

**SYLLABI & COURSES OF STUDIES
FOR
M.PHIL HAEMATOLOGY**

MAJOR (COMPULSORY) COURSE:

▪ MCQs Papers	150 Marks	150 Items	3 Hours
▪ SEQs Papers	150 Marks	15 Items	3 Hours
▪ Viva voce& Practical Examination =	100 Marks		
▪ Total	= 400 marks		

COURSE OUTLINE (THEORY)

A. Origin & Development Of Blood Cells

1. Hematopoietic organs:
 - Anatomy and functional aspects of bone marrow
2. Hematopoietic stem cells
 - Totipotent stem cell
 - Culture of hematopoietic stem cells.
 - Enrichment of hematopoietic stem cells
3. Committed hematopoietic “progenitor cells”
 - Multilineage progenitors
 - Terminal phases of differentiation
 - Replication potential of committed progenitors
4. Hematopoietic growth factors / cytokines
 - Types of receptors
 - Granulocytes and macrophage growth factors
 - Megakarocyte growth factors
 - Growth factors for b- lymphocytes
 - Growth factors for erythroid cells
 - Mechanism of action of growth factors

B. Erythropoiesis

1. Erythroid cells:
 - Erythroid progenitors CFU and BFU
 - Erythroid precursors
 - Stages of normoblastic differentiation
 - Proliferation and maturation of RBC
2. Biosynthesis of hemoglobin
 - Globin synthesis
 - Globin genes
 - Transcription and mrna processing

- Translocation
- Tetramer formation
- Regulation of globin synthesis
- Heme synthesis
- Biosynthesis of delta aminolevulinic acid
- Biosynthesis of porphobilinogen
- Biosynthesis of heme
- Regulation of heme synthesis

3. Control of erythropoiesis

- Tissue O₂
- Erythropoietin - structure
- Site and production
- Action
- Assay

C. The Mature Erythrocyte

1. Shape
2. Dimensions
3. Structure
 - Membrane transport protein and function
 - Membrane associated enzymes

1. Hemoglobin and erythrocyte function

- Normal hemoglobin structure and modifications
- Oxygen transport
- Oxidative denaturation of hemoglobin
- Glutathione metabolism

2. Energy metabolism

- Hexose monophosphate shunt
- Pentose phosphate pathway

D. Nutritional Factors In Production And Function Of RBC

1. Protein , AA and Glucose
2. Vitamin B₁₂ and folic acid
 - Sources, requirement, storage
 - Absorption and transport
 - Functions.
3. Other vitamins
 - Vitamins B₆, riboflavin, niacin, vitamin C
 - Vitamins A, vitamin E
4. Minerals iron
 - Total body iron
 - Iron balance
 - Iron cycle
 - Iron metabolism
 - Ferrokinetics

Copper

- Metabolism
- Deficiency in humans
- Role in erythropoiesis

E. Destruction of Erythrocytes

1. Life span of erythrocytes
 - Methods of estimation / Red cell survival study
 - Clinical applications
2. Erythrocyte aging
3. Mechanism of red cell destruction
4. Sites of red cell destruction
 - Extra vascular
 - Intra-vascular
5. Hemoglobin catabolism
 - Formation of bilirubin
 - Bilirubin transport and metabolism
6. Laboratory evaluation of hemoglobin catabolism and bile pigments (In practical)

F. Neutrophilic Leukocytes

1. Normal values for leukocytes
2. Differential cell counting
3. Development of neutrophils
4. Morphology of neutrophils
5. Sub cellular structure of neutrophils
6. Neutrophil functions (phagocytosis)
7. Neutrophil antigens
8. Neutrophilia and neutropenia

G. Eosinophils

1. Eosinophil mediators and functions
2. Eosinophilia & eosinopenia - causes and association in various diseases

H. Basophils and Mast Cells

1. Development of basophils and mast cells
2. Morphology
3. Activation and function
4. Basophilia, causes and associated diseases.

