Master of Science - Medical Lab Technology

Syllabus - First Semester

LABORATORY MANAGEMENT AND QUALITY CONTROL

Course Code: MLT4108 **Credit Units: 3**

Course Objective: To allow students to understand the laboratory management and quality control.

Course Contents:

Module-I: General Concept of Laboratory Management: Strategic planning; quality system management; human resource management; laboratory design and service model; regulation, accreditation and legislation; safety- biomedical hazard, chemical hazard, ergonomic hazard.

Module-II: Clinical Laboratory Informatics: Information flow (patient's registration/ID), test order, sample collection, labeling, performing test, releasing result & report, feedback. LIS selection, Implementations & management; good laboratory practice

Module-III: Quality Control: Introduction, analytical variability and calibration; calibration issue in quality control; proficiency testing; Westgurd rules; quality control of the product, chemicals, reagent; good, reliable, authentic report; total quality management framework of laboratory; essential elements of quality assurance programme; quality laboratory processes, quality assurance, quality assessment, quality control, quality planning and quality improvement

Module-IV: Internal Quality control: Control of pre-analytical variables, control of analytical variables, laboratory precision, accuracy & sensitivity; validation of methods; reference materials and calibrating definitive methods; sources of variation in laboratory test results. Systemic and random errors; quality control charts: Levy-Jenning chart, Cusum chart and Gaussian curve; Internal and external factors for quality control assurance; reference values

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- Praful B. Godkar, Darshan P. Godkar. Text book of Medical Laboratory Technology, 3rd Edition 2014, Bhalani Publishing House.
- J Ochei and A Kolhatkar. Medical Laboratory Science- Theory and Practice, 1st Edition 2000, Tata Mcgraw Hill Publishing Co. Ltd.
- Mc Pherson and Pincus. Henry's Clinical Diagnosis and management by Laboratory Method, 23rd Edition, Elsevier.

ADVANCED LABORATORY TECHNIQUE

Course Code: MLT4114 **Credit Units: 4**

Course Objective: To enable the students to understand the working principle of latest laboratory techniques.

Course Contents:

Module-I: Principles & Application of Chromatography: Definition and types of Chromatography; Paper Chromatography; Thin Layer Chromatography; Adsorption Chromatography; Partition Chromatography; Ion-exchange Chromatography; Gel Filtration; Affinity Chromatography; Column Chromatography; High Performance liquid Chromatography (HPLC).

Module-II: Electrophoresis: Definition, General Methodology; Factors affecting migration of charged particles; Theory and applications of paper, SDS-PAGE and agarose gel electrophoresis; Isoelectric Focusing; Two Dimensional Electrophoresis; Protein purification and Evaluation; Densitometry

Module-III: Immunological Technique: Enzyme Linked immunosorbent assay; Radioimmunoassay; Immunodiffusion, Florescent immunoassay; Immunofluorescence, Immunoarray, Chemiluminosence assay.

Module-IV: Molecular Techniques: Recombinant DNA technology; Polymerase chain reaction; RT PCR; RFLP; DNA Probe; DNA finger printing; Sequencing; Eastern blot; Southern blot; Northern blot; Gel documentation, DNA microarray, FISH, RFLP.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- Keith Wilson & John Walker. Principles and techniques of biochemistry and molecular biology. Cambridge University Press, 7th Edition, (2015)
- S.V.S. Rana. Biotechniques theory and Practice Rastogi Publications, 3rd edition, (2012)
- U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee Brothers Medical Publishers (P) Ltd.
- Mc Pherson and Pincus. Henry's Clinical Diagnosis and management by Laboratory Method, 23rd Edition, Elsevier.

LAB COURSE

Course Code: MLT4105 **Credit Unit: 1**

Course Objective:

- To impart the basic knowledge of principles, procedure and clinical importance of laboratory various test.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical laboratory.

Serology

1. HIV test.
2. HCV test.
3. HBsAg test.
4. widal test.
5. ASO test.
6. CRP test.
7. RA test.
8. VDRL and RPR test.
9. Coomb's test.

Molecular Pathology and Cytogenetics

1. To demonstrate PCR.
2. To demonstrate recombinant DNA technology.
3. To demonstrate DNA finger printing.
4. To demonstrate RT PCR and RFLP.

Examination Scheme:

Components	Internal Assessment	Attendance	Record	EE
Weightage (%)	20	5	5	70

Recommended books:

- DM Vasudevan, Subir Kumar Das, Practical Textbook of Biochemistry for Medical Students, Jaypee & Brothers Medical Publishers Pvt. Ltd.
- P K Godkar, Text Book of Medical Laboratory Technology 13th edition, Bhalani Publication.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations 4th edition, Jaypee & Brothers Medical Publishers Pvt. Ltd.
- Shivaraja Shankara YM, ,araknahS ,yrtsimehcoiB lacitcarP rof launaM yrotarobaL ,KM hsenaG .dtL .tvP srehsilbuP lacideM srehtorB & eepyaJ
- Medical Laboratory Science: Theory and practice by J. Ochei, Arundhati kolhatkar, Mcgraw Hill Education, 1stedition (2008).

