I. HISTORY OF TRANSFUSION MEDICINE
   Scientific landmarks in its development
   Impact of world wars on its development
   Development of PVC bags.

II. SCIENTIFIC BASIS OF TRANSFUSION
   A. Biochemistry & physiology of elements of blood
      2.0 Process of cell production and life span
         2.1 red cells
         2.2 white blood cells
         2.3 platelets

      3.0 Red cells
         3.1 Hemoglobin structure & function
         3.2 Metabolic pathways
         3.3 Membrane structure & function

      4.0 White cells
         4.1 Structure, function & kinetics

      5.0 Platelets
         5.1 Structure, function & kinetics

      6.0 Physiology of hemostasis
         6.1 Role of platelets
         6.2 Coagulation pathways
         6.3 Fibrinolysis
7.0 Hemodynamics of blood flow & volume
8.0 Iron metabolism
9.0 Bilirubin metabolism

B. IMMUNOLOGY
10. Principles of basic immunology
   Antigen, antibody, complement, immunoglobulin
   Antigen antibody reaction
   Lymphocytes in humoral & cellular immunity

11. Role of hybridoma technology in immunohaematology
12. Immunology of transplantation
13. HLA and genetic control of immune response

C. GENETICS
14. Principles of basic genetics
15. Genetics of blood groups
   Phenotype & genotype
   Principles of blood group inheritance
   Population genetics of blood groups

III. ANTIGEN SYSTEMS IN FORMED ELEMENTS OF BLOOD
16. Red cell antigens
17. Leucocyte antigens
18. Platelet antigens

IV. BLOOD COLLECTION, PROCESSING, COMPONENT PREPARATION
A. Management of blood donation
19. Donor recruitment
   Voluntary blood donation systems
Categories of blood donors

Education, awareness & information of prospective donor
Use of Information Technology for donor recruitment
Donor information programmes

20. Acceptability criteria of blood donor
21. Care of blood donor
   Pre donation
   Mid donation
   Post donation
   Prevention & management of complications of blood donation

22. Blood collection
   Anticoagulants & preservatives
   Procedure
   Blood donation camps

B. Blood components
23. Components
   Types
   Methods of preparation
   Indications, dosage & administration
   Leucodepletion
      Various methods
   Quality control

24. Storage of blood & components
   Whole blood
   Red cell concentrate
   Plasma
   Granulocyte
Cryoprecipitate
Stem cells
    peripheral blood stem cell
    cord blood
dendritic cell

25. Plasma fractionation
Viral inactivation
    Single donor
    Pooling
    Newer methods

V. PRE-TRANSFUSION TESTING
26. Compatibility testing
26.1 ABO grouping & Rh typing
26.2 Antibody screening
26.3 Cross matching methods
26.4 Newer methods of cross matching
    26.4.1 Solid phase
    26.4.2 gel technology

27. Screening for transfusion transmitted infections
27.1 Methodology
27.2 Nucleic acid amplification techniques
27.3 Newer emerging pathogens
    27.3.1 Prions
    27.3.2 CJ disease
    27.3.3 Lyme disease
    27.3.4 Others

28. Selection of blood, components & plasma products for transfusion

VI. ADVERSE EFFECTS OF BLOOD TRANSFUSION
29. Clinical presentation, pathophysiology, investigations, management
   Hemolytic transfusion reaction
   Non- Hemolytic transfusion reaction
30. Transfusion transmitted infections
   Bacterial
   Viral
   Parasitic
31. Transfusion associated graft versus host disease
32. Transfusion related acute lung injury
33. Others
   Hemosiderosis
   Volume overload

VII. APHERESIS
34. Technology of apheresis, various equipment & disposables
35. Hemapheresis ( platelets, granulocytes, plasma, stem cells )
   Donor selection
   Procedure
   Complications
36. Therapeutic apheresis
   Indication, procedure & complications
   Plasma exchange, red cell exchange
   Newer methods for immunoadsorption.

