RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M.S. Ramaiah University of Applied Sciences

Programme Structure and Course Details

Of

MD Pathology 2022 onwards

M.S. Ramaiah University of Applied Sciences

Ramaiah Medical College

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Dean - Academics
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Bangalore - 560 054

Shalini
Principal and Dean
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M.S. Ramaiah University of Applied Sciences
Bangalore-560054

Approved by the Academic Council meeting held on 27th September 2022

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M.S. Ramaiah University of Applied Sciences

Programme Specifications

MD Pathology Programme 2022 onwards

Programme Code: MD130

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University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society.
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society.
3. To promote health, human well-being and provide holistic healthcare.
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business.
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in.
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes.

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Programme Specifications: MD Pathology

Faculty	Ramaiah Medical College
Department	Pathology
Programme	MD – Pathology
Programme Code	MD130
Dean of Faculty	Dr Shalini C Nooyi
Head of the Department	Dr Mangalagouri S R

1. **Title of the Award:** MD Pathology
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Ramaiah Medical College
6. **Date of Programme Specifications:** September 2022
7. **Programme Approval by the Academic Council of MSRUAS:** 27th September 2022
8. **Programme Approving Regulating Body and Date of Approval:** National Medical Council of India
9. **Rationale for the Programme**

This programme is meant to standardize Pathology teaching at post graduate level in our University so that it will benefit in achieving uniformity in teaching and resultantly creating suitable manpower with appropriate expertise. The post graduate student should be trained in handling and processing histopathology, clinical pathology, cytopathology, microbiology, biochemistry and transfusion medicine samples with a knowledge of general principles and methodology. The student should also become a competent teacher and researcher capable of innovations in the field of expertise.

The purpose of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through learning and assessment. This document was prepared by various subject-content specialists. The Reconciliation Board of the Academic Committee has attempted to render uniformity without compromise to purpose and content of the document. Compromise in purity of syntax has been made in order to preserve the purpose and content. This has necessitated retention of "domains of learning" under the heading "competencies".

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Program Outcomes (PO) for MD Pathology (Program Code- MD130)

PO1. Develop the knowledge, skills and attitude to be a competent diagnostician (C, P).

PO2. Demonstrate a commitment to excellence and continuous professional development with integrity, compassion and sensitivity to patient care. (A)

PO3. Acquire and develop the knowledge, skills and attitude required to be a competent and ethical researcher and teacher. (A, C, P)

PO4. Be able to independently perform investigative procedures applicable to his speciality with a reasonable degree of professionalism and competence. (P)

Programme specific outcomes (PSO) for MD Pathology postgraduate students

PSO1.To acquire diagnostic skills in histopathology (Surgical pathology and autopsy), cytopathology and hematology by adequate use of slide bank, wet and mounted specimen bank, laboratory medicine (clinical pathology, clinical biochemistry) and blood banking (transfusion medicine) for understanding clinical manifestations of diseases. (C)

PSO2.To advise on the selection of appropriate specimens, samples and tests necessary to arrive at a diagnosis, interpret the data obtained with reasonable accuracy and clinicopathological correlation to compose lucid and succinct reports. (C, P)

PSO3. To demonstrate the ability to maintain all equipment, automation and their quality system procedures and quality assurance with the aid of SOPs along with safe and effective biomedical waste management. (C, P)

PSO4. To teach and assess medical, paramedical and allied health students, acquire skills to conduct fundamental and applied research either independently (including thesis work) or as part of a team. (C, P)

PSO5. To apply skills learnt in the advanced learning center for patient care, learn application of principles of professionalism, ethics and effective communication in the conduct of routine pathology services, teaching activities and research. (A)

PSO6. To perform grossing and dissection of autopsy and surgical specimens, collect samples for blood and bone marrow testing and fine needle aspirations (direct and guided) in an appropriate manner necessary for accurate diagnosis and treatment. (P)

Note: A- Affective Domain, C- Cognitive Domain & P- Psychomotor Domain.

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Programme Mapping (Course-PO-PSO Mapping)

Course Code and name	Program Outcomes POs				Program Specific Outcomes PSOs					
	PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDC513A Basic Sciences: General Pathology, pathophysiology, immunopathology and molecular biology	3	2	2	2	3	3	2	2	2	2
MDC514A Systemic Pathology-Surgical and cytopathology	3	3	2	3	3	3	3	2	3	3
MDC515A Hematology, transfusion medicine & laboratory medicine including instrumentation and quality Control	3	3	2	3	3	3	3	2	2	3
MDC516A Recent Advances in Pathology	3	3	3	2	3	3	2	3	3	2
MDP504A Thesis-Pathology	2	3	3	2	2	2	2	3	3	2

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10. Regulations:

(A) Attendance, Progress and Conduct

1. A candidate pursuing degree course should work in the concerned department of the institution for the full period as a full time student. No candidate is permitted to run or work in clinic/laboratory/nursing home while studying postgraduate course. No candidate shall join any other course of study or appear for any other examination conducted by this university or any other university in India or abroad during the period of study.
2. Each year shall be taken as a unit for the purpose of calculating attendance. Attendance of 80% every term is mandatory for appearing in the final university examination.
3. Every student shall attend symposia, seminars, conferences, journal review meetings, grand rounds, CPC, case presentation, clinics and lectures during each year as prescribed by the department and not absent himself / herself from work without valid reasons.
4. Every candidate is required to attend a minimum of 80% of the training during each academic term of the post graduate course. Provided further, leave of any kind shall not be counted as part of academic term without prejudice to minimum 80% attendance of training period every term.
5. Any student who fails to complete the course in the manner stated above shall not be permitted to appear for the University Examinations.

(B) Monitoring of progress of Studies

1. Work diary / Log Book - Every candidate shall maintain a work diary and record of his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. as per the model checklists and logbook specimen copy.
2. Special mention may be made of the presentations by the candidate as well as details of clinical or planning procedures, if any conducted by the candidate. The work diary shall be scrutinized and certified by the Head of the Department and Head of the Institution, and presented in the university practical/clinical examination.
3. Procedure for defaulters: There will be a committee constituted by all teachers to review such situations. The defaulting candidate is counselled by the guide and head of the department. In extreme cases of default, the departmental committee may recommend that defaulting candidate will be withheld from appearing the examination, if she/he fails to fulfil the requirements in spite of being given adequate chances to set himself or herself right.

Pathology is the medical specialty concerned with the study of nature and causes of diseases. It includes every aspect of medicine from diagnostic testing and monitoring of chronic diseases to genetic research and blood transfusion technologies. This intensive MD programme has a sound knowledge base and aims to develop the cognitive, psychomotor, research and

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interpersonal skills required to enable a postgraduate to undertake the independent practice of Pathology at a specialist level.

At the end of three years course in MD Pathology the student should have achieved following goals:

1. **Knowledge of Pathology**

1.1. Make a diagnosis based on histopathology (surgical pathology) and cytopathology specimens, blood and bone marrow examination and various tests of Laboratory Medicine (clinical pathology, clinical biochemistry) as well as Blood Banking (Transfusion Medicine).

1.2. Interpret clinical and laboratory data with reasonable accuracy and prepare a succinct and lucid report.

1.3. Compose reports following standard protocols including synoptic reporting.

1.4. Interpret and correlate clinical and laboratory data so that clinical manifestations of diseases can be explained.

1.5. Advise on the selection of appropriate specimens and tests necessary to arrive at a diagnosis in a problematic case including molecular tests.

1.6. Correlate clinical and laboratory findings with pathology findings at autopsy, identify miscorrelations and the causes of death due to diseases (apart from purely metabolic causes).

1.7. Maintain quality control of all tests by being part of Internal Quality Control Monitoring program.

1.8. Make and record observations systematically and maintain accurate records of tests and their results for reasonable periods of time. Identify problems in the laboratory, offer solutions thereof and maintain a high order of quality control.

1.9. Should be aware of safe and effective disposal of laboratory waste and ensure minimization risk of exposure to infection and accidents to laboratory personnel.

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2. **Teaching and training**

2.1. Should be able to teach Pathology to undergraduates, postgraduates, nurses and paramedical staff including laboratory personnel.

2.2. The postgraduate student should be able to teach effectively and assess undergraduate medical and allied health science students so that they become competent healthcare professionals.

3. **Research**

3.1. Plan, execute, analyze, and present research work independently or as part of a team.

3.2. The postgraduate student in Pathology should acquire knowledge and skills to be able to conduct a research project from the planning to the publication stage and become a life-long learner.

4. **Professionalism, Ethics and Communication skills**

4.1. The postgraduate student should learn and apply principles of professionalism, ethics, and effective communication in conduct of routine pathology services, research, and routine work.

