SYLLABUS FOR ASSISTANT PROFESSOR IN TRANSFUSION MEDICINE (BLOOD BANK) – (MEDICAL EDUCATION)

TOTAL MARKS : 100

I. History of Transfusion Medicine (5 Marks)

a) Early attempts in blood Transfusion

- Animal to human blood transfusion
- Human to human transfusion

b) Major scientific landmarks –

- Discovery of blood groups
- Discovery of anticoagulants, syringes, blood bags, additives solutions

c) Impact of world war I & II in the expansion of transfusion service

d) Evolution of apheresis technology

e) History of Transfusion transmitted disease testing

f) Major landmarks in the history of Indian Blood transfusion .service

g) Recent trends in the practice of transfusion medicine – cellular adoptive immunotherapy

II. Basic Science (5 Marks)

a) Physiology and Biochemistry of blood

1. Haematopoiesis
2. Composition and function of plasma constituents.
3. Production, metabolism and morphology of Blood Cells
4. Hemoglobin structure and functions, synthesis and degradation
5. Abnormalities of hemoglobin in oxygen transportation
6. Kinetics and functions of cellular elements of blood (normal and disease state)
7. Physiology of haemostasis with regard to role of platelets, coagulation pathways and fibrinolysis
8. Hemodynamics of circulation, estimation of blood volume
9. Iron metabolism
10. Bilirubin metabolism
11. Patho-physiology of blood donation.
12. Patho-physiology of hemorrhagic shock

13. Biochemical and hematological alternations during storage.

b) Genetics

1. Mendelian Laws of Inheritance
2. Principles of genetics.
3. Immunogenetics and blood groups. (Genetics of the major surface antigens of the formed elements of the blood)
4. Applied Genetics.
5. Population genetics of blood groups

c) Immunology

1. Immune response classification, immunoglobulins.
2. Mechanism of immune response after immunization and infection.
3. Antigens, Antibodies, complement, antihuman globulin test.
4. Humoral and Cellular immunity
5. Principles of structural and functional evaluation of B cells, T cells, NK cells.
6. Principles of antigen antibody reaction and factors affecting these reactions
7. Mechanisms of acute inflammation
8. Physiology of Immune System
9. Hypersensitivity reactions
10. Role of hybridoma technology in Immunohematology
11. Autoimmunity
12. Classification of primary immune deficiency diseases, including defects in humoral immunity, cellular immunity

III. Fundamentals of Immunohematology (10 Marks)

1. Antigen systems of formed elements of blood (Red cell antigens, Leucocyte antigens, Platelet antigens)
2. Biochemical properties and characteristics of blood group antigens and antibodies.
3. Clinical and pathological consequences of antibodies to red cells
4. Red blood cell production and kinetics
5. Red blood cell metabolism
6. Naturally occurring and immune antibodies against red cell antigens.

7. Techniques for detection of antibodies / complements on red cell membrane and their interpretation.
8. Outline of mechanisms of red cell destruction
9. Pathophysiology and laboratory features of intravascular and extravascular hemolysis
10. Importance of complement activation and antibody mediated red cell destruction
11. Platelet production and kinetics
12. Platelet immunology & alloimmunization
13. General principles & clinical utility of platelet function testing
14. Pathophysiology and classification of thrombocytopenia and thrombocytosis
15. Management of thrombocytopenia, including the role of transfusion therapy
16. Neutrophil production and kinetics: neutropenia & neutrophilia
17. Differentiate between immune and nonimmune neutropenia
18. Clinical and laboratory features of immune neutropenia.
19. Role of drugs in the induction of immune and Nonimmune neutropenia.
20. Appropriate management in the care of patients with neutropenia
21. Role of granulocyte transfusion
22. Transfusion related immunomodulation

IV. Blood collection, processing, component preparation (20 Marks)

a. Blood donor selection and phlebotomy

1. Voluntary blood donation program in India
2. Organization of outdoor blood donation camps
3. Categories of blood donors
4. Criteria for blood donor selection
5. Counselling and Care of blood donors (Pre-donation,During-donation, Post-donation)
6. Phlebotomy procedure
7. Blood containers and its configurations
8. Plasticizers
9. Anticoagulant and preservative solutions