I. Mononuclear Phagocytes

1. Development and kinetics of mononuclear phagocytes
2. Morphology
3. Distribution of tissue macrophages
4. Antigens and receptors

5. Functions (phagocytosis / cytokine production)

J. Lymphatic System

1. Lymphoid organs
2. Development of lymphocytes (b and t cells)
3. Morphology of lymphocytes (b and t cells)
4. HLA and CD molecules
5. Functions of lymphocytes.
 - The immune response
 - Major histocompatibility complex
 - Humoral immunity
 - Immunoglobulins
 - Complement system
 - Cell mediated immunity
 - Lymphokines

K. Platelets and Megakaryocytes

1. Megakaryocytes
2. Platelet formation and release
3. Platelet structural and functional anatomy
4. Platelet physiology
5. Platelet function
 - Platelet adhesion
 - Platelet aggregation
 - Platelet release reaction
 - Pathologic role of platelets in hemostasis and thrombosis
6. Platelet antigens

L. Blood Coagulation And Fibrinolysis

1. Normal coagulation cascade
2. Clotting factors
 - Structure and function of all factors
3. Natural inhibitors of coagulation system
 - Protein C and protein S pathway
 - Anticoagulant proteins
 - Alpha₂ macroglobulin, serine protease inhibitors, Anti thrombin III,
 - Protein C inhibitor
 - Heparin Co factor II
 - Tissue factor pathway inhibitor
 - Fibrinolytic system
 - Inhibitors of fibrinolytic system
 - Physiologic regulation of fibrinolysis
4. Role of fibrinolytic process in preventing thrombosis.

M. Endothelium and Regulation Of Hemostasis

1. Endothelial cell structure
2. Anti-thrombotic properties of endothelium
3. Pro-thrombotic properties of endothelium

N. Red Cell Antigens(Blood Group Systems)

Red cell immunohematology

1. ABO blood group system
 - Genetics biochemistry of ABO system
 - Antigens and antibodies of ABO system
 - Bombay phenotype
 - Genetics and biochemistry of secretor system.
2. Lewis blood groups system.
 - Antigens and antibodies
3. P blood groups system
4. MNS blood groups system.
5. LW blood groups system.
6. Kell blood groups system.
7. Duffy blood groups system.
8. Kidd blood groups system.
9. Lutheran blood groups system.
10. Other blood groups system.
11. Rh blood group system
 - Terminology and classification
 - Genetics
 - Antigens and antibodies

O. Principles and Practice Of Transfusion Medicine

1. Transfusion of blood and blood components

- Donor selection
- Blood donation and collection
- Collection process
- Red cell preservation
- Anticoagulants
- Components and fractionation of blood
- Blood components
- Plasma fractionation products
- Frozen RBC
- Autologous blood transfusion
- Indications of blood transfusion
- Exchange transfusion

2. **Platelet Transfusion**

- Indications of platelet transfusion
- Selection of platelet donors
- Preparation of platelet concentrates
- Platelet storage
- Frozen platelet

3. **Granulocyte Transfusion**

- Indications
- Selection of donors

- Preparation of granulocytes for transfusion
- Storage
- Dosage
- Adverse effects

4. Transfusion of Plasma And Plasma Derivatives.

- Fresh frozen plasma
- Anti hemophilic factor
- Factor concentrates
- Albumin
- Immunoglobulin preparation- indications and dosage

5. Adverse Effects Of Blood Transfusion

- Immunologic reactions
- Non immunologic reactions
- Infectious complications (diseases transmitted)
- Hepatitis B,C,D,A,E
- HIV, Cytomegalovirus, EB Virus
- Malaria and other parasitic infection

6. Therapeutic Aphaeresis

7. Hemopoietic Stem Cell Transplantation

1. Hemopoietic stem cells
2. Sources
3. Indications
4. Engraftment
5. Complications
 - Graft versus host disease
 - Infectious diseases

DISORDERS OF RED CELLS

A. General Aspects Of Anemia

1. Definition
2. Clinical manifestations
3. Pathophysiology
4. Classification and morphology
5. Diagnostic approach
 - Macrocytic anemia
 - Hypochromic microcytic anemia
 - Normochromic normocytic anemia

B. Iron Deficiency Anemia

1. Stages of development of iron deficiency
2. Etiology and pathogenesis
3. Clinical manifestations
4. Laboratory finding

C. Megaloblastic & Other Macrocytic Anaemias

1. Etiology of vitamin B₁₂ deficiency
2. Pernicious anemia
 - Prevalence
 - Etiology and pathogenesis
 - Clinical manifestations
 - Laboratory findings

D. Folate deficiency

1. Causes
2. Pathogenesis
3. Laboratory diagnosis

E. Anaemia of pregnancy

F. Anemia Unique to Infants and Young Children

1. Normal blood cells with heir values and metabolism
2. Erythroid changes throughout childhood.
3. Anemia in newborn
4. Anemia of prematurity