SUBJECT SPECIFIC COMPETENCIES

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

a. **Cognitive domain**

A post graduate student upon successfully qualifying in the MD (Pathology) examination should have acquired the following broad theoretical competencies andshould be:

i. Capable of offering a high quality diagnostic opinion in a given clinical situation with an appropriate and relevant sample of tissue, blood, body fluid, etc. for the purpose ofdiagnosis and overall wellbeing of the ill.

ii. Conversant with the standard operating procedures of various laboratories including histopathology, cytopathology, hematology and laboratory medicine.

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iii. Able to teach and share his knowledge and competence with others. The student should be imparted training in teaching methods in the subject which may enable the student to take up teaching assignments in Medical Colleges/Institutes.

iv. Capable of pursuing clinical and laboratory based research. He/she should be introduced to basic research methodology so that he/she can conduct fundamental andapplied research.

At the end of the course, the student should have acquired the following competencies as a diagnostician:

Surgical pathology

1. Be conversant in the histogenesis and pathophysiological processes associated with various diseases.
2. Should be able to identify problems in the histopathology laboratory and offer viable solutions.
3. Possess the background knowledge necessary for the evaluation and reporting of Surgical Pathology.
4. Conversant with the various equipment used in the histopathology laboratory.
5. Should have knowledge of automation and quality assurance in histopathology.

Cytopathology

1. Possess the background knowledge necessary for the evaluation and reporting of Cytopathology.
2. Demonstrate familiarity with, and guide clinical/radiology residents in keeping with the clinical information on the choice of site, collection, preservation, transport, type of preparation and method of obtaining various cytological specimens.
3. Conversant with the various equipment used in the cytopathology laboratory.
4. Should have knowledge of automation and quality assurance in cytopathology.

Hematology

1. Demonstrate ability to utilize the principles of the practice of Hematology for the planning of tests, interpretation, and diagnosis of diseases of the blood and bone marrow.
2. Conversant with the various equipment used in the hematology laboratory.
3. Should have knowledge of automation and quality assurance in hematology.

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Laboratory medicine

1. Demonstrate familiarity with the normal range of values of the chemical content of body fluids, significance of altered values, and interpretation thereof.

2. Possess knowledge of the following specialized organ function tests and relative utility and limitations of each and significance of altered values: (i) Renal function test (ii) Liver function test (iii) Endocrine function test (iv) Tests for malabsorption

3. Principles, advantage and disadvantages, scope, and limitation of automation in laboratory.

4. Learn the principle and methodology of quality control in the laboratory.

Transfusion medicine

1. Possess knowledge of basic immunology, ABO and Rh groups, minor blood groups and their clinical significance, transfusion therapy, pre-transfusion testing, transfusion related infections, transfusion reactions and quality control in blood bank.

Autopsy pathology

1. Conversant with the technique of autopsy.

2. Possess sufficient understanding of the various disease processes so that meaningful clinico-pathological correlation can be made.

Immunopathology

1.Demonstrate familiarity with current concepts of structure and function of the immune system, its aberrations, and mechanisms thereof.

2. Demonstrate familiarity with the scope, principles, limitations, and interpretations of the results of ELISA techniques, HLA typing, immunofluorescence, and immunoelectrophoresis.

Immunohistochemistry and flow cytometry

1. Demonstrate familiarity with the principles and procedures of performing immunohistochemistry including automation in procedure and interpretation.

2. Demonstrate familiarity with the principles and procedures of performing flow cytometry.

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Cytogenetics and Molecular biology

1. Demonstrate familiarity with the principles of molecular biopsy especially related to the understanding of disease processes and its use in various diagnostic tests at least including but not limited to in-situ hybridization, polymerase chain reaction, Sanger Sequencing and Next generation sequencing.

Electron microscopy

1. Demonstrate familiarity with the principles and techniques of electron microscopy and the working of the electron microscope.
2. Demonstrate familiarity with the tissue processing and staining methods for electron microscopy, including immune-labelling techniques and use of semi-thin sections.

Enzyme histochemistry

1. Demonstrate familiarity with the principles, use and interpretations of common enzyme histochemical procedures.

Quality Control

1. Demonstrate familiarity with various quality control programmes running in the department, both internal and external quality.
2. Demonstrate familiarity with inert and intra assay variations, batch variations, validation of chemicals and instruments.

Laboratory Safety and Good clinical lab practices

1. Demonstrate familiarity with good lab practices and safety, record maintenance of capital equipment and consumables, purchase specifications, approximate costs of reagents and equipment, maintenance of store logbooks, etc.

Biomedical Waste Management

1. Demonstrate familiarity with disposal methods for each specimen, reagents, instruments, autoclaving techniques, recycling of products and e-waste.

At the end of the course, **the student should have acquired the following competencies as a teacher:**

1. Demonstrate familiarity with different modes, methods, and principles of teaching including microteaching.

At the end of the course, **the student should have acquired the following competencies as a researcher:**

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1. Conversant with the principles of basic and applied research methodology, literature search, study design, sample size estimation, selection of controls, and appropriate application of medical statistics.

2. Possess knowledge about the methods of writing thesis and/or a research paper with the prescribed instructions, as expected of international standards.

3. Conversant with the use of digital slide imaging, algorithms to evaluate findings in imaging, morphometry, and application of artificial intelligence.

b. Affective domain

1. The student will show integrity, accountability, respect, compassion and dedicated patient care. The student will demonstrate a commitment to excellence and continuous professional development.

2. The student should demonstrate a commitment to ethical principles relating to providing patient care, confidentiality of patient information and informed consent and relating to research conduct and research publication.

3. The student should show sensitivity and responsiveness to patients' culture, age, gender and disabilities.

c. Psychomotor domain

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

Surgical Pathology: Skills

1. Given the clinical and operative data, the student should be able to identify, and systematically and accurately describe the chief gross anatomic alterations in the surgically removed specimens and be able to correctly diagnose at least 80% of the lesions received on an average day from the surgical service of an average teaching hospital.

2. A student should be able to demonstrate ability to perform a systematic gross examination of the tissues including the taking of appropriate tissue sections and in special cases as in intestinal mucosal biopsies, muscle biopsies and nerve biopsies, demonstrate the orientation of tissues in paraffin blocks.

3. The student should be able to identify and systematically and accurately describe the chief histo-morphological alterations in the tissue received in the surgical pathology service. He/she should also correctly interpret and correlate with the clinical data to diagnose at least 90% of the routinesurgical material received on an average day.

4. Be conversant with automatic tissue processing machine and the principles of its running.

5. Process a tissue, make a paraffin block and cut sections of good quality on a rotary microtome.

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6. Perform an autopsy, dissect various organ complexes and display the gross findings.

7. Conversant with the function, handling, and routine care of equipment in the laboratory and quality assurance.

8. Cut a frozen section using cryostat, stain and interpret the slide incorrelation with the clinical data provided.

9. Demonstrate the understanding of the utility of various immuno- histochemical stains especially in the diagnosis of tumour subtypes.

Stain paraffin sections with at least the following:

1) Haematoxylin and eosin
2) Iron stain
3) PAS stain
4) Acid fast stains
5) Gomori Methenamine Silver stain [GMS]

6) Van Gieson Stain [VG]
7) Verhoeff Stain
8) Reticulin stain
9) Congo red Stain
10) Masson's trichrome
11) Any other stains needed for diagnosis.
12) Demonstrate understanding of the principles of:
13) Fixation of tissues
14) Processing of tissues for section cutting
15) Section cutting and maintenance of related equipment
16) Differential (special) stains and their utility

Cytopathology Skills

1) Independently prepare and stain good quality smears for cytopathologic examination.

2) Be conversant with the techniques for concentration of specimens: i.e. various filters, centrifuge and cyto-centrifuge.
3) Independently be able to perform fine needle aspiration of all lumps in patients, make good quality smears, and be able to decide on the types of staining in a given case.
4) Given the relevant clinical data, he/she should be able to independently and correctly

5) Diagnose at least 75% of the cases received in a routine laboratory and categorize them into negative, inconclusive and positive.

6) Demonstrate ability in the technique of screening and dotting the slides for suspicious cells.

7) Indicate correctly the type of tumour, if present
8) Identify with reasonable accuracy the presence of organisms, fungi and parasites

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Haematology Skill

A. Correctly and independently perform the following special tests, in addition to doing the routine blood counts:

1) Haemogram including reticulocyte and platelet counts.
2) Bone marrow staining including stain for iron
3) Blood smear staining
4) Cytochemical characterization of leukemia with special stains like Peroxidase, Leukocyte Alkaline Phosphatase (LAP), PAS, Sudan Black, etc.
5) Hemolytic anemia profile including HPLC, Hbelectrophoresis etc.
6) Coagulation profile including PT, APTT, FDP.
7) BM aspiration and BM biopsy

B. Demonstrate familiarity with the principle and interpretation of results andthe utility in diagnosis of the following:

1) Platelet function tests including platelet aggregation and adhesion and PF3 release
2) Thrombophilia profile: Lupus anticoagulant (LAC), Anticardiolipin Antibody (ACA), Activated Protein C Resistance (APCR), Protein C (Pr C), Protein S (Pr S) and Antithrombin III (AT III)
3) Immunophenotyping of leukaemia
4) Cytogenetics
5) Molecular diagnostics.