CLINICAL TRAINING

Course Code: MLT4112 **Credits Units: 2**

Course objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Second Semester:

1. Serology Lab
2. Molecular Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme:

Components	**Viva**	**A**	**ME**	**EE**
Weightage (%)	10	5	15	70

Syllabus - Second Semester

CLINICAL BIOCHEMISTRY LAB COURSE-I

Course Code: MLT4215 **Credit Unit: 1**

Course Objective

- To impart the basic knowledge of principles, procedure and clinical importance of laboratory various test.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical laboratory.

Course Contents:

1) Carbohydrates: estimation of glucose (F, PP & R)
2) Protein: estimation of serum albumin, total protein and A/G ration.
3) Triglycerides : estimation of serum triglycerides
4) Cholesterol : estimation of total cholesterol
5) SGPT : estimation of SGPT
6) SGOT : estimation of SGOT
7) Alkaline phosphatase : estimation of alkaline phosphatase
8) Acid phosphatase : estimation of acid phosphatase
9) Bilirubin : estimation of serum bilirubin
10) Blood urea : estimation of blood urea in blood sample
11) Creatinine : estimation of serum creatinine
12) Calcium : estimation of serum calcium

Examination Scheme:

Components	Internal Assessment	Attendance	File	EE
Weightage(%)	20	5	5	70

Recommended books:

- Medical Laboratory Science: Theory and practice by J. Ochei, Arundhati kolhatkar, Mcgraw Hill Education, 1st edition (2008).
- P K Godkar, Text Book of Medical Laboratory Technology 13th edition, Bhalani Publication.

CLINICAL BIOCHEMISTRY CLINICAL TRAINING-I

Course Code: MLT4216 **Credit Units: 2**

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Clinical Pathology Lab
2. Instrumentation Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme:

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

DIAGNOSTIC MICROBIOLOGY-I

Course Code: MLT4218 **Credit Units: 3**

Course Objective:

- To develop theoretical as well as practical skills for handling the microorganisms in microbiology laboratory.
- To empower students aware of routine laboratory techniques.

Course Contents:

Module-I: Diagnostic Microbiology: Introduction and importance of diagnostic microbiology.
Specimen Collection: Collection, preservation, transportation and processing of various clinical specimens for microbiological investigations.

Module-II: Gross / Physical Examination: Significance and procedure for gross examination of various microbiological clinical specimens
Microscopic Examination: Unstained microscopic techniques; various staining techniques.

Module-III: Culture Media: Cultural characteristics of microbes; Preparation and application of various culture medias and broth
Cultural techniques: Different cultural techniques; antibiotic susceptibility test; interpretation of cultures and antibiotic testing; stock culture preparation and its maintenance.

Module-IV: Specific identification tests: Various biochemical tests; other laboratory techniques for identification of microbial strains or species.

Examination Scheme:

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- C P Baveja, Text book of Microbiology, Arya Publication.
- R. Ananthanarayan and Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, Orient BlackSwan.
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology 4th, CBS Publishers & Distributors.
- Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology 13th Edition, Churchill Livingston.
- R C Dubay & D.K.Maheshwari, Practical Microbiology revised edition, S Chand & Company LTD.
- Suvarna, Layton & Bancroft, Suvarna Bancroft's Theory & Pract. Of Histological Techniques, Churchill Livingstone.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology 9th edition, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology 7th, Woulter Kluwer.
- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology 2nd Edition, Oxford university press.
- Neal Chamberlain, Medical Microbiology: The Big Picture, Mc Grew Hill Medical.

CLINICAL MICROBIOLOGY LAB COURSE-I

Course Code: MLT4220 **Credit Unit: 1**

Course Objective:

- To impart the basic knowledge of principles, procedure and clinical importance of laboratory various test.
- To familiarize with basic knowledge of instruments commonly utilized in the clinical laboratory.

Course Contents:

1) **Preparation of culture media:** Peptone water, Nutrient broth, Selenite F broth, Thiosulfate citrate bile salt sucrose agar, Nutrient agar, Blood agar, chocolate agar, MacConkey's agar, Mueller-Hinton, Salmonella-Shigella agar, Xylose Lysine Deoxycholate agar, L J Medium, TSI agar, citrate agar, urease agar.
2) **Staining method**: Simple stain, Gram stain, ZN Stain, Albert stain, Negative stain,
3) **Culture Method**: Streak culture, Lawn Culture, Stroke Culture, Pour plate culture, Liquid culture.
4) **Biochemical tests:** Catalase test, Coagulase test, CAMP reaction, Bile solubility test,
5) Widal test
6) Hanging drop preparation and Satellitism.