G. Sideroblastic Anemias

1. Heme synthesis in red cells
2. Etiology
3. Laboratory findings

H. Pancytopenia, Aplastic Anemia, Pure Red Cell Aplasia

Bone marrow failure syndromes, Congenital / Acquired

1. Pathophysiology
2. Etiology

3. Symptoms and signs
4. Lab diagnosis

I. Methemoglobinemia

J. Iron Overload
Hemochromatosis

K. Porphyrias

1. Classification
2. Causes
3. Pathogenesis
4. Diagnosis

L. Haemoglobinopathies

The Abnormal Hemoglobins - General Principles

1. Classification
2. Genetic mechanism and molecular pathology
3. Pathophysiology
4. Hemoglobin C disorders
5. Hemoglobin D disorders
6. Hemoglobin E disorders

Sickle Cell Anemia

1. Hemoglobin s- prevalence and distribution
2. Pathophysiology
3. Clinical features
4. Laboratory diagnosis
5. Sickle cell trait
6. Other sickling syndromes
7. Prevention

Thalassemias and Related Disorders

1. Prevalence and geographic distribution
2. Genetic mechanisms and molecular pathology
3. Pathophysiology
4. Clinical and laboratory features of
 - Alpha thalassemia
 - Beta thalassemia
 - Hereditary persistence of fetal hemoglobin
 - Hb Lepore syndromes
5. Diagnosis and differential diagnosis
6. Prevention

M. Hemolytic Anemias : General Consideration

1. Definition
2. Classification
3. Clinical manifestations
4. Laboratory diagnosis

N. Hereditary Spherocytosis And Other Membrane Disorders

1. Genetics
2. Pathogenesis
3. Clinical features
4. Laboratory diagnosis
 - Hereditary elliptocytosis
 - Hereditary stomatocytosis

O. HEREDITARY HEMOLYTIC ANEMIAS ASSOCIATED WITH ABNORMALITIES OF ERYTHROCYTE GLYCOLYSIS AND NUCLEOTIDE METABOLISM

- 1. G-6 PD deficiency**
 - Genetics and distribution
 - The enzyme and its variants
 - Pathophysiology
 - Clinical features
 - Diagnosis
- 2. Related disorders of hexose mono phosphate shunt and glutathione metabolism**
- 3. Pyruvate kinase deficiency**
 - Geographic distribution
 - Genetics
 - Pathophysiology
 - Clinical features
 - Diagnosis
- 4. Other enzymopathies affecting glycolysis**
- 5. Abnormalities of purine and pyrimidine nucleotide metabolism**

P. Immune Hemolytic Anemias

- 1. Mechanisms of immune destruction of RBC**
 - Complement system
 - Destruction of IgM and IgG antibodies
 - Demonstration of anti red cell antibodies
- 2. Allo-immune hemolytic disease of fetus and newborn.**
 - Pathogenesis of maternal Rh alloimmunization
 - Pathogenesis of Rh hemolytic disease and other fetal hemolytic disease
 - Severity of Rh hemolytic disease
 - Antibody detection and measurement
 - Other hemolytic disorders
 - Prevention
- 3. Auto-immune hemolytic anemia**
 - Classification
 - Etiology
 - Clinical features
 - Laboratory Diagnosis

Q. Acquired Hemolytic Anemias

1. Infectious agents
 - Malaria
 - Other infections
2. Chemical agents, drugs and venoms
3. Physical agents
4. Red cell fragmentation syndromes
 - Large vessel abnormalities
 - Small vessel disease
 - Thrombotic microangiopathy
 - Malignant hypertension
 - March hemoglobinuria

R. Paroxysmal Nocturnal Hemoglobinuria

1. Etiology and pathogenesis
2. Clinical manifestations
3. Laboratory findings
4. Differential diagnosis

S. Acute Post Hemorrhagic Anemia

1. Clinical description
2. Pathophysiology
3. Hematological finding
4. Diagnosis
5. Treatment

T. Congenital Dyserythropoietic Anemias

1. Type I ,Type II,Type III, Other Variants
2. Pathogenesis
3. Clinical and hematological findings
4. Diagnosis

DISORDERS OF HEMOSTASIS AND COAGULATION

A. Diagnostic Approach to the Bleeding Disorders

1. Clinical evaluation of the bleeding patient .
2. Laboratory methods for the study of hemostasis and blood coagulation.
3. Bleeding and coagulation time
4. PT and APTT
5. Factor assays
6. Tests for inhibitors of coagulation

