Health Science, 15th Edition, 2021.

SEMESTER-I

CC – 101 Course Title- Clinical Laboratory Biosafety, Ethics and Quality Control

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title-I: Laboratory Biosafety

1. Code of good and safe laboratory practice for support staff and responsibilities of the workers regarding Biosafety.
2. ISO rules for laboratory medicine.
3. Set up of a laboratory on the basis of safety priority and Laboratory Biosafety Guidelines.
4. Laboratory Biosafety Level Criteria (BSL-1-4).
5. Handling, transfer and shipment of specimens. Decontamination and disposal. Treatment and disposal technologies for health- care waste.
6. Chemical, electrical, fire and radiation safety. Safety organization.
7. General Safety checklist.
8. Hazardous properties of instruments and Laboratory chemicals. Laboratory first-aid measures and kit.
9. Safety equipment and signs.
10. Decontamination and sterilization.
11. Good Microbial Practices (GMP).
12. Emergency Procedure- exposure response plans, spill response plans, fire and explosion response plans.

13. Regulatory compliances- a) biosafety regulations, b) biosecurity regulations, c) biosafety audit.

Unit-02

Unit Title- Ethics and Quality Control (Clinical Research, Medical Law)

1. Quality control of product, chemical reagents, good reliable and authentic report, total quality management framework of laboratory.
2. Essential elements in quality assurance programme, internal and external quality control, control of preanalytical variables, laboratory precision, accuracy and sensitivity validation method.
3. Quality control chart, Cusum chart, Gaussian curve, Westgard rule.
4. Internal and External factors for quality control.
5. Quality assessment- a) External Quality Assessment (EQA), b) Internal Quality Assessment (IQA), c) Statistical Quality Control (SQC).
6. Co-operation and working relationship with other health professionals.
7. Confidentiality of patient information and test results.
8. Dignity and privacy of patients.
9. Responsibility from acquisition of the specimen to the production of data.
10. Institutional ethical committee and its role, human and animal ethical committee, biosafety committee.
11. ISO accreditation rules, guidelines, criteria, ISO-15189 and ISO-9001 process.
12. Customer relation regulatory compliances.
13. Artificial Intelligence in ethical and regulatory considerations.
14. Research and Development in Laboratory Medicine.

Unit-03

Unit Title: Record Keeping and Health Informatics

1. Basics of computer application, MS office, Database and Spreadsheet Operations-Plan and create database, input and update data into records, store database and print quick
2. Reports from database, create spreadsheet, input data into spreadsheet, update data in spreadsheet and store spreadsheet.
3. Introduction to Health Information Management- Hospital Information System (HIS) with Electronic Medical Records (EMR) or Electronic Health Information Management System (HMIS), Medical Records for different patient encounters with health care facility Ambulatory Care Records [Emergency & Outpatient Records] Clinical Records in Long Term Care and Rehabilitation Facilities, Mental Health Records.
4. Microfilming of medical records: Microfilming Process, Equipment required for microfilming, Merits and Demerits of Microfilming Color Coding of Medical Records: Definition, Reason, Types, Advantages, Storage medium.
5. Disease and operation nomenclatures, International Classification of Disease 10, International Classification of Disease – 9 CM indexing of patient care data.

Unit - 04

Unit Title: Preparation of operating budget

1. General aspects of financial management of laboratories.
2. Preparation of laboratory inventory and maintenance, cost analysis of laboratory assays.
3. Cost-analysis of instruments; cost-benefit and cost-profit analysis, justification of providing new services or rejecting existing ones; lease and purchase decision analysis; delegation of budget responsibilities, workload statistics.
4. Laboratory design- Designing laboratories for different types and sizes of institutions: selection of equipment and systems for the laboratory, concepts of workstation consolidation, workflow analysis, concepts in laboratory automation (sample transportation systems, modular systems, robotics).

Course Outcome (C.O.):

A successful Clinical Laboratory Biosafety, Ethics, and Quality Control course should equip students with the knowledge and skills to ensure safe and ethical laboratory practices, while also emphasizing the importance of quality control in generating reliable results.

CC- 102: Course title – Human Anatomy and Physiology Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Overview of Human Body and Nervous System

1. Directional and regional terms - Cavities and planes, Cell, Tissues: types, function. Skin- Structure, function and body temperature regulation, surface anatomy with special reference to veins in brief.
2. Nervous system- Neurons & synapse- Structure & transmission of nerve impulse, Brain & Spinal Cord – anatomy, structure, function, Peripheral nervous system – Cranial and spinal nerves- Autonomic nervous system, Reflex- arc, Special senses (gross idea), Lumbar puncture for cerebrospinal fluid (CSF) collection- anatomy.

Unit-02

Unit Title- Skeletal and Muscular System

1. Axial and appendicular skeleton. Structural and functional classification of joints and movements.
2. Types of muscles, Mechanism of muscle contraction. N-M Junction.

Unit-03

Unit Title: Cardiovascular and Respiratory System

1. Anatomy of cardiovascular system (CVS), surface anatomy of veins for collection of blood, Cardiac cycle, Blood pressure and its regulation, Heart sound, Hypertension, Lymphatic system.
2. Respiratory system: Anatomy of respiratory organs, mechanism of respiration, gases transport, respiratory volumes and capacities.

Unit - 04

Unit Title: Digestive and Endocrine System:

1. Gross anatomy, Innervations, gastrointestinal secretions, digestion and absorption.
2. Endocrine System: Basic anatomy and physiology of the Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, their hormones, functions and disorders.

Unit - 05

Unit Title: Excretory and Reproductive System:

1. Structure and function of nephron, GFR, urine formation. Acid-Base balance.
2. Reproductive System: Structure and function of testis, ovary and associated glands- Physical characteristics of semen, Spermatogenesis. Menstrual cycle and its hormonal regulation, Ovulation process.

Course Outcome (C.O.):

The course outcomes on human anatomy and physiology typically focus on understanding the structure, function, and organization of the human body, and how these relate to clinical laboratory procedures and disease processes. Students learn to apply anatomical and physiological knowledge to interpret lab results, understand disease mechanisms, and perform laboratory tests accurately.

CC- 103: Course title –Clinical Biochemistry and Fundamental Laboratory Pathology

Marks: 50, Credits: 4 Classes: 40 L

Unit-01

Unit Title- Laboratory practice in clinical biochemistry

1. Precision, reliability, reproducibility and other factors in quality control. Normal values in health and diseases, radioisotopes in diagnosis.
2. Specimen collection and processing (blood, urine and faeces); Storage of specimens; Quality control; Pre-analytical, analytical post analytical variables in quality analysis.

Unit-02

Unit Title- Biomolecules:

1. Carbohydrates : Brief idea about classification of carbohydrates. Qualitative tests and biological role of carbohydrates.
2. Proteins : Brief idea about classification of proteins based on composition and solubility with examples. Qualitative tests and biological role of proteins and amino acids, Diseases related to malnutrition of proteins.
3. Lipids : Structure and functions of cholesterol in the body, Lipoproteins - types, composition and functions in the body, Qualitative tests and functions of lipids.
4. Nucleic acids : Definition, purine and pyrimidine bases, Components of nucleosides and nucleotides with examples, Structure of DNA (Watson and Crick model), RNA and their functions.
5. Enzymes : Basic idea about enzymes and inhibitors, Therapeutic and pharmaceutical importance of enzymes. Enzymes in cardiac assay marker, cancer marker, enzymes related to hepatitis, pancreatitis (assessment of severity level), gastric functions.
6. Vitamins : Definition and classification with examples, Sources, chemical nature, functions, coenzyme form, recommended dietary requirements, deficiency diseases of fat-and water-soluble vitamins.
7. Minerals : Types, Functions, Deficiency diseases, recommended dietary requirements.
8. Water and Electrolytes : Distribution, functions of water in the body, Water turnover and balance, Electrolyte composition of the body fluids, Dietary intake of electrolyte and Electrolyte balance, Dehydration, causes of dehydration and oral rehydration therapy. Hyperkalemia, hypokalemia, hyponatrimia, hyponatrimia, hypercalcemia, hypocalcemia, risk level, conditions or risk factors for developing these conditions, signs and symptoms.
9. Isotopes – Isotopes and their role in treatment and diagnosis of diseases. Thyroid function tests, autoradiography, PET scan. Technetium for renal function tests.
10. Buffer, Preparation of buffer, pH, buffer stabilizers, protease inhibitors, fixatives
11. Metabolic end products. Measurement of renal function tests (urea, creatinine etc.).
12. Fundamental concepts on clinical proteomics and metabolomics.