C. Describe accurately the morphologic findings in the peripheral and bone marrow smears, identifying and quantitating the morphologic abnormalities in disease states and arriving at a correct diagnosis in at least90% of the cases referred to the Haematology clinic, given the relevant clinical data.

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Laboratory Medicine Skills

A. Plan a strategy of laboratory investigation of a given case, given the relevant clinical history and physical findings in a logical sequence, with arational explanation of each step; be able to correctly interpret the laboratory data of such studies, and discuss their significance with a view to arrive at a diagnosis.

B. Demonstrate familiarity with and successfully perform:

1) Routine urinalysis including physical, chemical and microscopic, examination of the sediment
2) Macroscopic and microscopic examination of faeces and identify the ova and cysts of common parasites.
3) A complete examination: physical, chemical and cell content of Cerebrospinal Fluid (C.S.F), pleural and peritoneal fluid.
4) Semen analysis
5) Examination of peripheral blood for commonly occurring parasites.

C. Independently and correctly interpret at least the following quantitative estimations by manual techniques and/or automated techniques.

1) Blood urea
2) Blood sugar
3) Serum proteins (total and fractional)
4) Serum bilirubin (total and fractional)

D. Demonstrate familiarity with the following quantitative estimations ofblood/ serum by Automated Techniques:

1) Serum cholesterol, Uric acid, Serum Transaminases (ALT and AST/SGOTand SGPT), etc.

E. Explain the principles of Instrumentation, use and application of the instruments commonly used in the labs eg. Photoelectric colorimeter, Spectrophotometer, pH meter, Centrifuge, Electrophoresis apparatus, ELISA Reader, flow cytometer, PCR, chemiluminiscence.

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Transfusion Medicine Skills

The student should be able to correctly and independently perform the following:

1. Selection and bleeding of donors

2. Preparation of blood components i.e. Cryoprecipitates, Platelet concentrate, Fresh Frozen Plasma, Single Donor Plasma, Red Blood Cellconcentrates.

3. ABO and Rh grouping.

Demonstrate familiarity with Antenatal and Neonatal work up:

1) Direct antiglobulin test
2) Antibody screening and titre
3) Selection of blood for exchange transfusion

Demonstrate familiarity with principle and procedures involved in:

1) Resolving ABO grouping problems.
2) Identification of RBC antibody.
3) Investigation of transfusion reaction.
4) Testing of blood for presence of:
    a) HBV (Hepatitis B Virus Markers)
    b) HCV (Hepatitis C Virus Markers)
    c) HIV (Human Immunodeficiency Virus Testing)
    d) VDRL
    e) Malaria

- Be able to perform immuno-histochemical staining using paraffin sectionwith at least one of the commonly used antibodies (Cytokeratin or LCA) using PAP method.

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TEACHING AND LEARNING METHODS

During the course, students should have formal training in teaching and research. The sessions should be in the form of:

Teaching and Learning Methods

1. Team Teaching/ Integrated Teaching/ CPCs sessions
2. Face to Face Lectures using Audio-Visuals
3. Seminars/journal clubs/e-lectures
4. Case Based Discussions
5. Group Discussions, Presentations
6. Demonstrations on videos, computers and digital pathology
7. Clinical based learning- case workup as a part of routine hematology, cytopathology and histopathology reporting.
8. Hospital based learning – clinical examination of patients before performing FNAC and need based bedside visit.
9. Biomedical waste management.
10. Laboratory work- Regular postings in hematology, clinical and cytopathology and histopathology sections
11. Blood bank and Autopsy postings.
12. Dissertation/ Group Project work (research activities)
13. School visits / Outreach center visits as part of health camps
14. Interdepartmental meets
15. Continuing Medical education programs/symposiums/workshops
16. State/National/International conferences and conventions

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The following is a rough guideline to various teaching/learning activities that may be employed.

1. Collection of specimens including Fine Needle Aspiration of lumps.
2. Grossing of specimens.
3. Performing autopsies.
4. Discussion during routine activities such as during signing out of cases.
5. Presentation and work-up of cases including the identification of special stains and ancillary procedures needed.
6. Clinico-pathological conferences.
7. Intradepartmental and interdepartmental conferences related to case discussions.
8. Conferences, Seminars, Continuing Medical Education (CME) Programmes.
9. Journal Club.
10. Research Presentation and review of research work.

1) A postgraduate student of a postgraduate degree course in broad specialities would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him eligible to appear at the postgraduate degree examination.

2) Participation in workshops, conferences and presentation of papers etc.

3) Use and maintenance of equipment.

4) Maintenance of records. Log books should be maintained to record the work done which shall be checked and assessed periodically by the faculty members imparting the training.

5) Postgraduate students shall be required to participate in the teaching and training programme of undergraduate students and interns.

6) Department should encourage e-learning activities.

7) Should undergo training in Basic Cardiac Life Support and Advanced Cardiac Life Support.

8) During the training programme, patient safety is of paramount importance;therefore, skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently; for this purpose, provision of skills laboratories in medical colleges is mandatory.

9) Performance of FNAC, Phlebotomy and bone marrow aspiration demonstrated and hands on work experience given in Advanced learning centre.

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Duration and Year Wise Teaching Learning Activities

The course of the study shall be for 3 years

ACADEMICS/RESEARCH/PROFESSIONALISM
1st year
1) Orientation to the Department. 2) Understand the Competency, syllabus and assessment of the PG curriculum in Pathology as per the NMC requirement 3) Enroll for 6 month "Basic Course in Biomedical Research" conducted by National Programme on Technology Enhanced Learning (NPTEL). 4) Selection of topic for Dissertation under the guidance of allotted guide. 5) Writing and submission of the Dissertation synopsis to Research committee and Institutional Ethical committee. 6) Participate in preparing and conducting undergraduate classes. 7) Rotational posting to Anatomy, Physiology, Biochemistry & Microbiology for 4 months (one month each) 8) Attend regular Undergraduate MBBS lectures, tutorials, Small group discussion and practical [DOAP]. Mandatory to attend all lecture/practical class 9) Start taking Undergraduate small group teaching Hematology & histopathology slides, gross specimen discussion 10) Start Journal clubs and seminars 11) Attend the PG research methodology training programme and mandatory to complete NMC prescribed online research methodology course 12) Attend the Post graduate Medical education training program (PG MET) 13) Maintain logbook entry of all activities 14) Internal assessment I - theory, practical & viva voce 15) Begin review and data collection for thesis 16) Attend CME/Conferences/training Workshops 17) Preparation for Poster/Oral Presentation in State /National conference/InternationaL 18) Submission of 1st year logbook to HOD for signature 19) Feedback from guide and HOD 20)

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2ND year
1) Continue academic activities as per syllabus 2) Continue teaching of Undergraduate medical students 3) Plan for External postings: 1. Neuropathology & Electron Microscopy: (15days), 2. Oncopathology (KIDWAI): one month 4) Continue Journal club and seminars 5) An oral/poster presentation in State / Nationalconference / international conference 6) 6.Submission of logbook entry to HOD signature with all entries of the teaching learning methods and training programmes 7) Internal assessment II – both theory, practical and viva voce 8) Review thesis preparation 9) Feedback from Guide and HOD
3rd year
1) Continue academic activities as per syllabus 2) Continue teaching of Undergraduate medical students 3) Rotational Internal posting to Forensic Medicine and 4) Blood Bank (one month each) 5) Complete thesis 6) Presentation of thesis 7) Complete logbook entries 8) Mock examination (III IA– theory, practical and viva voce) three months prior to university examination 9) Feedback from Guide and HOD

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ASSESSMENT

FORMATIVE ASSESSMENT:

Formative assessment should be continual and should assess medical knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, selfdirected learning and ability to practice in the system.

General Principles

Internal Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills. The Internal Assessment should be conducted in theory and practical/clinical examination.

Monthly assessment during the MD training should be based on:

1) Journal based / recent advances learning
2) Patient based /Laboratory or Skill based learning
3) Self-directed learning and teaching
4) Departmental and interdepartmental learning activity
5) External and Outreach Activities / CMEs as and when available.

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

SUMMATIVE ASSESSMENT

The summative examination would be carried out as per the Rules given in NMC - Guidelines for Competency Based Postgraduate Training Programme for MD Pathology.

Thesis:

Every post graduate student shall carry out work on an assigned research project under the guidance of a recognised Post Graduate Teacher, the result of which shall be written up and submitted in the form of a Thesis. Work for writing the Thesis is aimed at contributing to the development of a spirit of enquiry, besides exposing the post graduate student to the techniques of research, critical analysis, acquaintance with the latest advances in medical science and the manner of identifying and consulting available literature.