10. Selection of blood containers
11. Patho-physiology of adverse reactions of blood donation
12. Whole blood donation Vs apheresis donation
13. Prevention and management of adverse reactions of blood donation
14. Post donation advice and care
15. Donor Hemovigilance

b. Blood component preparation

1. Various types of blood components
2. Preparation and composition of blood components
3. Basic steps in component production.
4. Methods of preparation of components – sedimentation, Centrifugation, Apheresis
5. Functional composition of each component
6. Leucodepletion of each component
7. Storage conditions and shelf-life of components
8. storage lesions for each component
9. Labelling of blood components
10. Transportation of blood components and Cold chain maintenance
11. Quality control standards of each component

c. Blood component modifications

1. Irradiation
2. Leucodepletion
3. Volume reduction
4. Pooling of components
5. Washed blood components and their indications.
6. Pathogen Reduction Technology
7. Cryopreservation

d. Specialized blood components

1. Stem cells
2. Peripheral blood stem cells
3. Umbilical cord blood stem cells

4. Dendritic cells
5. CAR T cells

e. Blood derivatives

1. Difference between a blood component and blood derivative
2. Plasma fractionation – type and procedures
3. Viral inactivation – single donor/pooled units
4. Preparation and production of blood derivatives
5. List of blood derivatives that are prepared commercially.
6. Storage conditions and storage lesions for each derivative with their shelf- life
7. Indication, dosage and administration of each derivative
8. Adverse effects of transfusion that may result from storage- induced change in blood derivatives

f. Blood Processing

1. Mandatory tests required for donor blood processing.
2. Indian History of blood donor screening for infectious diseases
3. Potential recipient's complications if errors occur in donor blood processing.
4. Infectious diseases that can be transmitted through blood transfusion
5. Emerging transfusion transmitted infections
6. Deferral period for various transfusion transmitted infections
7. Window period and residual risk of window period donation
8. Evaluation of testing kits for transfusion transmitted infections (TTI)
9. Principles of TTI testing platforms – ELISA, Chemiluminescence Western Blot, Immunoassays, Nucleic acid Amplification testing, Dot Blot hybridization, and others
10. Implications of reactive test results
11. Donor notification and look back
12. Screening for Autologous donations
13. Testing of donors of human cells, tissues and cellular and tissue based products
14. International Variations in Donor Testing

15. Screening of plasma derivatives
16. Diseases for which no screening tests are available

g. Autologous donation

17. Definition and classification of autologous donation
18. Basic principles, indications, contra-indications
19. Pre-operative autologous deposit
20. Acute normovolemic hemodilution
21. Intra-operative blood salvage
22. including equipment (cell savers)
23. Post-operative cell salvage
24. Advantages and disadvantages of autologous transfusion
25. Directed donation – indications, advantages, disadvantages

h. Bio-safety and waste management

1. Bio-safety levels in health care set up and blood banks
2. Bio-safety measures in blood centre, blood donation camps
3. Waste generation and segregation
4. Biomedical Waste management
5. Sterilization procedures in transfusion technology
6. Needle stick injury
7. Post exposure prophylaxis

V. Blood Group serology/Pretransfusion testing (10 Marks)

1. ISBT classification of Blood groups.
2. Clinically significant antigen systems and associated phenotypes
3. Expression of these antigen systems on red cells and other cells in blood
4. Blood groups and disease associations.
5. Serological techniques for blood group antigens and antibodies.
6. Blood group reagents, Polyclonal and Monoclonal.
7. Blood group substances.
8. Function of neutrophil defense against bacterial infection
9. Role of the platelet in hemostasis
10. Function of lymphocyte subpopulations in normal and disease states

11. Pathophysiology and clinical features of disorders caused by abnormalities of cell function or number
12. Applied serology.
13. Scientific principle for compatibility testing
14. Basic procedures for compatibility testing -
    - Patient's specimen and labeling requirements
    - Patient's request form for blood and or components
    - Patient identification requirements
    - ABO grouping & Rh typing
    - Red cell antibody screening
    - Blood component identification requirement
15. Techniques for compatibility testing
    - Criteria for selection of an appropriate donor unit
    - Emergency and elective techniques.
    - Typing and Screening.
    - Tube / Micro techniques for cross matching
    - Compatibility testing in special circumstances
    - Newer methods of cross matching
16. Apply immunologic principles of blood cell compatibility to clinical situations
17. Identify the clinical situations associated with formation of antibodies to blood cell antigens.
18. Correlate the results of laboratory tests with vivo reactions.