Examination Scheme:

Components	Internal Assessment	Attendance	File	EE
Weightage(%)	20	5	5	70

Recommended books:

- C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
- Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
- Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
- R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
- Mark Gladwin, Trattler William, C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
- Dr. C.P. Baveja, Dr. V. Baveja, Textbook of Microbiology for MLT, 2nd Edition, Arya Publication.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016,Wolters Kluwer Health.

CLINICAL MICROBIOLOGY CLINICAL TRAINING-I

Course Code: MLT4221 **Credit Units: 2**

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.

Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Microbiology Lab
2. Bacteriology Lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme:

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

Syllabus - Third Semester

SUMMER PROJECT EVALUATION

Course Code: MLT4335 **Credit Units: 6**

Summer Project report:
The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the layout of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or Cover Page:** The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.
- **Acknowledgement(s):** Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.
- **Abstract:** A good "Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.
- **Table of Contents**: Titles and subtitles are to correspond exactly with those in the text.
- **Introduction:** Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.
- **Materials and Methods:** This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.
- **Results and Discussion:** Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow. Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form.While presenting the results, write at length about the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather; it should lead to generalization of data on the chosen sample. Results and its discussion should be supporting / contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporting or contradicting the present case of research.
- **Conclusion(s) & Recommendations:** A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:
• Did the research project meet its aims (check back to introduction for stated aims)?
• What are the main findings of the research?
• Are there any recommendations?
• Do you have any conclusion on the research process itself?

- **Implications for Future Research:** This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.
- **Appendices:** The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
- **References:** References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

- For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic Escherichia coli O157: H7. Clin Microbiol Infect , 8 (suppl 1): 116–117.

- For book:

Kowalski,M.(1976) Transduction of effectiveness in Rhizobium meliloti. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), 7: 63-67

The Layout Guidelines for the Project File & Project Report:
• A4 size Paper
• Font: Arial (10 points) or Times New Roman (12 points)
• Line spacing: 1.5
• Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT
Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfil the following assessment objectives:
• Range of Research Methods used to obtain information
• Execution of Research
• Data Analysis (Analyze Quantitative/ Qualitative information)
• Quality Control
• Conclusions

Assessment Scheme:
Continuous Evaluation:
40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File.)
Final Evaluation:
60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the final evaluation should be carried out by internal supervisors.

Examination Scheme:

Components	**Continuous assessment (External Supervisor-20 & Internal Supervisor-20)**	**Final Evaluation (Attendance >75%-5, Viva-10, Presentation- 15 & Final report- 30**
Weightage (%)	40	60

SPECIALIZATION - CLINICAL BIOCHEMISTRY
CLINICAL ENDOCRINOLOGY

Course Code: MLT4307 **Credit Units: 4**

Course Objective: To make the students to understand the basics of hormones function; clinically important hormones; diagnostic procedure and clinical interpretations.

Course Contents:

Module-I: Basics of Endocrinology: Exocrine and endocrine; anatomical aspects of human endocrine system; regulation of endocrine system; chemical nature of human hormones; hormone receptors; mechanism of peptide and non- peptide hormones action; secondary messenger.
Hypothalamus: Introduction; production, secretion regulation and functions of hypothalamic hormones.

Module-II: Pituitary gland: Introduction; production, secretion regulation and functions of pituitary hormones; related disorders.
Pineal gland: Introduction; production, secretion regulation and functions of pineal hormones; related disorders.
Thyroid gland: Introduction; production, secretion regulation and functions of thyroid hormones; related disorders; thyroid function test.

Module-III: Parathyroid glands: Introduction; production, secretion regulation and functions of parathyroid hormones;
Adrenal gland: Introduction; production, secretion regulation and functions of adrenal hormones; related disorders.
Pancreas: Introduction; production, secretion regulation and functions of insulin and glucagon; somatostatin; related disorders.

Module-IV: Testes and Ovary: Introduction; production, secretion regulation and functions of testes and ovarian hormones; related disorders.
Other Biologically Important Hormones: Hormones involving incontraception; calcium metabolism; renin angiotensin; urotensin; erythropoietin; anti-mullerian hormone.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended Books:

- U Satyanarayan and U Chakrapani. Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde. Text book of Medical Biochemistry , 8th Edition 2012, Jaypee Brothers Medical Publishers (P) Ltd
- D M Vasudevan, SreekumariS, Kannan Vidhyanathan. Textbook of Biochemistry for Medical students, 8thEdition 2016, Jaypee& Brothers Medical Publishers (P) Ltd.
- S Ramakrishana, Test Book of Medical Biochemistry. 3rd Illustrated Edition 2004, Orient Longman.
- S Chitiprol. Biochemistry: Instant Notes for Medical students, 1st Edition 2006, Jaypee Brothers Medical Publishers (P) Ltd
- DM Vasudevan, Subir Kumar Das. Practical Textbook of Biochemistry for Medical Students, 2nd Edition 2013, Jaypee Brothers Medical Publishers (P) Ltd