Thesis shall be submitted at least six months before the Theory and Practical examination. The thesis shall be examined by a minimum of three examiners; one internal and two external examiners, who shall not be the examiners for Theory and Practical examination. A post graduate student shall be allowed to appear for the Theory and Practical examination only after theacceptance of the Thesis by the examiners.

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Theory:

The examinations shall be organized on the basis of 'Grading 'or 'Marking system' to evaluate and to certify post graduate student's level of knowledge, skilland competence at the end of the training. Obtaining a minimum of 50% marks in 'Theory' as well as 'Practical' separately shall be mandatory for passing examination as a whole. The examination for M.D. shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

A. There shall be four theory papers (as per PG regulations).

Theory (Written Paper) : 400 marks

There shall be four question papers, each of three hours' duration. Each paper shall consist of 10 short essay questions each carrying 10 marks. Total marks for each paper will be 100. Questions on recent advances may be asked in any or all the papers. Details of distribution of topics for each paper will be as follows.

Name of the course	Course Code	Topics	Marks
Basic Sciences	MDC513A	General Pathology, Pathophysiology, Immunopathology and Molecular Biology.	100
Systemic Pathology	MDC514A	Surgical and cytopathology.	100
Hematology, Blood Banking, Laboratory medicine	MDC515A	Haematology, Transfusion Medicine, Laboratory Medicine including instrumentation and quality control.	100
Recent advances	MDC516A	Recent Developments in Systemic Pathology, Cytopathology, Hematology, Blood Banking, Molecular Pathology, Laboratory Medicine	100
Thesis	MDP504A	**Approval 6 months before final examination.**	

B. Practicals /Clinical and Oral/viva voce Examination:

The practical/clinical examination should consist of the following and should be spread over two days.

Clinical Pathology:

- Discussion of a clinical case history.
- Plan relevant investigations of the above case and interpret the biochemistry findings.
- At least Two investigations should be performed including one hematology and clinical pathology.

Hematology:

- Discuss hematology cases given the relevant history. Plan relevantinvestigations
- Perform complete hemogram and at least two tests preferably including one coagulation exercise interpretation

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- Identify electrophoresis strips, osmotic fragility charts etc. Interpretation of data from autoanalysers, HPLC and flow cytometry.
- Examine, report and discuss around ten cases given the history and relevant blood smears and/or bone marrow aspirate smears and bone marrow biopsy interpretation.

Transfusion Medicine:

- Perform blood grouping
- Perform the necessary exercise like cross matching.
- Coomb's test, gel cards interpretation and significance

Histopathology:

- Examine, report and discuss 15-20 cases histopathology and 5-8 cytopathology cases, given the relevant history and slides.
- Perform a Haematoxylin and Eosin stain and interpret given special stain on a paraffin section. Should be conversant with histopathology techniques including cryostat.

Autopsy:

- Given a case history and relevant organs (Reconstituted Autopsy)), for anatomical diagnosis in the given autopsy case.

Gross Pathology

- Describe findings of gross specimens, give diagnosis and identify the sections to be processed. The post graduate student should perform grossing in front of the examiners for evaluation.

All practical exercises are to be evaluated jointly by all the examiners.
An oral question-answer session should be conducted at the end of each exercise.
Viva on dissertation and research methodology
General Viva-Voce

Pedagogy and Viva voce Component

Structured Viva Voce exam for 80 marks and pedagogy for 20 marks will be conductedduring practical exam.

D. Total Marks Distribution:

Maximum marks for	Theory	Practical	Viva	Grand Total
M.D degree course	400	200	100	700

The current curriculum and the marks status will be considered as it is without much change. Improvisation will be done as and when required.

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Annexures

I) Checklist for evaluation of Journal Review Presentations

II) Evaluation of Pedagogy

III) Checklist for evaluation of Seminar Presentations

IV) Checklist for dissertation Presentation

V) Continuous Evaluation of Dissertation work by Guide / Co-Guide

VI) Log book with record of academic activities attended by the student.

VII) Post Graduate student Appraisal Form

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Annexure – I

CHECK-LIST FOR EVALUATION OF JOURNAL REVIEW PRESENTATIONS

Date:

Name of the Student:

Name of the Faculty/Observer:

Sl. No.	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1)	Article chosen was					
2)	Extent of understanding of scope & objectives of the paper by the candidate					
3)	Whether cross references have been consulted					
4)	Whether other relevant publications consulted					
5)	Ability to respond to questions on the paper /subject					
6)	Audio-Visual aids used					
7)	Ability to discuss the paper					
8)	Clarity of presentation					
9)	Any other observation					
	Total Score					

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Annexure – II

EVALUATION OF PEDAGOGY

Name of the candidate: Date:

Register No.:

Centre:

Topic: Max. Marks:

20

Skills		Marks
Marks Set induction (1.5marks)	Aroused interest in the beginningby relating to previous learning, throwing a new idea, questioning, etc. Specified the objectives ofpresentation	
Planning (5 marks)	Organized material in a logicalsequence Used relevant content matter	
Presentation(5 marks)	Changed the pace of presentationby shifting emphasis, joke, etc Used specific example toillustrate main Ideas • Used non-verbal cues, eye contact, etc	
Pupil participation(5 marks)	Allowed questions from students Asked question Solicited/Raised questions Rewarded pupil effort	
Use of AV aids(2.5 marks)	Used proper AV aids used the aid(s) effectively	
Closure (1 mark)	Summarized most important points at the end of the sessionOverall marks	
(out of 20)		Signature

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Annexure – III

CHECK-LIST FOR EVALUATION OF SEMINAR PRESENTATIONS

Date:

Name of the Student:

Name of the Faculty/Observer:

Sl. No.	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	V.Good 4
1)	Whether other relevant publicationsconsulted					
2)	Whether cross references have beenconsulted					
3)	Completeness of Preparation					
4)	Clarity of Presentation					
5)	Understanding of subject					
6)	Ability to answer questions					
7)	Time scheduling					
8)	Appropriate use of Audio-Visual aids					
9)	Overall Performance					
10)	Any other observation					
	Total					

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Annexure – IV

CHECK LIST FOR DISSERTATION PRESENTATION

Name: Faculty/Observer: Date:

Sl. No.	Points to be considered divine	Poor 0	Below Average 1	Average 2	Good 3	Very Good 4
1.	Interest shown in selecting a topic					
2.	Appropriate review of literature					
3.	Discussion with guide & other faculty					
4.	Quality of protocol					
5.	Preparation of proforma					

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Annexure – V

CONTINUOUS EVALUATION OF DISSERTATION WORK BY GUIDE / CO-GUIDE

Name: Faculty/Observer: Date:

Sl. No.	Items for observation during presentation	Poor 0	Below Average 1	Average 2	Good 3	VeryGood 4
1	Periodic consultation with guide/co-guide					
2	Regular collection of case material					
3	Depth of analysis / discussion					
4	Departmental presentation of findings					
5	Quality of final output					
6	Others					
	Total Score					

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Annexure VI

LOG BOOK

Table 1: Academic activities attended by the student

Name: Admission Year:

College:

Date	Type of Activity Monthly postings/Seminar/ Journal Club/ Presentation/ UG teaching/ interdepartmental/ external postings/clinicopathologic conferences	Particulars, remarks, signature of faculty

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Annexure – VII

POSTGRADUATE STUDENTS APPRAISAL FORM

PARA CLINICAL DISCIPLINES

Name of the Department: **Date:**

Name of the Student:

Period of Training: From ..... To .....

0: Poor, 1: Average, 2: Good, 3: Very good, 4: Exceptional

Sl. No.	Particulars	Not satisfactory	Satisfactory	More than satisfactory	Remarks
		1 2 3	4 5 6	7 8 9	
1	Ability to teach UG students and Juniors				
2	Knowledge of Subject and practical skills in PG course				
3	Participation in Journal Club/Seminar,CME etc				
4	Conduct of research and other scholarly activity assigned (e.g Posters, publications etc)				
5	Punctuality, responsibility, accountability at work				
6	Ability to work in a team, contribute to growth of learning of the team				
7	Self directed learning				
8	Attitude towardscolleagues/Faculty				
9	Ability to communicatewith students				
10	Participation in documentation and quality improvement in work place, departmental andinterdepartmental activity initiatives				
11	Thesis /Research work				
12	Logbook maintenance				
13	Performance in work based assessments				

***REMARKS: Any significant positive or negative attributes of a postgraduate student to be mentioned. For score less than 4 in any category, remediation must be suggested. Individual feedback to postgraduate student is strongly recommended.**

SIGNATURE OF ASSESSEE

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Course Specifications

MD Pathology 2022 onwards

Course code: MDC513A

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Course Specifications

Course Title	Basic Sciences: General pathology, physiology, immunopathology, and molecular biology
Course Code	MDC513A
Department	Pathology
Faculty	Ramaiah Medical College

Course summary:

The course is designed in such a way that the student will master the basic sciences to understand the cause of disease and its pathogenesis, current concepts of structure and function of the immune system, principles of molecular biology and interpretation in diagnosis of diseases and in research procedures.