VI. Clinical Transfusion Service (20 Marks)

a. General aspects of transfusion

1. Selection of I.V. set for various components
2. On-line warmers
3. Bed side filtration for leucocyte
4. Flow rate of blood transfusion and duration
5. Proper Handling of blood and component units for transfusion
6. Identification of units with patient before transfusion

7. Monitoring of transfusion
8. Steps to be taken if patient exhibits adverse reactions
9. Materials to be collected and send for investigation of transfusion reactions
10. Major indications for blood components and derivatives.

b. Cardiac Surgery

1. Assessment of blood demand for open heart surgeries
2. Blood and blood component support in cardiac surgery
3. Autologous transfusion in cardiac and vascular surgery
4. Importance of cold agglutinins in cardiac surgery
5. Treatment of symptomatic coagulation abnormalities develop following cardiopulmonary bypass (CPB).
6. Laboratory tests to evaluate bleeding after CPB.

C. Emergency medicine (massive transfusion haemorrhagic shock, burns)

1. Define massive transfusion and conditions requiring massive transfusion
2. Construct appropriate orders for compatibility testing in massive transfusion.
3. Identify the correct use of ‘type- specific’ blood
4. Identify the correct use of O-negative or O-positive blood in patients with unknown ABO type.
5. Rationale for use of various components in massive transfusion.
6. Coagulation and metabolic abnormalities in massive transfusion
7. Risks and benefits of blood salvage techniques during massive transfusion.
8. Evaluate the risks and benefits of blood salvage techniques during massive transfusion.
9. Describe fluid losses associated with burns.
10. Describe operative and non operative mechanisms of fluid and protein loss in burn patients.

d. General surgical support

1. Construct appropriate preoperative orders for blood.
2. Criteria for evaluating haemostatic safety during anesthesia and surgical intervention

3. Identify appropriate orders for blood and blood components for elective surgical procedure, including the use of type and screen
4. Describe the use of the maximum surgical blood order schedule in preparing preoperative blood orders.
5. Evaluate preoperative transfusion needs.
6. Describe the methods of predicting estimated blood loss
7. Describe the treatment for hypovolemia
8. Correlate for clinical symptoms and measurements of blood loss to determine if transfusion is needed.
9. Causes of inappropriate blood usage and blood wastage.
10. Importance of cold chain maintenance
11. Define the desirable cross match: transfusion ratio.

e. Haematology and Oncology

1. Evaluation of Bleeding disorders
2. Importance of bleeding history
3. Coagulopathy of liver disease
4. Pathophysiology of vitamin K deficiency
5. Patho-physiology, diagnosis, clinical features,investigation, management
6. Transfusion support in hemostatic and coagulation disorders
7. Hemophilia A, B, C
8. Von willebrands disease
9. Other clotting factor deficiencies
10. Conventional coagulation tests and viscoelastic coagulation tests
11. International Normalized Ratio derivation and its clinical significance
12. Coagulation concentrates for inherited bleeding disorders
13. Coagulation factor concentrates and pharmacologic therapies for acquired bleeding disorders
14. Patho-physiology, diagnosis, clinical features, investigation, management and transfusion support in hemoglobinopathies –
    - Thalassemia
    - Sickle cell anaemia
    - Other hemoglobinopathies

15. RBC membrane disorders
16. Qualitative and Quantitative disorders of platelets and their management
17. Disseminated Intravascular Coagulation
18. Classification, pathophysiology, diagnosis and management of anemia
    - Iron deficiency anemia
    - Megaloblastic anemia
    - Aplastic anemia
    - Haemolytic anemia including fragmentation syndrome
    - Anemia of chronic diseases – liver disease, uremia,
    - Thyroid diseases
19. Choose the appropriate blood support in the treatment of anemia.
20. Identify the special transfusion problems in patients with chronic hypoproliferative anemia.
21. Describe the special transfusion problems in patients with haemolytic anaemia.
22. describe the clinical indications and contraindications for red cell transfusion.
23. Transfusion support for patient with neoplastic disease.
24. Hematologic problems in patients with specific forms of neoplasia.
25. Appropriate use of blood components in the treatment of neoplastic disease
26. Platelet refractoriness in patients with hematological malignancy

f. Neonatology and paediatrics

1. Describe the pathophysiology of haemolytic disease of the new born (HDN)
2. Blood group systems associated with HDFN
3. Describe the clinical effects of haemolytic disease in the foetus and new born.
4. Outline the diagnosis and management of HDN
5. Antenatal work up of HDFN (e.g. maternal history, maternal antibody titre, maternal and paternal phenotypes, and amniocentesis).
6. Define the indications, including the rationale, for each form of therapy for HDN (early delivery, plasmapheresis of mother, intrauterine transfusion, phototherapy and exchange transfusion).