- Ranjna Chawla. Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee Brothers Medical Publishers (P) Ltd
- David T Punmmer. An introduction to practical biochemistry, 3rd Edition 2004, Tata McGraw-Hill Education Private Limited
- YM ShivarajaShankara, MK Ganesh, AR Shivashankara. Laboratory Manual for Practical Biochemistry. 2nd Edition 2013, Jaypee Brothers Medical Publishers (P) Ltd
- Albert L Lehninger, Michel M Cox, David L Nension.Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
- Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly. Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.
- Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks. Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
- Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level: Life at the Molecular Level. Fifth Edition 2016, Wiley
- Henry M. Kronenberg, ShlomoMelmed, Kenneth S. Polonsky, P. Reed Larsen. William Textbook of Endocrinology, 11th ed. Saunders Elsevier 2008
- Bolander, F. F. Molecular Endocrinology, III ed. Academic Press, 2004.
- Nelson Cox. Lehninger's Principle of Biochemistry. 3rd ed. MacMillianWorth Publ. 2000.
- Mac E. Hadely. Endocrinology: 5thed. Pearson Education, 2000.

CLINICAL ENZYMOLOGY

Course Code: MLT4308 **Credit Units: 4**

Course Objective: To make the students to understand the basics of enzymes function; clinically important enzymes; diagnostic procedure and clinical interpretations.

Course Contents:
Module-I: Basic Enzymology: Historical perspective; general characteristics; factor affecting enzyme activity; nomenclature and IUB classification; holoenzyme; apoenzyme; co-factors; co-enzymes; prosthetic group; metallozyme; enzyme assay; units; Michaelis-Menten equation.

Module-II: Enzyme inhibition: Introduction; types; enzyme inhibitors; applications
Co-enzyme: NAD; NADP; FAD; Co-enzyme A TTP; Lipic acid; Vitamin B12; Tetrahydrofolate

Module-III: Enzymes In Clinical Medicine: Introduction; intra-cellular and extra-cellular enzymes; CPK; CK-MB; LDH; SGOT; SGPT; cholinesterase; amylase; lipase; aldolase; alkaline and acid phosphatase; Glucose-6-phosphatase; 5-nuceotidease; GGT.

Module-IV: Enzymes in the Diagnosis of Diseases: Diagnosis, prognosis and assessment of myocardial infarction, hepatitis, jaundice, pancreatitis, cancer, neurodegenerative disorders.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- U Satyanarayan and U Chakrapani. Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde. Text book of Medical Biochemistry , 8th Edition 2012, Jaypee Brothers Medical Publishers (P) Ltd
- D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8thEdition 2016, Jaypee & Brothers Medical Publishers (P) Ltd.
- P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014,Bhalani Publishing House.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee Brothers Medical Publishers (P) Ltd
- David T Punmmer, An introduction to practical biochemistry, 3rd Edition 2004, Tata McGraw-Hill Education Private Limited
- YM Shivaraja Shankara, MK Ganesh, AR Shivashankara. Laboratory Manual for Practical Biochemistry. 2nd Edition 2013, Jaypee Brothers Medical Publishers (P) Ltd
- Carl A Buttis, David E. Bruns, Teitz fundamental of clinical chemistry and molecular diagnosis,7th Edition 2015, Elsevier.
- Albert L Lehninger, Michel M Cox, David L Nension, Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
- Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.
- Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks, Marks' Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
- Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level: Life at the Molecular Level. Fifth Edition 2016, Wiley

ADVANCES IN INTERMEDIARY METABOLISM

Course Code: MLT4309 **Credit Units: 3**

Course Objective: The objective of the course is to provide students with knowledge of the various diseases arising due to disorders in the biochemical processes.

Course Contents:

Module-I: Electron Transport & Oxidative Phosphorylation: Components of Electron Transport Chain, Respiratory Chain, Energy Coupling hypothesis, Proton- Gradient generation, Mechanism of ATP synthesis, Uncoupling of Oxidative Phosphorylation

Module-II: Metabolic Disorders of Carbohydrates Metabolism
Galactosemia, glycogen storage disease, deficiency of glucose-6-phosphate dehydrogenase, Hypoglycemia, Diabetes mellitus.