Course Outcomes:

CO1: Be well versed with the histogenesis and pathophysiological processes of diseases, know the current concepts, mechanisms of the immune system, principles of molecular biology in understanding of disease processes and its use in various diagnostic tests (C)

CO2: The student should demonstrate integrity, accountability, respect, compassion and dedicated patient care, commitment to excellence, continuous professional development and ethical principles relating to research conduct and publication as applicable to all the specific courses (A)

Course Content:

General Pathology:

1. **Normal cell and tissue structure and function:**

1) The changes in cellular structure and function in diseases.
2) Causes of disease, its pathogenesis, reaction of cells, tissues, organ systems, and the body to various sub lethal and lethal injuries.
3) Cellular adaptation, cell injury, and cell death.
4) Mechanism, morphology and examples of cell injury, necrosis, apoptosis, autophagy, and newer forms of cell death including necroptosis and pyroptosis.
5) Sub cellular and cellular responses and adaptation to injury.
6) Intracellular and intercellular accumulations, pathological calcification, and cell aging.

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2. Acute and chronic inflammation:

1) Vascular and cellular events in acute inflammation, chemical mediators, outcome, and morphological patterns of acute inflammation.
2) Chronic inflammation with special reference to granulomatous inflammation.
3) Systemic effects and effects of deranged inflammation.
4) Tissue renewal and repair: Regeneration healing and fibrosis.
5) Control of normal cell proliferation and tissue growth, mechanism of tissue regeneration, repair by healing and fibrosis.
6) Extracellular matrix and cell matrix interactions.

3. Hemodynamic disorders, thromboembolic disease, and shock:

1) Edema, hyperemia, congestion, and hemorrhage.
2) Normal Hemostasis, thrombosis, DIC, embolism, infarction, and shock.

4. Genetic Disorders

1) Principles of genetics, normal karyotyping.
2) Mutations, Mendelian disorders, disorders with multifactorial inheritance cytogenetic disorders involving autosomes and sex chromosomes.
3) Single gene disorders with nonclassic inheritance.
4) Diagnosis of genetic disorders involving molecular and genetic techniques.

5. Neoplasia

1) Definition, nomenclature, and biology of tumor growth
2) Molecular basis of cancer with special reference to carcinogenic agents and molecular basis of multistep carcinogenesis.
3) Epidemiology and clinical features of tumors.
4) Grading, staging and laboratory diagnosis of cancer.

6. Infectious Diseases

1) Pathology and general principles of microbial pathogenesis, special techniques for diagnosing bacterial, fungal, parasitic, and viral infections.

7. Environmental and nutritional pathology

1) Common environmental and occupational exposures leading on to diseases.
2) Nutritional deficiencies and obesity related disorders.

8. Disease of Infancy and Childhood

1) Congenital anomalies, birth injuries, diseases of neonates, inborn errors of metabolism, tumor, and tumor like lesions of infancy and childhood.

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9. Immunopathology

1) Innate immunity- Role of phagocytic cells, complement, mast cells & humoral mechanisms.
2) Specific Acquired Immunity- Details about antibody production & action, Brief principles about memory, Ag specificity & vaccination.
3) Cell involved in Immune response- T- Lymphocytes, B-lymphocytes, macrophages, dendritic cells, and natural-killer cells.
4) Cytokines with details about their properties and functions.
5) Structure and function of histocompatibility molecules and disease association.
6) Disorders of the immune system.
7) All hypersensitivity reactions.
8) Autoimmune disorders with special reference to SLE, Rheumatoid arthritis, Sjogren's syndrome, systemic sclerosis, polyarteritis nodosa and other vasculitides, Mixed connective tissue disorders and inflammatory disorders.
9) Immunodeficiency syndrome – Acquired with emphasis on AIDS.
10) Amyloidosis including pathogenesis, special stains & clinical correlation.
11) Transplant rejection in detail.
12) Graft vs Host Disease.

10. Demonstrate following predominant psychomotor domain competencies

1) Interpret results of Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing in a given clinical context.
2) Interpret results of in-situ hybridization (fluorescent and chromogenic) in a given clinical context.
3) Prepare sample by appropriate methods and perform Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing, and in-situ hybridization including troubleshooting.
4) Interpret direct/ indirect immunofluorescence results in the context of common diseases of the skin, medical renal diseases and autoimmune diseases.
5) Prepare sample by appropriate methods and perform indirect immunofluorescence on a frozen section from skin/ renal biopsy.
6) Interpret transmission electron microscopy results in common non-neoplastic and neoplastic diseases.
7) Prepare specimen by appropriate methods and process tissue for electron microscopy, interpret semi-thin sections and view ultra-thin sections under electron microscope.
8) Navigate and annotate whole slide scanned images.
9) Select and scan slides for digitalization and perform basic image analysis functions such as length measurements, enumeration, etc.

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Course Mapping (CO-PO-PSO Mapping)

Course Code and name	Course Outcome	Program Outcomes POs				Program Specific Outcomes PSOs					
		PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDC513A Basic Sciences: General Pathology, pathophysiology, immunopathology and molecular biology	CO 1	3	2	2	2	3	3	2	2	2	2
	CO 2	2	3	3	2	2	2	2	3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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Course Specifications

MD Pathology 2022 onwards

Course code: MDC514A

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Course Specifications

Course Title	**Systemic Pathology: Surgical and Cytopathology**
Course Code	**MDC514A**
Department	**Pathology**
Faculty	**Ramaiah Medical College**

Course summary:

The course is designed in such a way that the student shall master study of normal structure and function of various organ systems and the etiopathogenesis, gross and microscopic alterations of structure of these organ systems in disease and functional correlation with clinical features, shall also master evaluation and reporting of cytopathology specimens.

Course Outcomes:

CO 1 Should know standard operating procedures, various equipment, automation and quality assurance in surgical pathology and cytopathology, possess the knowledge and techniques necessary for dissection in autopsy and grossing, taking appropriate sections and samples along with reporting in surgical pathology and cytopathology. (C, P)

CO 2 Should be well versed with histopathology tissue processing techniques, cutting of paraffin and frozen sections, making imprint smears and staining; performing direct fine needle aspirations and guiding clinical/radiology residents for guided aspirations in keeping with the clinical information on the choice of site, collection, preservation, transport, type of preparation and method of obtaining various cytological specimens (C, P)

CO 3 Should be introduced to basic research methodology so that he/she can independently conduct fundamental and applied research and he/she should independently write the thesis in accordance with the prescribed instructions as expected of international standards (C, P)

CO 4 Have knowledge of biomedical waste management and be familiar with appropriate disposal methods for each specimen, sample, reagents, instruments, autoclaving techniques, recycling of products and e-waste as applicable to the specific courses (C, P)

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Course content:

II. Systemic Pathology:

1. **Blood vessels, lymphatic and veins**

1) Normal morphology, congenital anomalies, atherosclerosis, hypertensive vascular disease.
2) Inflammatory and neoplastic diseases of all the vessels.

2. Heart

1) Normal morphology, its blood supply and effect of aging on heart.
2) Ischemic, Hypertensive, valvular, congenital heart diseases.
3) Cardiomyopathies
4) Myocardial disorders
5) Pericardial diseases.
6) Tumors of the heart.

3. Lungs and Mediastinum

1) Congenital anomalies
2) Obstructive and restrictive pulmonary diseases
3) Diseases of vascular origin
4) Infections of Lung
5) Infections of Mediastinum
6) Tumors of lung
7) Lung transplantation
8) Diseases of pleura
9) Thymus – Developmental, autoimmune, and inflammatory disorder and tumors.

4. **Head and Neck**

1) Oral cavity: - inflammatory disease, Preneoplastic lesions and tumors.
2) Diseases of teeth and supporting structures.
3) Upper airways and ear – congenital anomalies, infections, and tumors.
4) Salivary glands – Infections autoimmune disorders and tumors.

5.Gastrointestinal Tract

1) Congenital anomalies, infections, inflammatory and vascular disorders and tumors of esophagus, stomach, small and large intestines, appendix, and anal canal.
2) Diseases of the peritoneum, Omentum and Mesentery Retroperitoneum.
3) Inflammatory and neoplastic lesions.

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6.Liver

1) Normal morphology with general features of hepatic disease including LFTs.
2) Infectious, autoimmune drug induced metabolic and circulatory disorders of liver. 3. Hepatic diseases associated with pregnancy, neonates, organ and bone marrow transplantation.
3) Liver transplantation pathology.
4) Cysts, Nodules, and tumors of liver. Biliary tract
5) Congenital anomalies, injuries, Infection, inflammation, of Gallstones and tumors of gall bladder and extra hepatic bile ducts.