Unit-03

Unit Title: Metabolic and genetic disorders

1. Metabolism (Study of cycle/pathways without chemical structures)- Metabolism of Carbohydrates: Glycolysis, TCA cycle and glycogen metabolism, regulation of blood glucose level. Diseases related to abnormal metabolism of Carbohydrates, Metabolism of lipids: Lipolysis, β -oxidation of Fatty acid (Palmitic acid) ketogenesis and ketolysis.
2. Diseases related to abnormal metabolism of lipids such as Ketoacidosis, Fatty liver, Hypercholesterolemia, Metabolism of Amino acids (Proteins): General reactions of amino acids and its significance - Transamination, deamination, Urea cycle and decarboxylation. Diseases related to abnormal metabolism of amino acids, Disorders of ammonia metabolism, phenylketonuria, alkaptonuria and Jaundice, Biological oxidation: Electron transport chain and Oxidative phosphorylation.
3. Newborn screening: PKU, tyrosinemia, aminoacidurias, organic acidurias, porphyrias. Biochemical

monitoring of therapy; prenatal diagnosis of inborn errors of metabolism, chromosomal abnormalities by cytogenetics.

4. Molecular diagnosis of genetic defects: Diagnosis of genetic diseases by molecular biology techniques (cystic fibrosis, Hemochromatosis, thalassemias, sickle cell diseases) DNA probes; restriction fragment length polymorphism (RFLP); polymerase chain reaction (PCR); amplification of mRNA. AIDS, Clinical diagnosis. Oncogenic enzymology: acid phosphatase, alkaline phosphatase, lactate dehydrogenase.

Unit - 04

Unit Title: Introduction to Laboratory Pathology:

1. Collection, transport, preservation, and processing of various clinical specimens
2. Urine examination- microscopic- identification of casts and crystals and blood cells -RBC, WBC, smear for gram staining and urine culture and antibiotic sensitivity test (Kirby Bauer Method).
3. Test for hemosiderin pigment.
4. Stool examination- collection of specimens of feces, macroscopic inspection, concentration method, Flotation method. Microscopic examination, Chemical examination by Strip method Test for Occult blood – Benzidine Test
5. Sputum examination – collection of specimen Physical examination Microscopic – Gram's stain, Ziehl-Neelsen stain for AFB.
6. Gastric analysis Indications, contra indications. Method of collection. Fasting gastric juice – Macroscopic and microscopic examination. Fractional test meal
7. Augmented Histamine test, Hollander's test.

Course Outcome (C.O.):

Upon completion of a course in Clinical Biochemistry and Fundamental Laboratory Pathology, students will be able to: understand the biochemical basis of diseases, interpret laboratory results, apply knowledge to clinical diagnosis, and perform routine laboratory procedures with accuracy and efficiency. They will also demonstrate proficiency in sample collection, preservation, and quality control, and understand the importance of ethical considerations in laboratory practice.

CC- 194: Course title – Survey on Clinical Laboratory Biosafety, Ethics and Quality Control (P)
Marks: 50, Credits: 4 Classes: 80 Lecture Hours

Practical / Laboratory training:

1. Sample accountability
2. Labeling of sample
3. Making entries in Laboratory records
4. Reporting results
5. Basic format of a test report
6. Release of examination results
7. Alteration in reports
8. Ethics in medical laboratory practice in relation to the following:
 - Pre-Examination procedures
 - Examination procedures
 - Reporting of results
 - Preserving medical records
9. Access to medical laboratory records
10. Audit in a Medical Laboratory
11. Documentation

Course Outcome (C.O.):

This practical course aims to equip students with the knowledge and skills necessary to work safely and ethically in a clinical laboratory, while also ensuring quality control of laboratory procedures. Students will learn to apply biosafety practices, understand ethical considerations in clinical laboratory work, and implement quality control measures to ensure accurate and reliable results.

CC- 195: Course title – Clinical Biochemistry and Fundamental Laboratory Pathology (P)

Marks: 50, Credits: 4 Classes: 80 Lecture Hours

Skill enhancement training at pathological laboratory:**1. Clinical Biochemistry**

2. Introduction to pathological laboratory instruments and exposure of their handling and care.
3. Calibration of instruments.
4. Standard Operating Procedure (SOP)- meaning, importance.
5. Sterilization of glassware and other equipment.
6. Data replication and accuracy.
7. Cross-checking of result, output.
8. General approach to specimen collection, transport, and disposal.
9. Phlebotomy- types of blood collection tubes, method of blood collection and storage, separation of plasma and serum.
10. To study general properties of the enzyme (Urease) & Achromatic time of Salivary amylase.
11. Estimation of vitamin A, C, E from serum.
12. Identification of Carbohydrates (qualitative tests).
13. Identification of Proteins (qualitative tests).
14. Estimation of blood sugar by Glucose Oxidase Method
15. Renal, Pancreatic, Hepatic, Gastric function tests.
16. Tests for cardiac enzymes to detect cardiac diseases.
17. Estimation of total serum protein, serum globulin, albumin
18. Lipid profile test: Estimation of Cholesterol/HDL/LDL Cholesterol by enzymatic method. Estimation of Serum Triglyceride.

B. Clinical Pathology

1. Urine examination - microscopic.
2. Urine Test for hemosiderin pigment.
3. Estimation of common parameters in urine through use of strips.
4. Urine culture, sensitivity to antibiotics
5. Routine Urine Examination- 24 hr urinary protein and creatinine clearance test for renal dysfunction.
6. Stool examination –
 - a. Macroscopic examination
 - b. Concentration method, Flotation method.
 - c. Microscopic examination
 - d. Benzidine Test- for occult blood
7. Sputum examination - Macroscopic, Microscopic and AFB Staining
8. Pregnancy Test
9. Fractional Test Meal Augmented Histamine test, Hollander's test
10. Screening tests for Alcohol, Methanol, Acetone, Caffeine, Carbon Monoxide (CO), Opiates,

Cannabinoids, Cocaine, LSD, Barbiturates, Amphetamines, Diazepam and Ketamine, heavy metals (lead, mercury, arsenic, and cadmium) in blood.

Course Outcome (C.O.):

In Clinical Biochemistry and Fundamental Laboratory Pathology practical, students develop proficiency in laboratory techniques, biochemical analysis, and interpretation of results. They learn to collect, prepare, and process samples, perform assays, and apply quality control measures. Furthermore, students gain the ability to correlate biochemical findings with clinical data for informed decision-making.