Module-III: Metabolic Disorder of Lipid: SIDS, Tay-Sachs disease, Nieman Pick disease, Farber's disease, Gaucher's disease, Krabbe's disease, hyperlipoproteinemia

Module-IV: Metabolic Disorder of Amino Acid: Phenylketonuria, Richner-Hanhart syndrome, Hartnup's disease, glycinuria, alkaptonuria, Maple syrup urine disease, albinism.
Metabolic Disorder of Nucleotides: Gout, SCID, Lesch-Nyhan Syndrome, Orotic aciduria

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- U Satyanarayan and U Chakrapani. Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde. Text book of Medical Biochemistry , 8th Edition 2012, Jaypee Brothers Medical Publishers (P) Ltd
- D M Vasudevan, Sreekumari S, Kannan Vidhyanathan,Textbook of Biochemistry for Medical students, 8thEdition 2016, Jaypee & Brothers Medical Publishers (P) Ltd.
- P K Godkar, Text Book of Medical Laboratory Technology, 3rd Edition 2014,Bhalani Publishing House.
- Ranjna Chawla, Practical Clinical Biochemistry: Methods and Interpretations, 4th Edition 2014, Jaypee Brothers Medical Publishers (P) Ltd
- David T Punmmer, An introduction to practical biochemistry, 3rd Edition 2004, Tata McGraw-Hill Education Private Limited
- YM Shivaraja Shankara, MK Ganesh, AR Shivashankara. Laboratory Manual for Practical Biochemistry. 2nd Edition 2013, Jaypee Brothers Medical Publishers (P) Ltd
- Carl A Buttis, David E. Bruns, Teitz fundamental of clinical chemistry and molecular diagnosis,7th Edition 2015, Elsevier.
- Albert L Lehninger, Michel M Cox, David L Nension, Lehninger Principle of Biochemistry, 6th Edition 2013, W H Freeman & Co.
- Robert Kincaid Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Harpers Illustrated Biochemistry, 30th Edition 2015, McGraw Hill Professional.

- Michael Lieberman, Allan D. Marks, Colleen M. Smith, Dawn B. Marks, Marks' Essential Medical Biochemistry, 2nd Edition 2007, Lippincott Williams & Wilkins.
- Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level: Life at the Molecular Level. Fifth Edition 2016, Wiley

DIAGNOSTIC BIOCHEMISTRY

Course Code: MLT4310 **Credit Units: 4**

Course Objective: To make the students understand the basic principle, procedure, normal range and clinical significance of blood test.

Course Contents:

Module-I: Diabetes Profile: Diabetes mellitus**;** Blood glucose; Glucose tolerance test; Glycosylated hemoglobin; urine sugar.
Kidney Profile: Serum total protein; albumin; creatinine; urea; blood urea nitrogen; clearance test; Sodium and Potassium

Module-II: Pancreatic Function Test: Serum amylase; lipase; secretin stimulation test; serum trypsinogen.
Liver Function Test: SGOT, SGPT, phosphatase, serum bilirubin; albumin; globulins; A/G ratio; gamma-glutamyl transpeptidase .

Module-III: Cardiac Function Test: SGOT, SGPT, LDH, CK-MB, Troponins and heart-type fatty acid binding protein (H-FABP); Myoglobin; Brain type natriuretic peptide (BNP).
Lipid Profile: Total serum lipids; total serum cholesterol; triglyceride; HDL; LDL; VLDL; Apo 1 and Apo 2

Module-IV: Gastric And Intestinal Function Test: Examination of resting contents; fractional gastric analysis; achylia gastrica ; stimulation tests; serum pepsinogen; tubeless gastric analysis; zollinger-elison syndrome; lactose intolerance; xylose absorption test; inulin absorption test.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- Praful B. Godkar, Darshan P. Godkar. Text Book of Medical Laboratory Technology, 3rd Edition 2014,Bhalani Publishing House.
- U Satyanarayan and U Chakrapani, Text book of Biochemistry, 4th Edition 2013, Elsevier.
- M N Chatterjea and Rana Shinde, Text book of Medical Biochemistry , 8th Edition 2012, Jaypee Brothers Medical Publishers (P) Ltd.

CLINICAL BIOCHEMISTRY CLINICAL TRAINING-II

Course Code: MLT4315 **Credit Units: 2**

Course objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.
Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

1. Clinical Biochemistry Lab
2. Collection centre

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme:

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

SPECIALIZATION - CLINICAL MICROBIOLOGY
DIAGNOSTIC MICROBIOLOGY-II

Course Code: MLT4316 **Credit Units: 4**

Course Objective:

- To develop theoretical as well as practical skills for handling the microorganisms in microbiology laboratory.
- To make students aware of advanced laboratory techniques.

Course Contents:

Module-I: Molecular Techniques: DNA recombinant techniques, PCR, NAT, nucleic acid amplification, plasmid analysis, fingerprinting, ribo-typing and DNA sequencing, probe amplification, and other advanced techniques.

Module-II: Rapid and advanced diagnostic techniques: Immunoassays – ELISA, Immuno-electrophoresis, immuno- fluorescence, precipitation, flocculation and agglutination tests, rapid card methods; automatic blood culture system; rapid culture technique for MTB detection; micro-assays; laboratory techniques for cancer immunology.