7.Pancreas

1) Congenital anomalies, pancreatitis, and neoplasms of pancreas.

8. Kidney

1) Clinical manifestations of renal diseases
2) Congenital anomalies
3) Diseases affecting glomeruli, tubules, interstitium and blood vessels.
4) Cystic diseases of kidney
5) Nephrolithiasis
6) Tumors of kidney
7) Kidney Transplant pathology

9. Lower urinary tract and male genital system

1) Congenital anomalies, inflammation and tumors of bladder, ureter, urethra, penis, testis, epididymis, and Scrotum.
2) Inflammation, enlargement, and tumors of prostate.

10. Female genital tract

1) Physiology, cytology and histology of female genital tract, menstrual disorders, and hormonal abnormalities.
2) Congenital anomalies, inflammation, preneoplastic and neoplastic lesions of vulva, vagina, cervix, uterus, fallopian tubes, ovaries and mesonephron.
3) Gestational and placental disorders.

11. Breast

1) Inflammations, benign epithelial lesions, and tumors of the breast.
2) Diseases of male breast.

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12. Endocrine System

1) Normal hormonal levels and functions of all the endocrine glands.
2) Hypo and hyperactivity of glands of endocrine system i.e., pituitary, thyroid, parathyroid, pancreas, adrenals, and pineal gland.
3) Autoimmune diseases, inflammations and tumors affecting these glands,
4) Neuroendocrine tumors,

13. Skin and Subcutaneous tissue

1) Disorders of pigmentation and melanocytes,
2) Inflammatory, vesiculobullous, and infectious disease,
3) Proliferative lesions and Tumors of the epidermis, dermis, and skin appendage.

14. Musculoskeletal system

1) Bone Modelling, growth, and development, genetic and acquired abnormalities in bone cells, matrix and structure, factures, necrosis and infections of bones, tumors and tumor like lesions,
2) Joints: Arthritis, tumor, and tumor like lesions.
3) Soft tissue: Tumors and tumor like lesions.

15. Peripheral nerves and skeletal muscles

1) General reactions of motor units.
2) Inflammatory, infectious, hereditary, metabolic, and traumatic neuropathies.
3) Atrophy, dystrophy, myopathies of the skeletal muscles.
4) Diseases of neuromuscular junction.
5) Tumors of peripheral nerves and skeletal muscles.

16. Skull and Central Nervous System

1) Degenerative, metabolic, toxic, demyelinating, infectious, cerebrovascular malformations, and traumatic injuries.
2) Tumors.

17. Eye and Orbit

1) Infections, inflammatory, congenital diseases and neoplasms of orbit, eyelid, conjunctiva sclera, uvea, cornea, retina, and optic nerves.

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Demonstrate following psychomotor domain competencies:

Surgical Pathology:

1. Given the clinical and operative data, identify and systematically and accurately describe the chief gross anatomic alterations in the surgically removed specimens and be able to correctly diagnose common lesions received on an average day from the surgical service of an average teaching hospital independently.

2. Perform a systematic gross examination of the tissues including the taking of appropriate tissue sections and in special cases as in intestinal mucosal biopsies, muscle biopsies and nerve biopsies, demonstrate the orientation of tissues in paraffin blocks independently.

3. Identify and systematically and accurately describe the chief histomorphological alterations in the tissue received in the surgical pathology service. He/she should also correctly interpret and correlate with the clinical data to diagnose routine surgical material received on an average day. Independently.

4. Identify common problems in histopathology processing techniques (poor fixation, delayed fixation, poor staining, etc.,) including automated tissue processing machine troubleshooting and rectify common problems Independently.

5. Operate and maintain common equipment in the histopathology laboratory such as microtome, water bath, cryostat, tissue processor, auto Stainer, etc. Perform under supervision.

6. Process a tissue, make a paraffin block and cut sections of good quality on a rotary microtome Perform under supervision.

7. Stain paraffin sections with hematoxylin and eosin stain and common special stains needed for diagnosis Independently.

8. Cut a frozen section, stain and interpret the slide in correlation with the clinical data provided.

9. Standardize and validate new antibodies for immunohistochemistry with understanding of controls, clones, and dilutions Independently.

10. Perform immunohistochemistry on paraffin sections using manual method Independently.

11. Identify common problems in immunohistochemistry procedure (artifacts, inadequate retrieval, section floating, IHC failure, etc.,) and rectify such problems Independently.

12. Decide on the appropriate immunohistochemical panels for diagnosis, prognosis and predictive purposes in common disease conditions based on standard recommendations and interpret their results Independently.

13. Write histopathology reports, including synoptic reports, wherever needed, following protocols and international standards. The reports should be succinct and lucid, with clinical notes and advice, as necessary.

14. Perform an autopsy, dissect various organ complexes, and display the gross findings (Note: An improvised autopsy may also be arranged in places where full autopsy is not possible. Relevant

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organs from wet specimens in the museum with appropriate clinical history may be arranged for a detailed description and diagnosis).

15. Provide Provisional and Final Anatomic Diagnosis report, major findings correctly and systematically at autopsy, and the Autopsy Protocol as per prescribed instructions.

Cytopathology

1. Perform fine needle aspiration of superficial lumps and make good quality smears including collection of material for cell block preparation and decide on the type of fixative and stain in a given case Independently.

2. Prepare and stain good quality smears for cytopathological examination Independently.

3. Provide appropriate guidance to colleagues performing procedure such as a biopsy or an imaging guided biopsy including on-site microscopic assessment of specimen adequacy. Independently.

4. Decide on the technique of collection, preservation, transport and concentration of various exfoliative cytology specimens (such as filters, centrifuge, liquid-based cytology, cytospin, etc.) Independently.

5. Perform on-site adequacy assessment in image guided sampling procedures and decide on sample triage for routine diagnosis (type of preparation, stain, etc.) and ancillary tests including microbiological and molecular tests Independently.

6. Diagnose common cases received in a routine cytopathology laboratory and categorize them into negative, inconclusive and positive, using the correct technique of screening and dotting the slides for suspicious cells, correctly identify the type of tumor, if present, and the presence of organisms, fungi and parasites, if present.

7. Perform preparations (cytospin smears, liquid-based cytology, cell blocks, etc.) of common cytological samples using equipment such as centrifuge, cytocentrifuge and liquid based cytology apparatus.

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Course Mapping (CO-PO-PSO Mapping):

Course Code and name	Course Outcome	Program Outcomes POs				Program Specific Outcomes PSOs					
		PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDC514A Systemic Pathology-Surgical and cytopathology	CO 1	3	3	2	3	3	3	3	2	3	3
	CO 2	3	3	2	3	3	3	3	2	2	3
	CO 3	2	3	3	2	2	2	2	3	3	2
	CO 4	3	2	2	3	3	3	3	2	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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Course Specifications

MD Pathology 2022 onwards

Course code: MDC515A

Course Specifications

Course Title	**Hematology, transfusion and laboratory Medicine**
Course Code	**MDC515A**
Department	**Pathology**
Faculty	**Ramaiah Medical College**

Course summary:

The course is designed in such a way that the student shall master study of Hematology which includes all aspects of the diseases of the blood and bone marrow, knowledge of transfusion medicine, laboratory medicine including instrumentation and quality control. This would involve the study of the normal, and the causes of diseases and the changes thereof.

Course Outcomes:

CO 1 Be conversant with SOPs in hematology, laboratory medicine and transfusion medicine, know normal range of values of chemical content of body fluids, significance of altered values and their interpretation thereof in the practice of these specialities. (C, P)

CO 2 Possess knowledge of application of the principles of transfusion medicine, quality control, hemovigilance and regulatory requirements in the diagnosis of diseases of blood and bone marrow (C, P)

CO 3 Be conversant with automation, various equipment used in hematology, laboratory medicine and transfusion medicine, their principles, advantages and disadvantages, good lab practices, purchase specifications and approximate costs of reagents and consumables and record maintenance along with the principles and maintenance of quality assurance in the laboratory. (C)

CO 4 Be able to collect specimens by routinely performing non-invasive out-patient procedures such as venipuncture, finger-prick, and bone marrow aspirates, making smears and staining.(P)

CO 5 Should demonstrate knowledge of different methods of teaching-learning and assessments and should be independently able to teach and engage undergraduate students, paramedical staff and their own peers in the form of presenting seminars, journal clubs and clinicopathological conferences as applicable to all the specific courses. (C, P)

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Course content

I.Hematology and Transfusion medicine:

1. Biology of stem cell and Hematopoiesis

1) Overview of stem cell biology and cellular biology of hematopoiesis.
2) Transcription factors and humoral regulation in normal and malignant hematopoiesis.
3) Interaction between hematopoietic stem cells, progenitor cell and stromal compartment of bone marrow.
4) Stem cell homing & mobilization