7. Calculation of volume of blood required for intrauterine transfusion
8. Describe the selection of blood groups and volume of blood components for exchange transfusion
9. List the possible complications of exchange transfusion
10. Describe the role of Rh immunoprophylaxis (antepartum and postpartum) in the prevention of HDN
11. Methods of estimation of fetomaternal hemorrhage
12. Dosage, timing and route of administration of Rh immunoprophylaxis
13. Compare compatibility testing for neonatal and paediatric/ adults transfusion.
14. Identify the appropriate blood samples for neonatal testing
15. Describe the appropriate compatibility tests for the neonate.
16. Compare the procedure used to select blood for neonate and adult patients.
17. post transfusion risk that may be specific to the neonatal patient.
18. Identify situations in which the neonate is at risk for graft- versus host disease(GVHD)
19. Identify situations in which the neonate is at risk for postransfusion cytomegalovirus (CMV) infection.
20. Pathophysiology, diagnosis and management of neonatal alloimmune thrombocytopenia and neutropenia

g.Nephrology

1. Illustrate the use and limitations of blood component therapy in renal disease.
2. Describe the use of blood components in end-stage renal disease.
3. Describe the use of blood components in renal transplantation.

h.Autoimmunity

1. Characterize haemolytic anaemia
2. Differentiate between haemolytic and non haemolytic anemia.
3. Differentiate between immune and nonimmune haemolytic anemia.
4. Classification of autoimmune haemolytic anaemia according to immunologic and clinical criteria.
5. Propose a plan to diagnose and treat warm reactive autoimmune haemolytic anaemia(AIHA).

6. Describe the pathogenesis of warm reactive AIHA
7. Clinical and laboratory features of warm- reactive AIHA
8. Describe the appropriate therapy for patients with warm- reactive AIHA
9. Identify factors to be considered when transfusion therapy is necessary.
10. Describe the appropriate treatment of or response to cold-reactive autoimmune haemolytic anaemia (AIHA).
11. Describe the pathogenesis of cold-reactive AIHA
12. Outline the clinical and laboratory features of cold-reactive AIHA
13. Describe the process or recognizing and diagnosing cold-reactive AIHA
14. Identify the different syndromes produced by cold-reactive AIHA
15. Identify and distinguish between different types of cold-reactive AIHA
16. Algorithm for the diagnosis and treatment of drug induced immune haemolytic anaemia.
17. Describe the differential diagnosis of drug- induced immune haemolytic anaemia.
18. Identify and distinguish between different mechanisms of drug- induced immune injury.
19. Describe the appropriate treatment for patients with drug- induced haemolytic anaemia.
20. Differentiate between immune and non immune thrombocytopenia.
21. Outline the pathophsiology and clinical features of idiopathic Thrombocytopenic purpura (TTP, also known as autoimmune thrombocytopenic purpura, ATP).
22. Distinguish drug-induced thrombocytopenia form ITP
23. Describe the appropriate management o ITP, including the role of transfusion therapy.
24. Construct a plan to diagnose and treat neutropenia.

i.Transplantation

1. Transfusion practice in Organ transplantation.
2. Role of antigen matching and or compatibility in selecting organs or tissues for transplantation.
3. Organs and tissues for which ABO compatibility is considered essential.
4. Role of the major histocompatibility complex (HLA) in graft survival.
5. Bone marrow transplantation – Processing, Harvesting

6. Immunohematological problems in ABO mismatched BMT
7. Peripheral stem cell transplantation – Donor preparative regimens, Harvesting, Complications, Cryopreservation, Cell counting targets, Engraftment monitoring.
8. Donor lymphocyte transfusion
9. Umbilical cord blood transplantation – Collection, Processing, Storage
10. Transfusion support in specialized conditions – kidney,liver
11. Effect of pre-transplant transfusion on graft survival in renal and bone marrow transplantation.
12. Adverse effects associated with transfusion of immune compromised recipients
13. Graft vs Host reaction
14. Irradiation of blood products - Indications, dosage, adverse effects
15. Tissue banking

j. HLA &Transplant Immunology

1. HLA Biochemistry , tissue distribution, function, nomenclature and genetics
2. Various HLA typing platforms
3. Other non HLA Histocompatibility determinants
4. Cross matching and detection of HLA antibodies
5. Principles of the mixed lymphocyte culture test
6. Identification of clinical situations in which the mixed lymphocyte test is used for donor selection
7. The HLA system and transfusion (Platelet refractoriness, FNHTR, TRALI etc.)
8. HLA testing and transplantation (Stem cell transplant and solid organ transplant)
9. Other clinically significant aspects of HLA (HLA associated diseases)