SEMESTER-II

CC – 201 Course Title- CBCS-I - Nutrition and Public Health

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Concept of food and Diet

1. Concept on food, diet and nutrients
2. Food groups and Food pyramid
3. Functional Foods
4. Comparison among Core foods, Secondary foods and Peripheral foods
5. Concept of balanced diet
6. Healthy diet and dietary practices
7. Understanding Major and Minor food

Unit -02

Unit Title- Concept of Nutrition

1. Definition of Nutrition
2. Basic terms used in nutrition
3. Understanding Community Nutrition and its relation to health and wellbeing
4. Malnutrition and Under-nutrition and its different spectrum and manifestations
5. Concept on Bioactive compounds
6. Definition and multidisciplinary nature of public nutrition
7. Concept and scope Role of Public Nutritionist

Unit-03

Unit Title- Concept of Social Medicine and Public Health

Definition and concept of Public Health,

Core functions and essential services History of public health and its milestones Comprehensive health care Social development and health Dimensions and determinants of health Concepts and indicators of health and wellbeing natural history of disease Levels of prevention, globalization and its impact on health Roles and responsibility of state, community and private sector in health

Unit-04

Unit Title- Food safety

1. Microbial food safety: The significance of foodborne disease. Protozoa; Cryptosporidium parvum. Toxigenic fungi; mycotoxins of Aspergillus. Foodborne viruses; gastroenteritis viruses.
2. Control of Food Safety and Quality Management: Protecting public health and eliminating risk. Farm to table strategy and animal traceability.
3. Good Manufacturing Practices (GMPs); Hazard Analysis and Critical Control Point (HACCP) concept; Quality Management Systems: ISO 9000.

Course Outcome (C.O.):

A Nutrition and Public Health course aims to equip students with the knowledge and skills to improve population health through nutrition. Students will learn about the principles of nutrition, the impact of diet on health, and how to apply this knowledge in public health settings.

CC – 202 Course Title- Clinical Immunology, Hematology and Serology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01**Unit Title- Clinical Immunology**

1. Concepts of immune system, Innate and adaptive immunity; Immune cells & organs: T and B -lymphocytes, Monocytes and macrophages, Neutrophils, eosinophils, basophiles, NK cells, Mast cells and Dendritic cells, Bone marrow, Thymus, Lymph nodes, Spleen, MALT, GALT and CALT, Toll-like receptors.
2. Antigens - properties. Antibodies - Structure, function, Monoclonal antibodies. MHC Structure and cellular distribution of HLA antigens. Complement activation. Cytokines.
3. Hypersensitivity – types and mechanisms. Tumor immunology. Immunotherapy of infectious diseases; Types of grafts, immunologic basis of graft rejection, immunosuppressive therapy. Types and principles of immunization; Vaccine development.
4. Autoimmunity and Immunodeficiency disorders- Mechanisms of induction of organ specific (Hashimoto's thyroiditis, autoimmune anemias, Goodpasture's syndrome, IDDM), and systemic (myasthenia gravis, multiple sclerosis, and rheumatoid arthritis) autoimmune diseases.
5. Immunological principles of various reactions and techniques: Antigen-antibody interactions Affinity and avidity, cross reactivity, precipitation, agglutination, immunodiffusion, immune-electrophoresis and immunofluorescence.
6. Immune Complex-mediated disorders, glomerulonephritis.
7. Immunogenomics, single cell immunology, immuno oncology, mucosal immunology, neuro immunology, nanomedicine in immunology, synthetic immunology and in-situ immunoprofiling.

Unit-02**Unit Title- Hematology:**

1. Haematopoiesis: Origin, development, function and fate of blood cells.
2. Erythropoiesis: Origin, development of RBCs, biosynthesis of Hb, control of Erythropoiesis.
3. Disorders of Red blood cells: Anaemia, definition, Pathophysiology, classification -morphologic and Etiologic classification and clinical features. Investigations in a case of anemia. Morphologic - Microcytic hypochromic anaemia, macrocytic anaemia. Haemolytic anaemias - Definition, classification, clinical features. Investigations to establish a case of haemolytic anaemia. Tests done – i. Peripheral smear - specific morphologic abnormalities, Erythroblastosis fetalis/ Reticulocytosis.
4. Disorders of White Blood Cells: Leukocytosis, Leukopenia, Leukemoid reaction, Myelodysplastic syndrome (MDS). Leukaemias -Definition, Etiology, Clinical features. Classification- [French American British- FAB classification] Lab Investigations Cytochemistry of Acute leukaemias, Chronic myeloid leukaemia -clinical presentation. Investigations. Philadelphia chromosome. Chronic lymphocytic leukaemia.
5. Plasma Cell Disorders: Classification, Plasma cell myeloma – Definition, Clinical features, Investigations.
6. Special Haematological tests.

Unit-03

Unit Title- Serology

1. Laboratory procedures in serology- Collection, preparation of specimen, Application of different types of ELISA.
2. Different Serological screening and confirmatory test for syphilis (STS), VDRL test.
3. WIDAL test for *Salmonella typhi* and CRP test, RA test.
4. Serological tests for Lupus erythematosus, helicobacter pylori, tuberculosis and dengue.
5. Serodiagnosis of streptococcal Antistreptolysin O (ASO) test, streptozyme test.
6. Different Serodiagnostic test for AIDS (HIV1 & HIV-2). Serodiagnostic test for Hepatitis, SARS-COV.
7. ToRCH Panel test, Rubella, Toxoplasmosis, Trypanosomiasis, Leishmaniasis.
8. Intradermal hypersensitivity test, Mantoux test, Toxoplasmin, Histoplasmin.
9. Quantitative assessment of IgG and IgM. Titre assessment. Prozone effect.
10. IgE titre assessment (Atopic allergy).

Unit-04

Unit Title- Blood Bank and Blood Transfusion

1. Immunohematology, Weak antibody-antigen and ABO subgrouping, Principal Rh blood group antigens (D, C, c, E, and e) and their phenotypes, Bombay phenotype, clinical significance of Antibodies to Antigens in the ABO, Rh, Lutheran, Kell, Lewis, Duffy, Kidd blood grouping system.
2. Compatibility testing and significance of blood grouping in population genetics, forensic medicine and transfusion medicine.
3. Donor Screening, cell and serum sampling. AI and machine learning for donor's behaviour.
4. Blood bags, Anticoagulant and preservative solutions.
5. Optimization of blood collection strategy. Automated blood collection and processing.
6. Blood Components – fractionation, preparation, quality control.
7. Troubleshooting in red cell serology
8. Molecular blood typing, personalized transfusion medicine and genomics of blood transfusion.
9. Artificial blood substitute.
10. Infectious disease screening
11. Transfusion reactions, Haemolytic Disease of the Newborn (HDN), Autohemolytic transfusion reactions (AHTR), Febrile non-hemolytic transfusion reaction (FNHTR).
12. Choice of blood in specific clinical scenarios – HDN, Multiply transfused etc.
13. Basics of HLA typing and anti HLA antibody detection, Radial Immunodiffusion (RID) and Ouchterlony double diffusion test.
14. Massive transfusion protocol, Neonatal and pediatric transfusion, indication and contraindication of blood transfusion, restrictive vs. liberal transfusion, Transfusion associated circulatory overload (TACO).

Course Outcome (C.O.):

In Clinical Immunology, Hematology, and Serology courses, students gain the ability to diagnose, investigate, and manage immune-mediated disorders, perform and interpret laboratory techniques, understand the composition of blood, and conduct routine clinical hematology investigations.