2. Erythroid maturation, differentiation, and abnormality

1) Pathobiology of human erythrocyte & Hemoglobin Anemia.
2) Approach to anemia in adults and children in: Clinical correlation & diagnostic modalities.
3) Classification of anemias (Morphological, pathophysiological, and based on erythropoiesis i.e., proliferative vs non-proliferative).
4) Iron deficiency anemia including iron metabolism and differential diagnosis from other microcytic hypochromic anemias.
5) Disorder of iron metabolism including iron overload.
6) Anemia of chronic disorders with special reference to infections, collagen vascular disorders, inflammation etc.
7) Megaloblastic anemia and other causes of megaloblastosis.
8) Definition, approach, and classification of hemolytic anemia.
9) Lab diagnosis of Hemoglobin disorders and hereditary anemia like Thalassemia and related hemoglobinopathies, sickle cell anemia.
10) Hemoglobin associated with altered Oxygen affinity.
11) Red blood cell enzymopathy, membrane disorder, autoimmune hemolytic anemia, nonimmune hemolytic anemia, paroxysmal nocturnal hemoglobinuria.
12) Approach to Pancytopenia/ Cytopenia.
13) Bone marrow failure syndrome.
14) Porphyria.

3. WBC disorders, complement and immunoglobin biology

1) Normal granulopoiesis.
2) Acquired and congenital disorders of phagocytosis (neutrophil, monocyte, eosinophil, and macrophages.
3) Disorder of leukocyte number, function, and morphology. Storage disorder Hematological responses to Infections
4) Viral disorders - Infectious mononucleosis, Hepatitis, and dengue.
5) Parasitic infections - Malaria, Kala azar. Hematological malignancies
6) Conventional & molecular cytogenetic and immunohistochemical basis of hematological malignancies.
7) 7.Classification (WHO, ICC).
8) Their basis and diagnostic approach to various hematological malignancies.
9) Pathophysiology, prognostic factors, cytochemistry, cytogenetics of various leukemias.
10) Pathophysiology and classification of MDS, MPN/MDS, myeloproliferative disorders.
11) Pathophysiology of Non-Hodgkin's lymphoma, Clinical staging of Hodgkin's lymphoma.
12) Role of molecular cytogenetics and immunohistochemistry in Hodgkin's and Non-Hodgkin's lymphoma and lymphoproliferative disorders.
13) AIDS related and Transplant related lymphomas.

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14) Plasma cell dyscrasias and gammopathies.
15) Mastocytosis.
16) Role of chemotherapy and antineoplastic agents based on molecular mechanism of hematological malignancies, clinical use of hematopoietic growth factors.

4. Hematopoietic stem cell transplantation

1) Role and indications of HST, immunodeficiency state, hematological Malignancies and Non-hematological disorders.
2) Practical aspect of umbilical cord stem cells transplantation.
3) Peripheral stem cell collection.
4) Role of stem cell in tissue repair.
5) Complications of Hematopoietic stem cell transplant.
6) Gene therapy and genetic engineering.

Prenatal diagnosis of genetic hematological diseases

1. Hemostasis & Thrombosis

1) Megakaryocyte and platelet structure.
2) Molecular basis of platelet function, activation.
3) Role of blood vessel, coagulation system and fibrinolytic system in hemostasis.
4) Clinical and lab evaluation of bleeding and coagulation disorders.
5) Clinical & diagnostic aspects of factor deficiencies including hemophilia, von Willebrand disease, DIC, Vitamin K deficiency.
6) Thrombotic and non-thrombotic purpura.
7) Hereditary and acquired platelet disorders and its management.
8) Thrombophilia (Inherited & acquired).
9) Lab evaluation and management of hypercoagulable states.

2.Human blood group antigen and antibody and Immuno-hematology

1) Selection of donor and screening..
2) Principle, indication and storage of red blood cells, WBC, platelet, and plasma transfusion.
3) Various methods of component separation and plasma derivatives with special reference to Fresh frozen plasma, cryo-precipitates, platelet concentrate, single donor plasma, albumin, and Immunoglobulin.
4) 1Graft Rejection, GVH diseases, Transfusion Reactions, Blood grouping & cross matching.
5) Blood bank audit.
6) Apheresis Hematological manifestations of systemic diseases
7) Liver disorders, renal disorders, infections, cancers, parasitic diseases, AIDS, pregnancy, and surgical patients.

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3.Spleen and its disorders

Laboratory Medicine (Clinical Pathology including Parasitology)

1) Principles of testing, indications, values with ranges in normal and diseased states in relation to: a. Liver function tests b. Renal function tests c. Endocrine function tests d. Body fluid analysis including stool, urine, semen, CSF, etc.
2) Principles of laboratory automation, trouble shooting, and quality assurance.

Instrumentation and automation

1) Principles, indications, working, maintenance, and troubleshooting of equipment used in various laboratories: a. Histopathology laboratory – Histopathology tissue processor, microtome, water batch, embedding station, Stainer, IHC Stainer, ultramicrotome, etc. b. Microscopes – Immunofluorescence, FISH, Confocal, Electron, etc. c. Cytopathology Laboratory – Centrifuge, Cytocentrifuge, Cytospin apparatus, liquid-based cytology, etc. d. Hematology Laboratory – automated cell counter, flow cytometer, coagulometer, HPLC, Electrophoresis apparatus, immunoblot, etc. e. Clinical Pathology –Photoelectric colorimeter, Spectrophotometer, pH meter, Centrifuge, Electrophoresis apparatus, ELISA Reader, chemiluminescence, etc. f. Digital pathology – Whole slide scanners o Molecular pathology – PCR, Sanger sequencer, NGS sequencers, etc.
2) Automation in Pathology.
Good lab practices and safety, record maintenance of capital equipment and consumables, purchase specifications, approximate costs of reagents and equipment, maintenance of store logbooks, etc.

Quality assurance program

1) Internal and external quality assurance methods.
2) Intra assay variations, batch variations, validation of chemicals and instruments.

Psychomotor domain:

1) Perform venipuncture for peripheral blood collection and decide on appropriate collection tubes, storage, and anticoagulant based on indication, independently.
2) Prepare good quality peripheral blood smears, stain and report peripheral blood counts and other findings including reticulocyte and platelet counts on cell counter and manually Independently.
3) Perform bone marrow aspirates and biopsy, prepare good quality smears and imprints Perform under supervision.
4) Perform bone marrow aspirate staining including stain for iron Independently.
5) Perform cytochemical characterization of leukemia with special stains on bone marrow aspirates Perform under supervision.
6) Perform and interpret coagulation profile including PT, APTT and FDP Independently.
7) Perform and interpret sickling test and osmotic fragility test Independently.

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8) Describe accurately the morphologic findings in the peripheral and bone marrow smears, identifying and quantitating the morphologic abnormalities in disease states and arriving at a correct diagnosis in at least common cases referred to the Hematology clinic, given the relevant clinical data Independently.

9) Given the clinical data, interpret the results of i. Red cell indices ii. Plasma hemoglobin iii. Hemosiderin in urine iv. Hemolytic anemia profile including HPLC, Hb electrophoresis etc. v. Hemoglobin and serum protein electrophoresis vi. Clotting time and other point of care tests for bleeding vii. G6PD enzyme estimation viii. Platelet function tests including platelet aggregation and adhesion and PF3 release ix. Russell's viper venom time (RVVT) x. Coagulation Factor assays xi. Serum Fibrinogen xii. Screening for coagulation factor inhibitor, Bethesda Assay, xiii. Fibrin Degradation Products (FDP), D-Dimers xiv. Monitoring of anti-coagulant therapy xv. Thrombophilia profile (Lupus anticoagulant (LAC), Anticardiolipin Antibody (ACA), Activated Protein C Resistance (APCR), Protein C (Pr C), Protein S (Pr S) and Antithrombin III (AT III)) xvi. Serum ferritin, Serum iron and total iron binding capacity.

10) Interpret flow cytometry findings in the immunophenotyping of leukemia, CD34 enumeration, CD 3/CD 19 enumeration, PNH work up, etc. Independently.

11) Interpret results of cytogenetics and molecular diagnostics in the work up of hematological diseases Independently.

12) Prepare samples as appropriate for the indication, and operate equipment such as automated cell counter, flow cytometry, coagulometers, HPLC and electrophoresis apparatus.

Laboratory medicine

1) Plan a strategy of laboratory investigation of a given case, given the relevant clinical history and physical findings in a logical sequence, with a rational explanation of each step; be able to correctly interpret the laboratory data of such studies, and discuss their significance with a view to arrive at a diagnosis. Independently.

2) Perform urine analysis including physical, chemical and microscopic, examination of the sediment as well as by Dipstick methods. Independently.