VIII. AUTOLOGUOS TRANSFUSION
37. Basic principles, indication & contra indications
   Pre deposit
   Hemodilution
   Intra operative blood salvage including equipment
   Directed donation
IX. ANTENATAL AND NEONATAL TRANSFUSION PRACTISE

38. Pathophysiology, diagnosis & management
   Rh incompatibility
   ABO & other blood group incompatibility

39. Exchange transfusion
   Indications, methodology & complications

40. Neonatal transfusion practice
   Strategies to reduce donor exposure
   Organised donor selection
   Intra uterine transfusion

X. IMMUNOHAEMATOLOGY

41. Classification, diagnosis & management
   Immune hemolytic anemia
   Immune thrombocytopenia
   Immune neutropenia

42. Immunohaematological problems in multi transfused patients

XI. HEMOTHERAPY

43. Pathophysiology, diagnosis & management of anemia
   Anemia
   Iron deficiency anemia
   Megaloblastic anemia
   Aplastic anemia
   Anemia of chronic diseases
   Neonatal anemia
   Hereditary anemia
   Thalassaemia
   Sickle cell anemia
   Enzymopathy
44. Pathophysiology, diagnosis and management of hemostatic disorders
   Hemophilia
   Von Willebrand disease
   Platelet disorders
      Qualitative disorders
      Quantitative disorders
   DIC
   Acquired disorders
   Others
45. Pathophysiology, diagnosis and transfusion support in acute blood loss
   Shock
   Massive transfusion
46. Transfusion support in surgery
   General surgery
   Specialised surgery – Cardiopulmonary bypass
47. Classification, diagnosis & transfusion support in oncology
   Hemopoietic malignancy
   Non-hemopoietic malignancy

XII. TRANSPLANTATION
48. Transfusion support in transplantation
   Stem cell transplantation
      Harvesting
      Cryopreservation
      CD34 counting & quality control
   Bone marrow transplantation
      Harvesting
      Processing
Immunohaematological problems in ABO mismatched BMT
Transfusion support specialized conditions
   Renal transplantation
   Liver transplantation
   Others
49. Irradiation of blood products
   Indications, dosage, adverse effects
50. Tissue banking

XIII. BLOOD SUBSTITUTES AND HEMOPOIETIC AGENTS
51. Crystalloids & colloids
52. Oxygen carrying compounds
53. Use of hematins
54. Hemopoietic growth factors
55. Plasma products

XIV. MEDICOLEGAL CONSIDERATIONS IN TRANSFUSION MEDICINE
56. Ethical and legal considerations pertaining to transfusion practice
57. Identification of blood stains
58. Paternity testing
59. Donor notification & counseling
60. Look back programme
61. Drugs & Cosmetics Act, Accreditation
62. Consumer protection Act
63. Others

XV. TOTAL QUALITY MANAGEMENT
64. Development of Standard Operating Procedures (SOP) manual.
65. Quality control
   Reagents & diagnostic kits
   Instruments
Personnel
Blood & components

66. Quality assurance
   Internal quality control
   External quality control
   Proficiency testing

67. Hospital Transfusion Committee

68. Medical audit

69. Turnaround time

70. ISO certification

XVI. ORGANISATION & MANAGEMENT OF TRANSFUSION SERVICES

71. Organisation & function of blood services & hospital transfusion practice
   Donor recruitment & motivation
   Operation of blood mobile
   Development of transfusion service
   Inventory control
   Development of forms, labels, records, etc.

XVII. BIOSAFETY

72.1 Personnel
72.2 Laboratory
72.3 Equipment
72.4 Sterilization
72.5 Disposal of waste material

XVIII. MODERN BIOLOGICAL TECHNIQUES

73. Principle, methods, relevance in transfusion medicine
   73.1 Western blot
73.2 Polymerase chain reaction
   73.2.1 SSCP
   73.2.2 SSOP

73.3 Dot blot hybridization

73.4 Others – Animal experiments, museum techniques

XIX. AUTOMATION & COMPUTERISATION

  74. Instrumentation
  75. Automated blood group & processing
  76. Automated infectious screening
  77. Use of bar codes
  78. Use of computer
TRAINING PROGRAMME:

The candidates will be rotated through various sections of the Department as under:

A. Blood donor management
   - Donor recruitment & motivation
   - Donor selection
   - Phlebotomy
   - Post donation care of donor
   - Apheresis
     - Donor apheresis
     - Therapeutic plasma exchange
   - Outdoor blood donation camps
   - 5 months

B. Component preparation & quality control
   - Preparation of various components
     - PRBC, FFP, PC, Cryo, Leuco poor
     - Irradiation of blood components
     - Storage & quality control
   - 5 months