VII. Adverse effects of blood transfusion (10 Marks)

1. Definition and classification of transfusion reactions
2. Etiopathogenesis of transfusion reactions
3. Clinical presentation of transfusion reactions
4. Investigation for transfusion reactions

5. Management of transfusion reactions
6. Prevention of transfusion reactions
7. Immunological reactions (etiology, pathogenesis,investigation, clinical outcome, prevention and management)
   – Hemolytic transfusion reaction
   - Intravascular reactions (immediate)
   - Extravascular reactions(anamnestic/delayed)
8. Non-hemolytic / febrile transfusion reactions
9. Allergic and Anaphylactic reactions
10. Platelet alloimmunization
11. leucocyte alloimmunization
12. Transfusion associated Graft vs Host reactions
13. Transfusion Related Acute Lung Injury(TRALI)
14. Non-immunological reactions (etiology, pathogenesis,investigation, clinical outcome,prevention and management)

VIII. Apheresis (5 Marks)

1. Basic principles of apheresis technology
2. Technology of apheresis (Manual or Automated)
3. Cell separators – types and principle
4. Indications, risk and benefits of apheresis procedures
5. Donor Hemapheresis (platelets, red cell, granulocytes,plasma)
6. ASFA classification for therapeutic apheresis
7. Indications for therapeutic apheresis and of the appropriate replacement fluids to be used in various situations.
8. Evaluation and preparation of patients for therapeutic apheresis, including discussion with the patient of the risks and benefits associated with apheresis procedures.
9. Evaluating and treating adverse reactions associated with therapeutic apheresis.
10. Specialized methods for therapeutic apheresis(e.g.,photopheresis and immunoadsorption columns).

IX. Quality Assurance (5 Marks)

1. Various regulatory and accrediting agencies.

2. training, certification, licensing, and competency assessment standards for transfusion laboratory professionals, including medical laboratory technicians.
3. comprehensive transfusion laboratory safety policy and program.
4. Documentation in blood centre
5. Levels of documnentation
6. quality assurance, quality management, and process improvement principles in laboratory operation and planning.
7. instrumentation and computerization in a transfusion laboratory
8. risk management in the transfusion laboratory
9. Compare and contrast the various means of performing blood utilization reviews.
10. Explain the logistics required in determining appropriate blood inventory for a geographic region and the process of meeting daily, weekly and monthly collection goals.
11. elements of current good manufacturing practices as they apply to the collection, processing, and storage of all blood components /products
12. Total quality management in transfusion service including premises, personnel, instruments / reagents, biosafety and external /internal quality control.
13. principles of specimen collection (e.g., phlebotomy technique, safety, and specimen tubes) and specimen processing.
14. sources of preanalytical variation and the role of biological variability in laboratory assessment.
15. Development of Standard Operating Procedures (SOP) manual
16. Quality control of
    - Reagents
    - Blood & Components
    - Testing procedures
17. Quality assurance
    - Internal quality assurance (IQA)
    - External quality assurance (EQA)
18. Servicing and calibration of equipment – log book for equipment
19. Medical audit
20. Hospital transfusion committee

21. Good manufacturing practice (GMP)
22. Turnaround time
23. ISO certification
24. Accreditation

X. Indian Blood Transfusion Services (5 Marks)

1. Planning and development of Transfusion Services.
2. Interactions between regional blood centres and hospital based blood services.
3. Organization of Blood Donor services Donor motivation and promoting voluntary blood donation.
4. Organization and functions of blood centre, including quality management programme
5. Organization and function of hospital transfusion services, including issues of appropriateness of transfusion and informed consent.
6. Records and Statistics.
7. Development of forms, labels, records etc.
8. Bio statistics and Health Economics.
9. Inventory management.
10. Medical audits - Blood audits.
11. Accreditation of blood banks

XI. Recent Trends (5 Marks)

- Blood substitutes and hematopoietic agents
- Gene therapy applications to transfusion medicine
- Tissue engineering and regenerative medicine Human tissue allografts
- Chimeric antigen receptor T cells and other immunotherapies
- Disaster Management

  Preparation strategies

  Response
- The Covid 19 Pandemic and Transfusion Medicine

NOTE: It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.