3) Perform macroscopic and microscopic examination of feces and identify the ova and cysts of common parasites.

4) Perform a complete examination: physical, chemical and cell content of Cerebrospinal Fluid (C.S.F), pleural and peritoneal fluid Independently.

5) Perform semen analysis and interpret results in the context of clinical and hormone findings Independently.

6) Perform quantitative estimation of blood/serum by automated techniques for common biochemical tests Independently.

7) Prepare standard solutions and reagents relevant to common biochemical tests including the preparation of normal solution, molar solution and buffers Independently.

8) Interpret and report common laboratory biochemical tests (LFT, KFT, endocrine function tests) with understanding of clinical implications Independently.

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9) Operate, maintain and troubleshoot common equipment used such as photoelectric colorimeter, Spectrophotometer, pH meter, Centrifuge, Electrophoresis apparatus, ELISA Reader, PCR, chemiluminescence, etc

Transfusion Medicine

1) Perform selection and bleeding of donors, ABO and Rh grouping and cross match, antibody screening and titer, selection of blood for exchange transfusion
2) Resolve ABO grouping problems and outline measures for investigation of transfusion medicine
3) Perform and interpret anti-globulin test in antenatal and neonatal work up
4) Prepare blood components such as cryoprecipitates, platelet concentrates, fresh frozen plasma, single donor plasma, red blood cell concentrates, etc. and test blood for presence of pathogens including HBV, HCV, HIV, VDRL, Malaria, etc. observation only.

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Course Mapping (CO-PO-PSO Map)

Course Code and name	Course Outcome	Program Outcomes POs				Program Specific Outcomes PSOs					
		PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDC515A Hematology, transfusion medicine & laboratory medicine including instrumentation and quality Control	CO 1	3	3	2	3	3	3	3	2	2	3
	CO 2	3	3	2	3	3	3	3	2	2	3
	CO 3	3	3	2	3	3	3	3	2	2	3
	CO 4	3	3	2	3	3	3	3	2	3	3
	CO 5	2	3	3	2	2	2	2	3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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Course Specifications

MD Pathology 2022 onwards

Course code: MDC516A

Course Specifications

Course Title	**Recent advances and applied aspects in Pathology**
Course Code	**MDC516A**
Department	**Pathology**
Faculty	**Ramaiah Medical College**

Course summary:

The course is designed in such a way that the student shall master recent advances in Pathology, molecular Biology, electron microscopy, digital Pathology.

Course outcomes

CO 1 Should be conversant with the principles, procedures, use and quality control of automated equipment in the areas of immunohistochemistry, flow cytometry, molecular tests including but not limited to in situ hybridisation, polymerase chain reaction, Sanger sequencing and next generation sequencing, principles and techniques of electron microscopy (C,P).

CO 2 The student should be conversant with the use of whole slide scanned images and principles and applications of digital pathology and artificial intelligence. (C)

Course Content:

1. Immunopathology,
2. Electron microscopy,
3. Histochemistry,
4. Immunohistochemistry,
5. Cytogenetics and in-situ hybridization,
6. Molecular Biology,
7. Digital Pathology and image analysis
8. Use of Computer and Internet in medicine.
9. Recent advances in all subspecialties of Pathology with applied aspects.

Psychomotor domain

1. Interpret transmission electron microscopy results in common non-neoplastic and neoplastic diseases.

2. Observe preparation of specimen by appropriate methods and processing of tissue for electron microscopy, interpret semi-thin sections and view ultra-thin sections under electron microscope.

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Digital pathology - Navigate and annotate whole slide scanned images

1. Observe selection and scanning of slides for digitalization and performing of basic image analysis functions such as length measurements, enumeration, etc.
2. Interpret results of Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing in a given clinical context.
3. Interpret results of in-situ hybridization (fluorescent and chromogenic) in a given clinical context.
4. Prepare sample by appropriate methods and perform Polymerase Chain Reaction (PCR), real time PCR, Sanger Sequencing, and in-situ hybridization including troubleshooting .
5. Artificial intelligence in Pathology

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Course Mapping (CO-PO-PSO Mapping)

Course Code and name	Course Outcome	Program Outcomes POs				Program Specific Outcomes PSOs					
		PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDC516A Recent Advances and applied aspects in Pathology	CO 1	3	3	2	3	3	3	3	2	2	3
	CO 2	3	3	3	2	3	3	2	3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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Course Specifications

MD Pathology 2022 onwards

Course code: MDP504A

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Course Specifications

Course Title	Thesis- Pathology
Course Code	MDP504A
Department	Pathology
Faculty	Ramaiah Medical college

Course Summary:

The course is designed in such a way that the student will master the science of research in terms of designing, conducting and interpreting the results.

Course Outcome:

CO 1 Should be introduced to basic research methodology so that he/she can independently conduct fundamental and applied research and he/she should independently write the thesis in accordance with the prescribed instructions as expected of international standards(C, P).

CO 2 The student should demonstrate integrity, accountability, respect, compassion and dedicated patient care and a commitment to excellence, continuous professional development and ethical principles relating to research conduct and research publication as applicable to all the specific courses.

Course details:

Every candidate pursuing MD Medicine degree course is required to carry out work on a selected research project under the guidance of a recognised post graduate teacher. The results of such a work shall be submitted in the form of a dissertation. The dissertation is aimed to train a post graduate student in research methods and techniques. It includes identification of a problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, comparison of results and drawing conclusions.

Every candidate shall submit to the Registrar (Academic) of the University in the prescribed proforma, a synopsis containing particulars of proposed dissertation work within six months from the date of commencement of the course on or before the dates notified by the University. The synopsis shall be sent through the proper channel.

Such synopsis will be reviewed and the dissertation topic will be registered by the University. No change in the dissertation topic or guide shall be made without prior approval of the University.

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The dissertation should be written under the following headings:

1. Introduction
2. Aims or Objectives of study
3. Review of Literature
4. Material and Methods
5. Results
6. Discussion
7. Conclusion
8. Summary
9. References (Vancouver style)
10. Tables
11. Annexures

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Course Mapping (CO-PO-PSO Mapping)

Course Code and name	Course Outcome	Program Outcomes POs				Program Specific Outcomes PSOs					
		PO1	PO2	PO3	PO4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
MDP504A Thesis-Pathology	CO 1	2	3	3	2	2	2	2	3	3	2
	CO 2	2	3	3	2	2	2	2	3	3	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution											

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Course materials

Recommended Books and Journals

Books (latest edition)

1. Histology for Pathologists. Stephen S. Sternberg (Ed), Raven Press, New York.
2. Robbin's Pathologic Basis of Disease Ramzi S.Cotran, Vinay Kumar, Stanley L Robbins WB Saunders Co., Philadelphia.
3. Ackerman's Surgical Pathology. Juan Rosai Mosby. St. Louis.
4. Diagnostic Surgical Pathology. Stephen S Sternberg. Lippincott, William Wilkins. Philadelphia.
5.Diagnostic Histopathology of Tumours. Christopher DM Fletcher (Ed). Churchill Livingstone. Edinburgh.
6. Manual & Atlas of Fine Needle Aspiration Cytology. Svante R Orell, et al London.
7. Theory and Practice of Histological Techniques, Bancroft JD, Stevens A, Turner DR, Churchill Livingstone, Edinburgh.
8. Diagnostic Cytology and its Histopathologic Basis, Koss LG, J.B. Lippincott, Philadelphia.
9. Comprehensive Cytopathology, Bibbo M, W.B. Saunders Co., Philadelphia.
10. Wintrobe's Clinical Hematology, Lee GR, Foerster J, Lupeus J, Paraskevas F, Gveer JP, Rodgers GN, Williams & Wilkins, Baltimore.
11. Atlas and Text of Hematology 4th edition. Singh T. Avichal Publishing Company.
12. Dacie and Lewis Practical Hematology, Bain BJ, Bates I, Laffan MA. Elsevier.
13. Bone Marrow Pathology, Bain BJ, Clark DM, Lampert IA, Blackwell Science, Oxford.
14. Henry's clinical diagnosis and management by laboratory methods.
15. WHO classification of tumors. IARC Lyon. Journals 03-05 international Journals and 02 national (all indexed) journals.
16. Lever's Dermatopathology
17. Novak's Gynecologic and Obstetric Pathology with Clinical and Endocrine Relations by Edmund R. Novak.
18. Bone Pathology by H. Jaffe
19. MacSween's Pathology of the liver
20. Iochim's Lymph Node Pathology
21. Text Book on Breast Pathology by Tavasoli
22. Text Book on Thyroid Pathology by Geetha Jayaram
23. Heptinstall's Pathology of the Kidney
24. Enzinger's Soft Tissue Tumours

Journals

- 3 - 5 international Journals and 02 national (all indexed) journals – available in RMC Central Library

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