CC – 203 Course Title- Diagnostic Cytotechnology and Histotechnology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Introduction to histopathology

1. Definition, Morphology and physiology of cells, sources and types of histological specimens, kinds of histological presentations.
2. Recording and labelling, fixation, properties of fixing fluids, classification, and composition of fixing fluids. Advantages and disadvantages of secondary fixatives.
3. Tissue processing- Processing of histological tissues, Tissue Processor - dehydration and clearing. Embedding - Water soluble substances, embedding in paraffin nitrocellulose. Technique of processing bone for histological studies. Mounting - Techniques, various mountings. Decalcification of calcified tissue.
4. Section Cutting- Equipment for sectioning: Microtome, knife, honing and stropping. Types, care, and use of microtome. Techniques and principles of section cutting – Frozen Section Techniques: Carbon Dioxide Freezing, Cryostat and freezing microtome. Technique for sectioning – Paraffin embedded tissue, Errors in sectioning and remedies. Attaching blocks to carriers.
5. Histochemistry (silver staining, hematoxylin and eosin staining, Periodic Acid-Schiff staining, Sudan Black staining) and immunohistochemistry (IHC)- marker studies using ABC (Avidin-Biotin Complex), PAP (Peroxidase-Anti-Peroxidase), direct and indirect IHC methods.

Unit-02

Unit Title- Cytology

1. Cell structure, function, cell cycle, division with recent advances.
2. Cytology of epithelial and connective tissues.
3. Cytopathology Techniques.
4. Fixation of Cytology specimens various fixatives, pre fixation, coating and spray fixation, advantages and disadvantages.
5. Collection, preparation of gynecological and non-gynecological specimens-exfoliative cytology. Gynecological –vaginal, cervical, endocervical, endometrial Non-gynecological –sputum, bronchial, Body fluids (serous effusions), CSF, urine.
6. Concentration technique in cytology Centrifugation, cyto-centrifugation, membrane filters, cell blocks.
7. Liquid based cytology –monolayer preparation, liquid biopsy and circulating tumour cells.
8. Dual enzyme based staining and fluorescence-based staining.
9. Cancer cytology
10. Cervical cytology: Normal cells in cervical smear, Inflammatory lesions of the female genital tract –specific and nonspecific inflammation.
11. Respiratory tract cytology sputum, bronchial materials.
12. Urinary cytology –urine.
13. Serous effusions.
14. FNAC –Scope, advantages, and disadvantages,
15. Immunohistochemistry and the various immunohistochemical stains in the diagnosis of various disorders
16. Cytological studies of various tissues – nervous system, Hard tissue, Miscellaneous cells, Endocrine cells

Unit-03

Unit Title- Staining and immunochemistry

1. Stains & staining technique: Staining – theory, types of staining agent. Preparation of haematoxylin & eosin, special stain preparation, Weigert's iron haematoxylin, trichrome stain, phosphotungstic acid haematoxylin technique (PTAH). Trichrome Staining, papanicolaou staining. Staining of bone and calcified tissue. Nissl body's Toluidine blue, Staining of frozen section by PAS, Sudan –IV, Sudan black B stain, Oil red O stain. Ninhydrin-schiff method for amino group, Millon reaction for tyrosine, Performic-Alcian Blue for disulphide linkage, Fecelgen nuclear reaction for DNA and Methyl green-Pyronin method for RNA.
2. Immunochemistry- Immunofluorescence and Immunoenzymatic Histotechnology-Multiplex immunohistochemistry (mIHC) - Fluorescence mIHC, Tyramide Signal Amplification (TSA).
3. Immunofluorescence Cytotechnology, Flow cytometry, Immunopathology of lymphomas, Cell fraction isolation, DNA, RNA quantification, Molecular pathology: Proximity Ligation Assay, In-situ hybridization and TUNEL study.
4. Marker study: Cancer marker, Apoptotic marker, Tissue Necrosis marker.

Unit-04

Unit Title- Cytology laboratory and Cryopreservation techniques

1. Organization of cytology laboratory- Cytology laboratory safety, quality control measures in cytology, cytology laboratory equipment
2. Automation in cytology –Preparation, Staining, Auto screening.
3. In vitro cell culture techniques
4. Cryopreservation techniques

Course Outcome (C.O.)

Upon completing courses in Diagnostic Cytotechnology and Histotechnology, students should be able to prepare, analyze, and interpret histological and cytological samples for clinical diagnostics and research. They will understand different histological techniques, handle specialized instruments, and interpret results, differentiating between normal and abnormal cell and tissue structures. Additionally, they will understand staining methods and gain knowledge in cytochemistry and immunohistochemistry

CC – 204 Course Title- Research Methodology, Epidemiology and Health Statistics

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title-Research in Medical Laboratory Technology

1. Research – Definition, concept, purpose, approaches.
2. Types of research- basic, applied, action, qualitative, quantitative, experimental.
3. Research Fundamentals- Define measurement, Study design, Types of variables, Reliability & Validity, Drawing tables, graphs, master chart etc. Writing a research proposal, Critiquing a research article, Defining a problem, Review of literature, Formulating a question, Operational definition, Inclusion and exclusion criteria, Research hypothesis, Sampling types, Research report writing.
4. Research Ethics: Importance of Ethics in Research, Main ethical issues in human subjects' research, Main ethical principles that govern research with human subjects, Components of an ethically valid informed consent for research, plagiarism.

Unit-02

Unit Title-Epidemiology and Public Health

1. Concept of Health and Diseases- Concepts and dimensions of health, well being, Quality of life, spectrum of health Determinants of Health, Indicators of Health.
2. Measuring the Occurrence of Diseases- Morbidity Mortality
3. Epidemiology Definition, Principles, Uses, Identification of Health Problems
4. Survey methods- Planning, Designing and Conducting of Epidemiological Surveys, Screening for Diseases Types of screening test Assessing the validity and reliability of diagnostic and screening tests.
5. Surveillance - Association and causation, Bias, Confounding Factors, Investigation of an epidemic, Applying Epidemiology to evaluate health services and policy.
6. Epidemiology & control of Infectious Diseases - Acute diarrheal diseases, Cholera, Typhoid fever (Enteric fever), Brucellosis, Leptospirosis Plague, HIV/AIDS, Leprosy, Malaria, Filariasis, Yellow fever Dengue, Chikungunya, Kala-Azar, Japanese Encephalitis.
7. Epidemiology and control of vaccine preventable diseases: Tuberculosis, Diphtheria, Whooping Cough, Measles, Tetanus, Poliomyelitis, Hepatitis.
8. Epidemiology & control of Non Communicable Diseases - Cardiovascular Diseases, Rheumatic Heart Disease, Coronary artery disease, Hypertension, Neurological Diseases, Diabetes, Mental Health Problems, Obesity, Blindness, Accidents.

Unit-03

Unit Title- Basic statistics

1. Health statistics- Introduction, Definition, Types, Application in clinical data analysis
2. Measures of central value- Arithmetic mean, median, mode. Relationship between them Partition values- Quartiles, Deciles, Percentiles, Graphical presentation of data.
3. Measures of Dispersion- Range, Mean Deviation, Standard Deviation, Standard Error.
4. Normal Distribution Curve- Properties of normal distribution, Standard normal distribution, Transformation of normal random variables, Inverse transformation, Normal approximation of Bioaxial distribution.

Unit-04

Unit Title- Statistics in Clinical Application

1. Correlation analysis- Bivariate distribution, Scatter Diagram, Coefficient of correlation, Calculation & interpretation of correlation coefficient, t-test, Z-test, P-value.
2. Regression analysis- Lines of regression, Calculation of Regression coefficient, Sampling distribution, Standard error, Types I & II error.
3. Probability (in Brief)
4. Hypothesis Testing- Null Hypothesis, Alternative hypothesis, Acceptance & rejection of null Hypothesis, Level of significance
5. Parametric & non parametric tests- Chi square test, Mann-Whitney U test, Wilcoxon Signed test, Kruskal-Wallis test, Friedman test, t-test/student t-test, Analysis of variance (ANOVA).
6. Use of SPSS software for clinical data analysis

Course Outcome (C.O.)