B. Bleeding Disorders Caused By Vascular Abnormalities

- 1 Classification
- 2 Pathophysiology

C. Thrombocytopenia

1. Classification
- 2 Causes of thrombocytopenia
3. Pathophysiology of immunological platelet destruction
4. Thrombotic thrombocytopenic purpura
5. Other forms of non immunologic platelet destruction

D. Thrombocytosis

E. Qualitative Disorders Of Platelet Function

- 1 Bernard Soulier syndrome
- 2 Glanzmann's thrombasthenia
- 3 Storage pool disease
- 4 Abnormal platelet mechanism
5. Acquired disorder of platelet function

F. Inherited Coagulation Disorders

- 1 Hemophilia a
- 2 Von Willebrand's disease
- 3 Hemophilia B
- 4 Factor XIII deficiency
- 5 Prothrombin deficiency
- 6 Factor V deficiency
- 7 Factor VII deficiency
- 8 Factor X deficiency
- 9 Factor XI and XII deficiency
- 10 Pre kallikarein deficiency

G. Acquired Coagulation Disorders

- 1 Deficiency of vitamin k dependent factors
- 2 Liver disease
- 3 Disseminated intravascular coagulation
- 4 Primary fibrinolysis
- 5 Pathologic inhibitors of coagulation

H. Thrombosis and Anti Thrombotic Drugs

1. Pathophysiology of thrombosis
2. Inherited thrombotic disorders
3. Anti thrombotic drugs
4. Laboratory evaluation & monitoring of anticoagulant therapy

NON MALIGNANT DISORDERS OF LEUKOCYTES, THE SPLEEN AND IMMUNOGLOBULINS

A. Variations Of Leukocytes In Disease

1. Abnormalities of the Neutrophils
 - Neutropenia and Neutrophilia
 - Qualitative disorders of neutrophils
2. Abnormalities of the Eosinophils & Basophils
 - Eosinopenia and Eosinophilia
 - Basophilia
3. Abnormalities of the monocyte macrophage system
 - The lysosomal storage diseases
 - Gaucher disease
 - Niemann Pick disease
 - Fabry's disease
3. Abnormalities of the lymphocytes
 - Langerhans cell histiocytosis
 - Infectious mononucleosis
 - Etiology
 - Clinical manifestations
 - Laboratory findings
 - Complications
- Other EBV associated conditions

B. Disorders of the Spleen

- Structure and function of spleen
- Causes of splenomegaly
- Hematological findings in splenomegaly / Hypersplenism
- Indications and complications of splenectomy

C. Haematological Changes in Systemic Diseases

Anemia of Chronic Disorders

1. Associated disorders
2. Pathogenesis
3. Laboratory diagnosis

Anemia's Associated with Renal, Liver and Endocrine Diseases

1. Pathogenesis
2. Clinical findings
3. Lab diagnosis
4. Management

Hematological Aspects of Viral Diseases

HIV, HBV, HCV, HTLV, EBV etc.

MALIGNANT DISORDERS OF HAEMATOPOEITIC SYSTEM

A. Hematologic Malignancies

1. General aspects
2. Molecular genetics
3. Complications

B. Classification and Differentiation of Acute Leukemias

- Acute Lymphoblastic Leukemia
- Clinical features
- Laboratory diagnosis
- Differential diagnosis
- Acute Myelogenous Leukemia
- Clinical presentation
- Classification
- Lab diagnosis including cytogenetics
- Special issues

D. The Myelodysplastic Syndromes

- Classification
- Pathogenesis and genetic features
- Clinical findings
- Laboratory diagnosis

E. Myeloproliferative Disorders

Chronic Myeloid Leukemia

- Clinical presentation and course
- Cellular and molecular pathogenesis
- Laboratory diagnosis

Polycytemia Vera

- Clinical features
- Cytogenesis
- Pathogenesis
- Laboratory diagnosis

Myelofibrosis

- Etiology and pathogenesis
- Laboratory diagnosis
- Differential diagnosis
- Treatment

Essential Thrombocythemia

- Etiology and pathogenesis
- Laboratory diagnosis
- Cytogenetics
- Differential diagnosis