Module-III: Emerging Diseases: Detailed study (etiology, transmission, pathogenesis, clinical manifestations, laboratory Diagnosis, prevention and control) of following infections – Dengue, Listeriosis, VRE (Vancomycin Resistant enterococci), Leptospirosis, Hepatitis non A , Swine flu, infections caused by Campylobacter , and prions.

Module-IV: Epidemiology of infectious diseases: Introduction, historical aspects, objectives and significance, epidemiological principals in prevention and control of various epidemic microbial diseases or infections; Measures of risks: frequency measures, morbidity frequency measures, mortality frequency measures natality (birth) measures, measures of association, measures of public health impact.

Examination Scheme

Components	CA	A	ME	EE
Weightage (%)	15	5	10	70

Recommended books:

- C P Baveja, Text book of Microbiology, Arya Publication.
- R. Ananthanarayan and Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, Orient BlackSwan.
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology 4th, CBS Publishers & Distributors.
- Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology 13th Edition, Churchill Livingston.
- R C Dubay & D.K.Maheshwari, Practical Microbiology revised edition, S Chand & Company LTD.
- Suvarna, Layton & Bancroft, Suvarna Bancroft's Theory & Pract. Of Histological Techniques, Churchill Livingstone.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology 9th edition, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic

Microbiology 7th, Woulter Kluwer.
- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology 2nd Edition, Oxford university press.
- Neal Chamberlain, Medical Microbiology: The Big Picture, Mc Grew Hill Medical.

CLINICAL VIROLOGY

Course Code: MLT4317 **Credit Units: 4**

Course Objectives:

- To impart knowledge about harmful effects of virus in human health.
- To develop understanding of morphology, cultivation, transmission, Pathogenicity, and control strategies of clinically important Virus.
- To familiarize with techniques of sample collection, transport and processing to diagnose viral infection.

Course Contents:

Module-I: Virology: The nature of viruses, Classification of viruses, structure of virus, Cultivation and replication of virus, Bacteriophase, Interferon, Viral vaccines and antiviral drugs, sample collection, transport and storage of sample for viral diagnosis.

Module-II: Clinically important DNA virus: Herpes simplex virus, Varicella Zoster virus, Cytomegalovirus, Epstein-Barr virus, Poxviridae, Adenoviridae, Parvoviridae, Papillomaviridae.

Module-III: Clinically important of RNA virus: Orthomyxoviruses, Paramyxoviruses, Rubella virus, Picornaviruses, Dengue virus, Chikungunya virus, Japanese B encephalitis virus, Kyasanur Forest disease virus, Rhabdoviruses, HIV and other Retroviruses.

Module-IV: Clinically important of miscellaneous virus: Hepatitis viruses, Oncogenic viruses, Hantaviruses, Arenaviruses, Ebola virus, Coronaviruses, Slow viruses, Rotavirus. Emerging viral infections – SARS, Avian influenza, H1N1.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
- Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
- Mark Gladwin, Trattler William, C. Scott, Mahan Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
- Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
- R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.
- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology,10th German Edition 2005, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
- Neal Chamberlain, Medical Microbiology: The Big Picture, 1St Edition 2008, Mc Grew Hill Medical.

CLINICAL MYCOLOGY

Course Code: MLT4318 **Credit Units:4**

Course Objectives:

- The subject includes the study of fungi (yeasts and moulds) which can cause infectious disease in humans.
- It discusses the present classification of fungi, modes of transmission, and infection, disease spectrum.
- Laboratory isolation and identification techniques by cultural and non cultural methods and susceptibility testing to antifungal agents will be emphasized.

Course Contents:

Module-I: Mycology: Introduction of Mycology, Characteristic of Fungi, Taxonomy of Fungi, Immunity to Fungal diseases, Fungal culture media, Fungal reagent and staining, Discuss the procedures used in properly collecting specimens for mycology; Diagnosis of fungal disease; Anti Fungal drugs.

Module-II: Superficial Mycoses: Malassezia Versicolor, Atopic Dermatitis, Malassezia Folliculitis and Systemic Malassezia infection. Tinea Nigra, White Piedra, Black Piedra, Dermatophytes, Tinea Capitis, Dermatophytid or id reaction, wood,s lamp examination.

Module-III: Subcutaneous Mycoses: Mycetoma, Sporotrichosis, Chromoblastomycosis, Phaeohyphomycosis, Rhinosporidiosis and Lobomycosis.

Module-IV: Systemic and Opportunistic Mycoses: Histoplasmosis, Blastomycosis, Coccidioidomycosis and Paracoccidioidomycosis. Candidiasis, Cryptococcosis, Pneumocystosis, Penicilliosis Marneffei, Aspergillosis, Zygomycosis and Oppertunistic Mycoses.