Upon completion of a course in Research Methodology, Epidemiology, and Health Statistics, students are expected to demonstrate a comprehensive understanding of research principles, epidemiological concepts, and statistical methods relevant to health studies. This includes formulating research questions, designing studies, collecting and analyzing data, and interpreting results. Students should also be able to critically appraise research findings and apply them in practice.

CC – 295 Course Title- Hematology and serology Practical/ Short-term training at diagnostic laboratory

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

Practical/laboratory training

A. Hematology

1. Reagent Preparation of Blood Bank.
2. Determination of blood groups (forward grouping and reverse grouping) and Rh typing
3. Determination of cross matching by blood group testing techniques, Coomb's test (direct and indirect)
4. Fraction collection from blood and its storage.
5. Pre-transfusion blood screening.
6. Widal for Typhoid and RPR (Rapid Plasma Reagin) Inflammatory Disorders, General inflammatory marks and specific therapeutic bio indicators. CRP (C-Reactive Protein), RA (Rheumatoid Arthritis), ASO (Anti- Streptolysin O)
7. Immunological test for pregnancy, Haemagglutination, Complement fixation, Precipitation and Immuno-diffusion
8. HbsAg, HCV, HIV (ELISA, Western Blot tests), TPHA (Treponema pallidum haemagglutination), malarial parasites.
9. Antiphospholipid Antibody -work up
10. Bone marrow examination - Preparation of bone marrow aspiration and Trephine biopsy smears staining, Examination of bone marrow samples, Test for Leukemias, Megakaryocytes.
11. Microcytic Hypochromic Anaemia: Serum iron. Serum Total iron binding capacity [TIBC] Percent Saturation.
12. Macrocytic Anaemia: Peripheral smear, Vit. B12 assay, Folate assay.
13. Haemolytic Work up, Peripheral smear, specific morphologic abnormalities
14. Special tests: Sickling test, Alkali denaturation test, Ham's test, Coomb's test, Electrophoresis - HbF, HbA2 Estimation, Tests for G-6PD deficiency.

B. Serology

1. Serological tests: Antibody measurement by Radial immuno-diffusion (RID) technique.
2. Antigen-Antibody reaction testing by precipitating ring.
3. Ouchterlony Test. Quantitative assay of Immunoglobulins in plasma (IgG and IgM)

Course Outcome (C.O.)

Upon completion of a Hematology and Serology Practical course, students should be able to apply principles of safety, quality assurance, and quality control in hematology. They should also be able to evaluate specimen acceptability, compare and contrast hematology values under normal and abnormal conditions, and perform and explain the principles and procedures of hematological tests, including sources of error and clinical significance of results

CC – 296 Course Title- Histopathology and Cytochemistry Practical/ Short-term training at diagnostic laboratory

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

Practical/laboratory training

1. Preparation of buffers, stains and fixatives

2. Tissue collection, preservation and processing.
3. Microtomy, tissue sectioning and slide preparation
4. Staining Methods: Types of stain, Sample preparation, Stain preparation, Negative staining, application
5. Processing and staining of various fluids for cytological examination
6. Demonstration of normal cytology of respiratory tract, urinary tract, CSF, effusions.

Course Outcome (C.O.)

Upon successful completion of a Histopathology and Cytochemistry Practical course, students will be able to: recognize and describe the basic morphological and functional characteristics of tissues and cells, apply various histopathological and cytochemical techniques, critically evaluate diagnostic staining methods, and communicate findings effectively. They will also demonstrate proficiency in laboratory safety protocols and maintain accurate records.

SEMESTER-III

CC – 301 Course Title- CBCS-II First Aid and Cardiopulmonary Resuscitation (CPR) Emergency Handling

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Introduction to First Aid

1. First Aid: Basics and necessary tools
2. Healthy lifestyles
3. Action before giving care
4. Disease prevention

Unit-02

Unit Title- Victim Assessment and Rescue Methods

1. Checking an unconscious and conscious victims
2. Respiratory emergencies
3. Conscious choking (methods and procedures for adult, child and infant)
4. Rescue breathing (methods and procedures for adult, child and infant)

Unit-03

Unit Title- Response to Cardiac Emergencies

1. Cardiac emergencies and unconscious choking
2. Causes of cardiac difficulties
3. Methods and procedures of Cardiopulmonary Resuscitation (CPR) for adult, child and infant
4. Demonstration of CPR method
5. Automated External Defibrillator (AED)- Overview

Unit-04

Unit Title- Primary Home-based Treatment to Diarrhoea, Burn and Snake or Insect-bite

1. Bleeding and shock
2. Shock due to severe bleeding
3. First aid for open wounds
4. Elevation and pressure bandages
5. Basic knowledge for emergency relief.

Course Outcome (C.O.)

A successful First Aid and CPR course equips individuals with the knowledge and skills to respond effectively to emergency situations, ultimately saving lives and preventing further injury. Key outcomes include the ability to recognize life-threatening situations, provide CPR, and administer basic first aid techniques.

CC – 302 Course Title- Clinical Endocrinology and Reproductive Technology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Endocrine glands and hormones

1. Endocrine glands
2. Hormones- classification, general mechanism of hormone action, regulation of hormone secretion.
3. Difference between hormones and enzymes.
4. Neurotransmitter families of hormones.
5. Hormone receptors- fixed and mobile models.
6. Pituitary gland & hypothalamus and its hormones and related diseases.
7. Hormones of the Thyroid gland- chemistry and normal physiology, Thyroid disorders- its types, hypo and hyperthyroidism, goiter, myxedema, autoimmune thyroiditis, tumors of the thyroid gland, hyperthyroidism, Graves disease, Calcitonin, Parathyroid Hormone (PTH), Hypo and hyper-parathyroidism.
8. Assessment of thyroid function- The laboratory tests for evaluation of thyroid disorders and be able to interpret these analytes in their clinical context with an appreciation for the euthyroid sick state.
9. Current analytical methodologies for thyroid testing (TSH methods : 1st-, 2nd-, and 3rd-generation assays; nonisotopic methods; T4; free T3 methods; T-uptake methods; TSH suppression and stimulation tests).

Unit-02

Unit Title- Hormones of the gonads, adrenal gland and gastrointestinal tract

1. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addison's disease, Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
2. Adrenal medulla-metabolism of catecholamines
3. Male and female reproductive endocrinology -Testosterone, Estrogens, Progesterone, their synthesis and functions. Hyper and hypogonadism - primary and secondary.
4. Endocrinology of pregnancy and parturition, Human Chorionic Gonadotropin (HCG), menstrual cycle, Menopause
5. Gastrointestinal hormones.
6. Hormone of pancreas - Insulin- its metabolic effects on carbohydrates, fats & protein, control of insulin secretion, Insulin like growth factor, Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin. Insulin and C-peptide for pancreatic beta cell function, pancreatic endocrine disorders- pancreatic insufficiency, pancreatic tumour (insulinomas and glucagonomas).
7. Hormone of kidney - Renin, Erythropoietin.
8. Hormone assays - Enzyme-Linked Immunosorbent Assay (ELISA), Radioimmunoassay (RIA), Fluorescence Immunoassay (FLIA), Chemiluminescence Immunoassay (CLIA)- methodology, graphical presentation, quality control of hormone assays, Assay variation.

Unit-03

Unit Title- Male and Female reproductive system, stem cells and chromosomal disorders

1. Male reproductive system- Spermatogenesis, Sperm (Morphology, Structure and function);

Diagnosis of male infertility (Semen analysis, Microscopic and Functional); Evaluation of male infertility (etiology, medical aspects, genetic diagnosis, clinical aspects).