C. Transfusion Transmitted infection screening
   - Screening for various markers
     - HIV, HCV, HBsAg, Syphilis
   - Methodology
     - Elisa, spot, rapid, automated analyzer
     - Molecular techniques
   - 5 months

D. Immunohaematology
   - Diagnosis & transfusion support in
     - AIHA
     - PNH
     - Transfusion reaction
     - Antenatal serology
     - Multi transfused patients
     - Secretor status
     - Minor red cell antigen typing
   - 5 months

E. Pretransfusion testing & cross match
   - ABO group & Rh type
   - Du testing, genotype
   - Irregular antibody screening
   - Cross match
   - 5 months
F. Quality control/ computers/ records 2 months

Total 27 months

Training in allied departments:
Students should be sent for training for 9 months including following subjects

**Laboratory areas subjects**:
- Complete hemogram
- Reading peripheral smear
- Coagulation work up
- HLA typing
- Hematological disorders
- Isolation of lymphocytes
- CD4/CD8 counts
- Immunofluorescence
- PBSCT
- Bacterial culture
- Grams staining
- Special molecular techniques

**Clinical Department subjects**:
- Transfusion support for thalassaemia, haemophilia, leukemia
- Transfusion support in transplantation
- Platelet transfusion therapy and its monitoring
- Intraoperative hemodilution
- Use of Cell saver
- Intraoperative Blood salvage
- Fractionation
Examination pattern –

**Theory papers :**

- Paper I – Basic applied aspects related to Transfusion Medicine
- Paper II – Immunohaematology, immunogenetics, applied serology
- Paper III – Blood donor organization, Technology of components, clinical hemotherapy.
- Paper IV – Recent advances & technology.

**Question paper** – 10 questions, no choice.

**Dissertation** – Guidelines as per NBE norms.

**Practical examination pattern for approval –**

A] **Laboratory and clinical skill:** Minimum of 6 exercises *(stations)* covering all aspects of Transfusion Medicine including

- blood donor / apheresis donor selection,
- blood processing,
- component preparation,
- immunohematology,
- antenatal serology
- transfusion reaction management
- quality control of reagents, equipment, components
- coagulation testing,
- basic hematology tests,
- transfusion transmitted infection screening
- stem cell transplantation

shall be given to each candidate. The duration of each exercise shall vary from 30 min to 1 hour. Each exercise or *Station* shall be followed by Viva on the particular exercise.

B] **Clinical case discussion** (6 / candidate)
There shall be minimum 6 Hemotherapy exercise and administrative issues for each candidate. The candidate is required to make his own assessment of the problem and come out with solutions.

C] Spots (minimum 10)

D] Thesis defense

E] Log book discussion

G] Grand Viva Voce

RECOMMENDED BOOKS ON TRANSFUSION MEDICINE

A. BOOKS

1- Blood transfusion in clinical medicine.
2- Transfusion Medicine  

3- Clinical Practice of Transfusion Medicine  

4- Blood transfusion therapy: A problem oriented approach  
   Ed. JAF napier, John Willey & sons, Chichester, 1987

5- Principles of transfusion medicine  
   Ed. EC Rossi, TL simon, GS Moss, William & Wilkins, Tokyo 1991

6- Modern blood banking & transfusion practices.  

7- Transfusion Immunology & Medicine  
   Ed. Carel J van Oss, Marcel Dekker, New York, 1990

8- Blood separation & plasma fractionation  
   Ed. J Robinson, Harris, Willey Liss, New York, 1990

9- Blood groups in man  
   Ed. RR Race, R Singer, Blackwell Scientific Pub, Oxford, 8th edition

10- Applied blood group serology  

11- Practical blood transfusion  
    Ed. DW Huestis, JR Bove, J Case, Little Brown & com, Boston 1987

12- Progress in transfusion medicine  
    Ed. JD Case, Vil I, II, III, Churchill Livingstone, London

13- Blood component therapy in clinical practice  

14- Transfusion Medicine: Recent technological advances  
    Ed K Murawski, F Poetooni, Blackwell Sci Pub, Oxford

15- Clinical Blood Transfusion  
    Ed LA Kay, ER Huehns, Churchill Livingstone, London 1986

16- Blood transfusion (Methods in Hematology, Vol 17 )  