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	5	5	5	70

Recommended books:

- C P Baveja, Text book of Microbiology, 4th Edition 2010, Arya Publication.
- Arti Kapil, Ananthanarayan and Paniker's Textbook of Microbiology, 9th Edition 2013, Orient BlackSwan.
- Mark Gladwin, Trattler William, C. Scott, Mahan, Clinical Microbiology Made Ridiculously Simple. 6th Edition 2013, Medmaster.
- D.R.Arora / Brij Bala Arora, Textbook of Microbiology, 5th Edition 2016, CBS Publishers & Distributors.
- Eds J. G. Collee, J. P. Duguid, A. G. Fraser & B. P. Marmio, Mackie and McCartney: Practical medical microbiology, 14th Edition 2007, Church New Delhi (India): Elsevierill Livingston.
- R C Dubay & D.K.Maheshwari, Practical Microbiology, Revised edition 2014, S Chand & Company LTD.
- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, Presscot's Microbiology, 9th Edition 2014, McGraw-Hill Education.
- Gary W Procop & Elmer W. Koneman Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 7th Edition 2016, Wolters Kluwer Health.

- F. H. Kayser, K. A. Bienz, J. Eckert, Medical Microbiology,10th German Edition 2005, Thieme Stuttgart, New York.
- Michael Ford, Medical Microbiology, 2nd Edition 2014, Oxford university press.
- Neal Chamberlain, Medical Microbiology: The Big Picture, 1St Edition 2008, Mc Grew Hill Medical.
- Jagdish Chander, Text book of medical Mycology, 3rd Edition2009, Mehta publishers.

CLINICAL MICROBIOLOGY CLINICAL TRAINING-II

Course Code: MLT4322 **Credit Units: 2**

Course Objective: The purpose of a Clinical training is to provide hands on practical experience in relevant sections of diagnostic labs as per the need of healthcare system. Students will participate in samples collection, documentation, transportation, receiving, processing and dispatch of reports. Students will help in the performance of clinical protocols, quality maintenance and laboratory research. In some cases, students may be deputed in community services or assist in organizing camps like blood testing or blood donation camp.
Students will be sent to diagnostic laboratory or hospital once a week outside campus or may be within the campus if facility available.

Plan for clinical training:

- Serology Lab
- Microbiology lab

Note: Students must submit training report during examination and the same would be evaluated through Viva voice and presentation.

Examination Scheme:

Components	Viva	A	ME	EE
Weightage (%)	10	5	15	70

Syllabus - Fourth Semester

ON JOB TRAINING

Course Code: MLT4401 **Credit Units: 9**

On-the-job training, also known as OJT, is teaching the skills, knowledge, and competencies that are needed to perform a specific job within the workplace and work environment. The main purpose is to correlate laboratory investigations, through case studies and laboratory tests and their correlations. Implementation of Quality controls and guidelines for implementation in accreditation programmes. Students will learn in an environment in which they will need to practice the knowledge and skills which he/she learnt in the class. On-the-job training uses the regular or existing workplace tools, machines, documents, equipment, knowledge, and necessary skills required for an employee to learn to effectively perform his or her job where ever he/she is sent for OJT.

Examination Scheme:

Components	**Continuous assessment (External Supervisor-20 & Internal Supervisor-20)**	**Final Evaluation (Attendance >75%-5, Viva-10, Presentation- 15 & Final report- 30**
Weightage (%)	40	60

CLINICAL RESEARCH-DISSERTATION

Course Code: MLT4437 **Credit Units: 9**

GUIDELINES FOR PROJECT FILE AND PROJECT REPORT

Research experience is as close to a professional problem-solving activity as anything in the curriculum. It provides exposure to research methodology and an opportunity to work closely with a faculty guide. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation.

Research is genuine exploration of the unknown that leads to new knowledge which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a research report written by the student.

Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critically analyzed by the faculty guide and corrected by the student at each stage.

PROJECT FILE

The Project File may be a very useful tool for undertaking an assignment along-with a normal semester, an exploratory study, sponsored projects, a project undertaken during summer period or any other period as per curricular where the researcher is working with a company/organization. The project/ assignment may also be a part of the bigger research agenda being pursued by a faculty/ institution/ department

The Project File is the principal means by which the work carried out will be assessed and therefore great care should be taken in its preparation. This file may be considered in continuous assessment.

In general, the File should be comprehensive and include:

- A short account of the activities that were undertaken as part of the project;
- A statement about the extent to which the project has achieved its stated objectives;
- A statement about the outcomes of the evaluation and dissemination processes engaged in as part of the project;
- Any activities planned but not yet completed as part of the project, or as a future initiative directly resulting from the project;
- Any problems that have arisen and may be useful to document for future reference.