2. Female reproductive system- Menstrual cycle; Gametogenesis -Oogenesis. Oocyte (Morphology, Structure and competence markers); Basics of ovarian stimulation; Clinical diagnosis of female infertility; (Evaluation of (infertility: etiology, medical/physical aspects, and genetic diagnosis, treatment options); Types of infertility.
3. Stem Cell Basics- Stem Cell Definition and Classification; Adult & Embryonic Stem Cells; Sources of Stem Cells; Isolation and Characterization; Cryopreservation & Banking.
4. Study and arrangement of Human chromosomes (Normal karyotyping); Turner, Klinefelter's and Down syndrome (Karyotyping); Karyotyping of abnormal semen samples; Record keeping and documentation

Unit-04

Unit Title- Reproductive technology

1. In Vitro Fertility (IVF) Lab Setup: Technical aspects of Establishing, Maintenance & Troubleshooting; Quality improvement techniques; IQC/EQAS. Major and minor instruments in IVF lab (Clean room, Laminar airflow, Centrifuge, Microscope, etc.); Orientation and setting up of IUI Lab; Equipment for Intrauterine Insemination (IUI) Room; Manipulators; Equipment for Embryology and Intracytoplasmic Sperm Injection (ICSI) labs; Principle, maintenance & calibration of instruments.
2. Assisted Reproductive Technology (ART): Types, criteria for application, New guidelines for setting up an ART laboratory; Current standards in ART laboratories; Andrology Lab embryology; Cryopreservation setup. Role of Platelet rich plasma (PRP); Maintenance of ART Lab; Biomedical waste Management; Quality control and quality assurance in ART, Instruments and disposables; Andrology laboratory; Handling of Semen Sample; Biohazards in Andrology laboratory; Precautions during handling of semen sample, media and liquid nitrogen.
3. Basic of Preimplantation Genetic Diagnosis (PGD) : Assisted Reproductive Care for PGD Patients; PGD for Sex Determination and Chromosome Rearrangements; PGD Analysis of Embryos for Monogenic Disorders.
4. Approaches to Preimplantation Diagnosis: Preimplantation Diagnosis for Single-Gene Disorders; Preimplantation Diagnosis for Chromosomal Disorders; Ethical and Social Aspects of PGD; PGD Regulation Worldwide; Recent Advances and Future Prospects in PGD.
5. Micromanipulation and Biopsy of Polar Bodies, Blastomeres, and Blastocysts; Intracytoplasmic Sperm Injection; Blastocyst Biopsy; Laser-assisted Hatching; Trophoctoderm Biopsy. Nuclear Transfer Techniques for Preimplantation Diagnosis: Polar Body and Blastomere Chromosomes; Sperm Duplication.
6. Spermiology: Sperm count, Viability, Motility, Acrosome status, Comet assay to assess sperm DNA damage and its impact on fertility. Sperm preparation for IUI, IVF and ICSI.
7. Recent developments in cryobiology: Semen banking; Oocyte banking; Cord blood and tissue banking; Storage of cryopreserved samples and safety

Course Outcome (C.O.)

Clinical Endocrinology and Reproductive Technology theory course will demonstrate a strong understanding of the underlying principles, diagnostic skills, and clinical application of reproductive endocrinology and assisted reproductive technologies (ART). They will be able to analyze hormonal imbalances, diagnose infertility, and understand the various ART procedures and their ethical implications.

CC – 303 Course Title- Clinical Entomology and Parasitology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Basic Entomology

1. Taxonomy and anatomy.
2. Public Health Entomology and Arthropods.
3. Introduction to arboviruses (arthropod-borne viruses). Yellow fever. Dengue and dengue hemorrhagic fever
4. Biology of mosquitoes and key concepts.
5. Mosquitoes and Lymphatic Filariasis.
6. Mosquitoes and Malaria- Global health perspectives.

Unit-02

Unit Title- Vector borne diseases

1. Phlebotomine sandflies and leishmaniasis.
2. Biology of Leishmania. Diagnosis, symptoms and treatment of the disease.
3. Tse-tse flies and African trypanosomiasis. Biology of the pathogen. Diagnosis, symptoms and treatment of sleeping sickness.
4. Ectoparasites (ticks, mites, fleas, lice).

Unit-03

Unit Title- Medical parasitology

1. Introduction to medical Parasitology - Classification, impact on public health.
2. Protozoa - *Entamoeba* - *Plasmodium*, *Leishmania* - *Trypanosoma* - *Giardia* *Trichomonas* - *Balantidium*.
3. Platyhelminthus -- *Taenia* - *Fasciola* - *Paragonimus* - *Schistosoma*.
4. Nematihelminthes - *Ascaris* - *Ankylostoma* - *Enterobius* – *Trichuris* - *Wuchereria* - *Dracunculus*.

Unit-04

Unit Title- Applied parasitology

1. Laboratory techniques in Parasitology.
2. Examination of faeces for ova and cysts - Concentration methods.
3. Blood smear examination for Parasites- Thick and thin smear preparation for malarial parasites.
4. Immunological diagnosis of parasitic infections.
5. Cultivation of Protozoan Parasites.

Course Outcome (C.O.)

Upon completion of a course in Clinical Entomology and Parasitology, students should be able to demonstrate a comprehensive understanding of the biology, life cycles, pathogenesis, and diagnosis of human parasitic infections, as well as the biology and control of their vectors. They should also be able to perform practical laboratory identification of parasites, design and conduct research, and communicate scientific information effectively.

CC – 304 Course Title- Clinical Bacteriology, Virology and Mycology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- General Microbiology

1. Classification of microorganisms.
2. Gram's Stain, principle, Modification of Gram's Staining. Acid fast stain, Modifications, Interpretation, About Stain.
3. Sterilization and disinfection: Physical agents – drying heat, dry heat, flaming, incineration, moist heat, filtration, radiation, ionizing radiation, non-ionizing radiation.
4. Chemical agents of sterilization – Alcohol, Aldehydes. Phenols, halogens, Iodine, Chlorine, Oxidizing, agents, heavy metals, surface active agents. Cationic, Anionic. Dyes – Aniline, Phenol, Coefficient (Rideal Walker Test).
5. Culture media and Methods-Constituents of culture media, meat extract, yeast extract. Agar types of culture Media-Liquids Semisolid, solid, Peptone water, nutrient, broth, nutrient, Agar basal media, Enriched media, Blood Agar, Chocolate Agar Loeffler's serum slope, Blood Culture Media. Enrichment broth selective media, transport media, differential media, MacConkey Agar, CLED Agar,
6. Culture Method - Streak culture, Lawn or carpet culture, Stroke culture, Stab culture, liquid culture, pour plate culture.
7. Anaerobic culture methods : Anoxomat, McIntosh & Fildes Anaerobic Jar, Gaspak system
8. Collection and handling of various samples.
9. Antimicrobial sensitivity and assay.
10. Lab animals handling and care and laboratory Safety

Unit-02

Unit Title- Medical Bacteriology

1. Morphology of Bacteria – Shape, Cell wall, Gram positive cell wall, Gram negative cell wall, Cell membrane. Cytoplasm, Cell wall, Appendages – Capsule, Flagella, Fimbriae/pilli.
2. Bacterial spore
3. Bacterial growth and nutrition- Growth requirement, sources, environmental factors affecting growth.
4. Bacterial count
5. Bacterial growth curve, Lag phase, log phase, stationary factors, affecting growth of bacteria – oxygen carbon dioxide, temperature, pH, Light, Osmotic effect.
6. Study of Staphylococcus, Neisseria, Listeria, Mycobacterium, Vibrios, Salmonella, Shigella, Escherichia, Klebsiella, Mycoplasma, Rickettsiae, and Spirochaetes.