F. Lymphoproliferative Disorders

Classification

Chronic Lymphocytic Leukemia

- Etiology
- Clinical and laboratory findings
- Laboratory diagnosis
- Staging

Hairy Cell Leukemia

Non – Hodgkin Lymphomas

1. Etiology and cytogenetic studies
2. Classification
3. Morphology
4. Clinical features
5. Prognostic factors

Hodgkin Disease

1. Etiology and pathogenesis
2. Clinical features
3. Classifications
4. Staging

Cutaneous T cell Lymphoma; Mycosis Fungoides and Sezary Syndrome

G. Plasma Cell Dyscrasias

General Considerations

Multiple Myeloma

1. Etiology , cytogenetics and pathogenesis
2. Clinical manifestations
3. Laboratory diagnosis

Waldenstrom Macroglobulinemia

Heavy Chain Disease

1. Clinical features
2. Lab diagnosis

Amyloidosis

1. Physical and chemical nature of amyloid fibrils
2. Pathogenesis
3. Clinical findings
4. Laboratory diagnosis

Cryoglobulin and cryoglobulinemia

1. Classification
2. Clinical findings
3. Laboratory diagnosis

Syllabus M.Phil Haematology –Practicals

1. Anti-coagulants and their preparation
2. Collection of various Blood samples
3. Romanowsky stains and preparation of Leishman stain
4. Bone marrow aspiration and trephine biopsy
5. Preparation and staining of blood and bone marrow smears
6. Haemoglobin estimation: methods, preparation of reagents, calibration and quality control
7. RBC counting
8. WBC counting
9. Platelet counting
10. Haematocrit estimation
11. Measurement of ESR
12. Electronic cell counting
13. Absolute values and their calculation
14. Differential leukocyte count
15. Cell morphology – peripheral blood & bone marrow
16. Iron staining of bone marrow and sediments
17. Examination of bone marrow smears
18. Staining for reticulocytes, Hb.H and Hienz bodies
19. Heat instability test
20. Isopropanol precipitation test
21. Osmotic fragility test
22. G-6-PD screening test
23. Pyruvate Kinase deficiency
24. LE cell preparation
25. Malarial parasites and malarial index
26. Preparation, staining and examination of smears for LT bodies
27. Kliehauer test
28. Hb.F estimation

29. Preparation, preservation and transport of haemolysate
30. Hemoglobin electrophoresis
31. Hb.A2 estimation
32. Sickling tests
33. Solubility test for Sickle cell anaemia
34. Bleeding time, Clotting time and Hess test
35. Preparation of thromboplastin & phospholipid
36. Prothrombin time
37. Partial thromboplastin time
38. Thrombin Time
39. Measurement of Fibrinogen levels
40. Lupus anticoagulant screening
41. Mixing studies
42. Coagulation factor assays
43. Clot retraction
44. FDP measurements
45. Screening tests for Thrombophilia
46. Cytochemical staining (SB, PAS, ACP, Esterases)
47. LAP staining and scoring
48. Tests for PNH
49. Other tests for Haemoglobinopathies
50. Coagulation factor assays
51. Blood grouping with Slide and tube method – forward & reverse
52. compatibility testing
53. Antiglobulin test – direct & indirect
54. Antibody screeninig & identification
55. Antibody Titration
56. Quality assurance – Haematology & Transfusion services
57. Semen analysis
58. CSF examination
59. Examination of other fluids

1st Minor Course:

General Pathology

1st Minor=100 Marks 100 Items 2 Hours

2nd Minor (Elective) Course:

2nd Minor=100 Marks 100 Items 2 Hours

One elective course shall be selected from the following:

- Chemical Pathology
- Microbiology
- Immunology/Serology
- Morbid anatomy & Histopathology.

Thesis:

Thesis Examination = 200 Marks

Recommended Books

1. Pathological Basis of Disease Cortan, Kumar, Collins 6th Ed.
2. Clinical Haematology G.C. Degruchi
3. Disorders of the Blood Whitby and Britton
4. Handbook of Haematology and Blood Transfusion Technique J.W. Delancy and G.Garralty
5. Manual of Laboratory Medicine Armed Forces Institute of Pathology Rwp 2nd Ed, 2003
6. Tietz Applied Laboratory Medicine by Mitchell G Scott
7. Henry's Clinical Diagnosis and Management by Laboratory Methods by Richard A Mcpherson