17- Blood transfusion: A conceptual approach
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Ed./Authors</th>
<th>Publisher</th>
<th>Year</th>
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<tbody>
<tr>
<td>18</td>
<td>The Human blood groups</td>
<td>Ed. PH Anderson, CC Thomas</td>
<td>Springfield, USA</td>
<td>1984</td>
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<tr>
<td>20</td>
<td>Transplantation &amp; blood transfusion</td>
<td>Ed. CTS Sibinga, PC Das, G Opel</td>
<td>Martinus Nijhoff Pub, Boston</td>
<td>1985</td>
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<td>21</td>
<td>Future developments in blood banking</td>
<td>Ed. CTS Sibinga, PC Das, TJ Greenwalt</td>
<td>Martinus Nijhoff Pub, Boston</td>
<td>1984</td>
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<tr>
<td>22</td>
<td>Quality assurance in blood banking &amp; its impact.</td>
<td>Ed. CTS Sibinga, PC Das, HF Tassel</td>
<td>Martinus Nijhoff Pub Boston</td>
<td>1984</td>
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<tr>
<td>23</td>
<td>Microbiology in blood transfusion</td>
<td>Ed. JJ Barbara, PSG Wright</td>
<td>Bristol</td>
<td>1983</td>
</tr>
<tr>
<td>24</td>
<td>The human Blood groups</td>
<td>Ed. C Salmon</td>
<td>Year Book Medical Pub, New York</td>
<td>1984</td>
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<tr>
<td>28</td>
<td>Transfusion transmitted infections</td>
<td>Ed. DM Smith, RY Dodd</td>
<td></td>
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<td>29</td>
<td>Blood looss replacement</td>
<td>Ed. M Marshall, T Bird</td>
<td></td>
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<tr>
<td>30</td>
<td>Modern trasfusion therapy</td>
<td>Ed. JP Dutcher</td>
<td>Vol I &amp; II</td>
<td></td>
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<tr>
<td>31</td>
<td>Bone marrow &amp; stem cell processing : A manual of current techniques</td>
<td>Ed. EM Areman, HJ Deeg, RA Sacher</td>
<td>FA Davis PA,</td>
<td>1994</td>
</tr>
</tbody>
</table>
32- Scientific basis of transfusion medicine: Implications for clinical practice
   Ed Anderson, PM Ness, Saunders, 1994

BOOKS FROM AMERICAN ASSOCIATION OF BLOOD BANKS (AABB)

1- Technical manual, ed FK Widman
2- Donor room procedures, ed TS Green, D Steckler
3- Blood transfusion therapy: A physicians handbook, ed EL Snyder, MS Kennedy
4- Accreditation requirement manual, ed RE Klein
5- Standards for blood banks & transfusion service, ed PV Hollan, PJ Schmidt
6- Therapeutic apheresis, ed J Kolins, JM Jones
7- Legal issues in transfusion medicine, ed GM Clark
8- New frontiers in blood banking, ed CH Wallas, LJ McCarthy
9- Autologous transfusion, ed SG Sandler, AJ Slivergleid
10- Autologous transfusion & hemotherapy, ed HF Tasswell, AA Pineda
11- Platelets, ed DM Smith, SH Summers
12- Blood groups system: Rh ed W Tyler, SR Pierce
13- Blood groups system: MN, ed BL Fryer, J Levitt, C Daniel
14- Blood groups system: Duffy, Kidd, Lutheran, ed SR Pierce, CR Macpheroo
15- Computer in blood banks, ed LK Wilson, DM Eliot
16- Competition in blood services, ed GM Clark
17- Educational programmes in transfusion medicine, ed CH Wallas, TL Simon
18- Plasmapheresis, ed Y Nose, J Smith, RS Krakeur

LIST OF JOURNALS

1- Lancet
2- Nature
3- British Medical Journal
4- British Journal of Hematology
5- Blood
6- Journal of clinical pathology
7- American journal of clinical pathology
8- Annals of Hematology
9- American journal of hematology
10- Vox Sanguinis
11- Transfusion
12- Transfusion medicine review
13- Transfusion Medicine
14- Transfusion Science
15- Journal of clinical apheresis
16- Thrombosis & hemostasis
17- Seminars in hematology
18- Seminars in thrombosis & hemostasis
19- European journal of hematology