Unit-03

Unit Title- Medical Virology

1. General morphology and ultra-structure of Viruses: Capsids- Helical Symmetry, icosahedral symmetry, and complex symmetry.
2. General Properties of viruses - Detection of viruses and antigens in clinical specimens.
3. Bacteriophages: Classification, Morphology and ultrastructure, One step growth curve (Latent period,

- eclipse period and burst size). Lytic and lysogenic life cycle.
4. Study of Hepatitis, Rabies, Pox, Adeno, Rota viruses, Oncogenic viruses.
 5. Life cycles of DNA viruses: Herpes and SV40.
 6. Life cycle and other details of RNA viruses: Retroviruses and HIV.

Unit-04

Unit Title- Medical Mycology

1. Morphology, Taxonomy, classification of fungi, detection and recovery of fungi from clinical specimens.
2. Dermatophytes and agents of superficial mycoses.
3. Yeasts of medical importance- Candida, Mycotoxins, Dimorphic fungi, Opportunistic fungi.

Course Outcome (C.O.)

Upon completion of a course in Clinical Bacteriology, Virology, and Mycology, students will be able to understand the structure, characteristics, and classification of bacteria, viruses, and fungi, as well as their roles in human disease. They will also be able to apply this knowledge to understand and diagnose infectious diseases, including how to collect and process clinical specimens, interpret laboratory tests, and understand the mechanisms of antimicrobial resistance. Additionally, students will gain practical skills in research and epidemiology, including planning and executing research projects and providing advice on disease outbreaks.

CC – 395 Course Title- Clinical Endocrinology, Spermiology

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

A. Endocrinology

1. Techniques followed in hormones assay and different types of standard curve used in immunoassay.
2. Different types of ELISA and steps for antibody coating, enzyme conjugate preparation, second antibody preparation. Testing of hormones by ELISA- Sandwich ELISA.
3. Intra-assay and inter-assay coefficient of hormones assay.
4. Different steps of RIA, Assay of hormone by RIA.
5. Thyroid function test: Estimation of T3, T4, TSH.
6. Estimation of gonadal hormones and fertility tests: FSH, LH, hCG, Cortisol, Progesterone, testosterone

B. Spermiology:

1. Evaluation of sperm (Microscopic-manual & automation)- sperm count, viability and motility, acrosome status and HOS test (HypoOsmotic Swelling Test to check membrane integrity of sperm).
2. Sperm preparation techniques (Classical, Standard, Density gradient method);
3. Sperm chromatin assessment;
4. Oocyte retrieval and selection; Advanced sperm selection techniques for ICSI (MACS, Microfluidics).
5. IVF Lab Procedures- Use of in vitro maturation in clinical settings; Intracytoplasmic sperm injection (ICSI); Assisted hatching; Human embryo biopsy procedures; Assisted oocyte activation; Oocyte cooling & vitrification; Oocyte bank management.
6. Embryo handling methods; Culture systems for human embryos; Embryo quality evaluation (Morphology, Physiology, Time-lapse imaging, Proteomics); Embryo freezing and vitrification; Embryo transfer technique; USG guided embryo transfer; ZIFT, GIFT, Embryo reduction. Third Party Reproduction: Oocyte donation, Embryo donation, Surrogacy, Uterus transplantation.

Course Outcome (C.O.)

The course aims to equip students with the necessary knowledge, skills, and attitudes to effectively diagnose and manage a range of endocrine and reproductive health issues.

CC – 396 Course Title- Diagnostic Microbiology, Entomology and Parasitology

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

Practical / Laboratory training

1. Demonstration of Autoclave and Hot air oven
2. Cleaning and decontamination of glassware and laboratory waste materials
3. Sterilization techniques
4. Culture media preparation and composition -Nutrient Agar, MacConkey, Cled, Sabouraud's etc.
5. Gram's staining of different specimens like pus, sputum, urine, CSF, endometrial tissue, pleural fluid.
6. AFB staining of different specimens like sputum, pus, pleural fluid, endometrial tissue.
7. Cultivation of bacteria and fungi in laboratory
8. Staining of bacteria: Simple staining, Gram staining, and Negative staining.
9. IMViC test
10. Antibiotic sensitivity test of bacteria
11. Isolation of DNA from bacteria
12. Agarose gel electrophoresis of DNA
13. Restriction digestion of lambda DNA using EcoR1 and HindIII
14. SDS-PAGE analysis
15. Polymerase Chain Reaction
16. Parasitology-
 - a. Collection, Presentation & Identification of different disease causing Arthropods (Housefly, Mosquito etc.)
 - b. Whole mount preparation of slides of different disease causing arthropods for their detailed anatomical studies.
 - c. Identification of different diseases causing Helminth and Protozoan parasites.
 - d. Identification of different phases of life cycle of arthropods protozoa, helminth, having medical importance for causing disease.
 - e. Slide identification of microfilaria, *Taenia Solium*, *Ascaris*, and different stages of malaria.
17. Techniques for Intestinal Parasites: Identification of Parasites in wet mounts, Concentration methods, direct centrifuge floatation method and ether extraction method for ova and cysts. Culture especially for enriched groups of organisms.

Course Outcome (C.O.)

Upon completion of the Diagnostic Microbiology, Entomology and Parasitology practical course, students will be able to: identify and characterize microorganisms, insects, and parasites; understand their life cycles and disease mechanisms; perform relevant laboratory techniques for diagnosis; and appreciate the importance of these fields for public health and disease control.

SEMESTER-IV

CC – 401 Course Title- Biomedical Instrumentation and Molecular Diagnostic Techniques

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Concepts on instruments and techniques

1. Different types of centrifugation, Ultracentrifugation, Density gradient centrifugation.
2. Sonication and its application.
3. UV-VIS spectroscopy, IR spectroscopy, and NMR spectroscopy.
4. DNA sequencing method, Sanger sequencing, Next Generation Sequencing, Whole Genome Sequencing, Whole Exome Sequencing.
5. Microscopy, types, Scanning Electron Microscope, Transmission Electron Microscope, application of Microscope.
6. PCR, RT-PCR, Application - CT values for assessment of severity of diseases.
7. ELISA reader and Auto-analyzer.
8. Mass spectrometer

Unit-02

Unit Title- Methods of analysis of biomolecules

1. Principles, experimental procedures and application of chromatography – paper, thin-layer, ion exchange, affinity, gel filtration, gas-liquid and HPLC.
2. Principles, procedures and application of electrophoresis – paper, polyacrylamide gel, agarose gel, capillary and cellulose acetate.
3. Principles, procedures and application of blotting techniques – Northern, Southern, and Western Blotting.
4. Principles and applications of Photometry, Spectrophotometry, fluorometry, atomic absorption spectrometry. Ion selective electrodes and their applications in Medicine.
5. Radioisotopes- Detection and measurement of radioactive isotopes, application of isotopes in research and clinical biochemistry, Radioactive emissions, radiation-matter interaction, radiation dose, Geiger-Müller (GM) counter, scintillation counter.
6. Laboratory Automation, Efficiency and Diagnostic Accuracy.
7. Real time monitoring system and its merits.

Unit-03

Unit Title- Concepts on cellular energy and characterization of cell

1. Bioenergetics and Biological oxidation- Concept of free energy change, high energy compounds, ATP generation, redox Potential Assessment, Electron transport chain, oxidative phosphorylation, inhibitors, Uncouplers, ionophores.
2. Cell Fractionation, Biochemical activities of different fractions, marker enzymes.
3. Purification of enzymes from cells, characterization and Internal Assessment of purity, purification of proteins.
4. Characterization of cells using Flow cytometer, Fluorescence Activated Cell Sorter and Analyzer, Immunophenotyping.