PROJECT REPORT

The Project Report is the final research report that the student prepares on the project assigned to him. In case of sponsored project the layout of the project could be as prescribed by the sponsoring organization. However, in other cases the following components should be included in the project report:

- **Title or Cover Page:** The title page should contain Project Title; Student's Name; Programme; Year and Semester and Name of the Faculty Guide.
- **Acknowledgement(s):** Acknowledgment to any advisory or financial assistance received in the course of work may be given. It is incomplete without student's signature.
- **Abstract:** A good"Abstract" should be straight to the point; not too descriptive but fully informative. First paragraph should state what was accomplished with regard to the objectives. The abstract does not have to be an entire summary of the project, but rather a concise summary of the scope and results of the project. It should not exceed more than 1000 words.
- **Table of Contents**: Titles and subtitles are to correspond exactly with those in the text.
- **Introduction:** Here a brief introduction to the problem that is central to the project and an outline of the structure of the rest of the report should be provided. The introduction should aim to catch the imagination of the reader, so excessive details should be avoided.

- **Materials and Methods:** This section should aim at experimental designs, materials used (wherever applicable). Methodology should be mentioned in details including modifications undertaken, if any. It includes organization site(s), sample, instruments used with its validation, procedures followed and precautions.
- **Results and Discussion:** Present results, discuss and compare these with those from other workers, etc. In writing this section, emphasis should be laid on what has been performed and achieved in the course of the work, rather than discuss in detail what is readily available in text books. Avoid abrupt changes in contents from section to section and maintain a lucid flow throughout the thesis. An opening and closing paragraph in every chapter could be included to aid in smooth flow. Note that in writing the various sections, all figures and tables should as far as possible be next to the associated text, in the same orientation as the main text, numbered, and given appropriate titles or captions. All major equations should also be numbered and unless it is really necessary, do not write in "point" form. While presenting the results, write at length about the various statistical tools used in the data interpretation. The result interpretation should be simple but full of data and statistical analysis. This data interpretation should be in congruence with the written objectives and the inferences should be drawn on data and not on impression. Avoid writing straight forward conclusion rather; it should lead to generalization of data on the chosen sample. Results and its discussion should be supporting/contradicting with the previous research work in the given area. Usually one should not use more than two researches in either case of supporting or contradicting the present case of research.
- **Conclusion(s) & Recommendations:** A conclusion should be the final section in which the outcome of the work is mentioned briefly.

Check that your work answers the following questions:
• Did the research project meet its aims (check back to introduction for stated aims)?
• What are the main findings of the research?
• Are there any recommendations?
• Do you have any conclusion on the research process itself?

- **Implications for Future Research:** This should bring out further prospects for the study either thrown open by the present work or with the purpose of making it more comprehensive.
- **Appendices:** The Appendices contain material which is of interest to the reader but not an integral part of the thesis and any problem that have arisen that may be useful to document for future reference.
- **References:** References should include papers, books etc. referred to in the body of the report. These should be written in the alphabetical order of the author's surname. The titles of journals preferably should not be abbreviated; if they are, abbreviations must comply with an internationally recognised system.

Examples:

- For research article:

Voravuthikunchai SP, Lortheeranuwat A, Ninrprom T, Popaya W, Pongpaichit S, Supawita T. (2002) Antibacterial activity of Thai medicinal plants against enterohaemorrhagic Escherichia coli O157: H7. Clin Microbiol Infect , 8 (suppl 1): 116–117.

- For book:

Kowalski,M.(1976) Transduction of effectiveness in Rhizobium meliloti. SYMBIOTIC NITROGEN FIXATION PLANTS (editor P.S. Nutman IBP), 7: 63-67

The Layout Guidelines for the Project File & Project Report:
• A4 size Paper
• Font: Arial (10 points) or Times New Roman (12 points)
• Line spacing: 1.5
• Top and bottom margins: 1 inch/ 2.5 cm; left and right margins: 1.25 inches/ 3 cm

ASSESSMENT OF THE PROJECT FILE AND THE PROJECT REPORT
Essentially, the assessment will be based on the quality of the report, the technical merit of the project and the project execution. Technical merit attempts to assess the quality and depth of the intellectual efforts put into the project. Project execution is concerned with assessing how much work has been put in.

The Project should fulfil the following assessment objectives:
• Range of Research Methods used to obtain information
• Execution of Research
• Data Analysis (Analyze Quantitative/ Qualitative information)
• Quality Control
• Conclusions

Assessment Scheme:
Continuous Evaluation:
40% (Based on punctuality, regularity of work, adherence to plan and methodology, refinements/mid-course corrections etc. as reflected in the Project File.)

Final Evaluation:
60% (Based on the Documentation in the file, Final report layout, analysis and results, achievement of objectives, presentation/ viva)

It is recommended that the Final evaluation should be carried out by a panel of evaluators.

Examination Scheme:

Components	**Continuous assessment** (External Supervisor-20 & Internal Supervisor-20)	**Final Evaluation** (Attendance >75%-5, Viva-10, Presentation- 15 & Final report- 30