Unit-04

Unit Title- Basic Bioinformatics

1. Basic idea of Bioinformatics.
2. Sequence databases- NCBI, SwissProt, UniProt, Ensemble, GenBank.
3. Sequence analysis- BLAST, FASTA.
4. Sequence Alignment by using CLUSTALW.
5. Construction of a phylogenetic tree based on the 16S rRNA gene.
6. Basic concepts of proteomics, genomics, transcriptomics, metabolomics
7. Application of bioinformatics tool in proteomics and genomics data analysis - MASCOT, Expasy, Human Protein Atlas.

Course Outcome (C.O.)

After completing a course in Biomedical Instrumentation and Molecular Diagnostics, students should be able to understand and apply principles of instrumentation for medical diagnosis, monitoring, and treatment, as well as gain knowledge of molecular diagnostic techniques. This includes understanding biosignals, medical imaging techniques, and the principles behind various diagnostic tools. Students should also be able to apply their knowledge to solve real-world medical problems and potentially develop new technologies.

CC – 402 Course Title- Advanced Laboratory Pathology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Analysis of Cerebrospinal fluid (CSF)

1. Cerebrospinal fluid - formation, physiological function and pathological role.
2. Method of obtaining CSF, indications, contra indications.
3. Examination of CSF:
 - Physical examination
 - Biochemical examination
 - Microscopic examination
 - Cytological examination
 - Bacteriological examination

Unit-02

Unit Title- Analysis of different body fluids

1. Basic information about different body fluids and their clinical significance
2. Microscopic examination of
 - Pleural fluid
 - Vaginal smear
 - Pericardial fluid
 - Synovial fluid
 - Ascitic fluid
 - Peritoneal fluid.
 - Papanicolaou test

Unit-03

Unit Title - Digital pathology and artificial Intelligence (AI).

1. Fundamental concept of digital pathology- Whole Slide Imaging (WSI), Workflow Optimization, Transition to Digital Systems.
2. Application of AI in digital pathology- AI-driven Image Analysis, Tumor Grading and Micrometastasis

Detection, Biomarker Analysis, Prognostic and Predictive Tools.

3. Regulatory requirements, validation protocols and compliance in Digital Pathology.
4. Telepathology and Remote Diagnostics.
5. Healthcare Big Data for Pathology.

Course Outcome (C.O.)

An Advanced Laboratory Pathology Theory course aims to provide students with in-depth knowledge of analysis of various body fluids including CSF, urine, semen. Successful students will be able to perform routine pathological investigations, interpret results, and manage a modern pathology laboratory. They will also develop skills in quality control, instrument operation, and potentially research. They will also gain basic knowledge on the application of digital pathology and artificial intelligence in pathological analysis.

CC – 403 Course Title- Advanced Diagnostic Bacteriology, Virology

Marks: 50 Credits: 4 Classes: 40 L

Unit-01

Unit Title- Clinical Bacteriology

1. Culturable and unculturable microbes, metagenomics approach.
2. Normal microflora in the human body and their beneficial effect.
3. Epidemiology, symptomatology. General description of microbial pathogens, diagnosis, prevention and therapy of - meningitis, tuberculosis, urinary tract infection, cholera, syphilis, diphtheria, mycotoxicosis, opportunistic fungal pathogens, and dermatophytes.
4. Toxin- types and effects.
5. Antibiotic resistant microbes – concept and mechanisms. Antibiotic sensitivity test.
6. Hospital acquired pathogens and their prevention.
7. Quorum sensing.

Unit-02

Unit Title- Clinical virology

1. Systematic Virology- Parvo viruses, Papova virus, Herpes virus, orthomyxovirus, paramyxovirus, Rubella virus, Arbovirus, Rhabdovirus, Human enteric viruses, Prions, Virusoid.
2. Diagnostic virology-
 - i. Laboratory diagnosis of viral infections.
 - ii. Collection, Preservation, transportation, Processing, and reporting of various clinical specimens for viral infections.
 - iii. Immune response to viral infections
 - iv. Epidemiology of viral infections, antiviral agents
 - v. Viral infections in immunocompromised patients.

Unit-03

Unit Title- Molecular diagnostic techniques relevant to medical microbiology

1. PCR and its modifications including nested PCR, Multiplex PCR. Special emphasis to Real-time PCR. Principles of recombinant DNA technology.
2. Clinical diagnosis serological techniques for identification of bacteria: TMV Bacteriophages. HIV. SV 40, Orthomyxo & Paramyxovirus.

Course Outcome (C.O.)

In an Advanced Diagnostic Bacteriology and Virology theory course, students would learn to identify and differentiate between various bacterial and viral pathogens, understand their mechanisms of infection, and apply advanced diagnostic techniques to detect and diagnose infections. They would also gain knowledge of the epidemiology, prevention, and treatment of infectious diseases caused by these pathogens.

CC – 494 Course Title- Advanced Laboratory Pathology (P)

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

Practical/Laboratory training

1. Urine analysis: Reducing sugar-Benedict test, protein -Heat and acetic acid test, and sulfosalicylic acid method, Ketone bodies-Rothera's test, Bile pigment (Fouchet method), bile salt (Hay's test), Urobilinogen- Ehrlich aldehyde test and Bence Jones protein test, Renal clearance test-urea, creatine, Test for mucin.
2. Test for Drugs of Abuse - Methadone, metha - Amphetamine, Benzodiazepine, Cocaine, Morphine, Cannabinoids and Phenobarbitone.
3. Semen analysis- microscopic
4. Examination of CSF
5. Examination of body fluids
6. Examination of sputum
7. Immunopathology
8. Serological tests (Screening & diagnostic) used in different pathological conditions.
9. Delayed type hypersensitivity testing.
10. Histocompatibility testing

Course Outcome (C.O.)

A successful completion of an Advanced Laboratory Pathology practical course will equip students with the ability to perform advanced diagnostic and research procedures in pathology, understand the principles of laboratory management, and interpret complex results. They will also gain proficiency in advanced techniques like CSF, urine, semen sample processing and analysis.

CC – 495 Course Title- Advanced Diagnostic Bacteriology, Virology

Marks: 50 Credits: 4 Classes: 80 Lecture Hours

Practical /Laboratory training

1. Isolation, characterization and identification of pathogens from clinical samples.
2. Identification of E. coli by biochemical tests.
3. Staining of bacteria: Endospore and acid fast staining.
4. Cultivation of Escherichia coli from urine samples and test the antibiotic sensitivity of the isolates.
5. Determination of Minimum Inhibitory Concentration (MIC) antibiotics.
6. Common serological tests for the diagnosis of bacterial infections.
7. Demonstration of cell line, Animal cell cultures, Media, sterilization.
8. Detection of Dengue Virus by ELISA.
9. Detection of HIV by ELISA.
10. Detection and quantification of DNA/RNA virus using Real-time PCR.

Course Outcome (C.O.)

Upon completion of a course in Advanced Diagnostic Bacteriology and Virology, students should be able to demonstrate a strong understanding of advanced diagnostic techniques, the principles of microbial pathogenesis, and the application of these concepts to clinical practice and research. Specifically, they should be able to identify and characterize pathogens, analyze their virulence factors, and apply diagnostic tools for accurate and timely diagnosis of infectious diseases

CC – 496 Course Title- Internship at hospitals (2 months)

Marks: 50 Credits: 4 Classes: 160 Lecture Hours

Course Outcome (C.O.)

An internship in a pathological laboratory or hospital aims to equip students with practical skills and knowledge in various aspects of pathology, from clinical samples or specimen handling to performing and interpreting laboratory tests. Students will learn to adapt to a real-world laboratory setting, handle clinical samples, and complete tests within specified timeframes. They will also develop interpersonal and communication skills, crucial for working in a collaborative environment.