

## 1. Aero-Science

### B.Sc. Aero Science-I

Total Mark: 100

#### Appendix 'A' (Outlines of Tests)

Aero-Engines : 100 Marks

Note:- The questions will be set in each paper. Candidates are to attempt any five except in Paper B in which the question on Computer will be compulsory.

#### Appendix 'B' (Syllabi and Courses of Reading)

### Aero-Engine

100 Marks

Note: The depth and treatment of the topics given below will conform to the relevant material specially published by the P.A.F. College, Sargodha. The Material is referred to below:

S.No.	Topic	Reference Material Training Notes and Precis.
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### 1. GAS Dynamics:

AENG-B-I

- (a) Continuity Equation—Derivation.
  - (b) Momentum Equation—Derivation.
  - (c) Energy Equation—Derivation.
  - (d) Thrust of a Static Jet Engine—Derivation
  - (e) Thrust of a Moving Jet Engine—Derivation.
  - (f) Thrust of a Turbofan Engine.
  - (g) Engine Performance Parameters
- Definition of:
- (i) Propulsion Efficiency.
  - (ii) Thermal Efficiency.
  - (iii) Propeller Efficiency.
  - (iv) Over-all Efficiency.
- (h) Derivation of Brequet's Range formula and its analysis.
  - (i) Take-Off Thrust.
  - (j) Specific Fuel Consumption.
  - (k) Effective exhaust Velocity.
  - (l) Gross Thrust.
  - (m) Net Thrust.

- (n) T-S diagram of actual and ideal, Turb-jet, Efficiencies of Diffuser, Compressor. Turbine and Nozzle, Pressure Ratios of Diffuser compressor. Combustor.
- (o) Characteristics of subsonic and supersonic flow in venturi tube. (Review).
- (p) Shock wave formation (Review).

**2. Ramjet and Pulsejet:**

AENG-B-II

- (a) Thermodynamic limitations of Turbojet Engine.
- (b) Operation Principle of Ramjet.
- (c) Subsonic Combustion Ramjet.
- (d) Supersonic Combustion Ramjet (Scram Jet).
- (e) Application of Ramjet.
- (f) Operating Principle of Pulsejet.
- (g) Advantages and disadvantages of Pulsejet.

**3. Intakes:**

AENG-B-III

- (a) Introduction.
- (b) Ideal Intake Conditions.
- (c) Flow speed and pressure behind Shockwaves.
- (d) Intake design.
- (e) Intake Shape.
- (f) Types of Intake for Supersonic Flight.
- (g) Problems of Supersonic Intake Design.

**4. Compressors:**

AENG-B-IV

- (a) Introduction.
- (b) Requirements of a Compressor.
- (c) Centrifugal Compressor :
  - (i) Introduction.
  - (ii) Principles of Operation.
  - (iii) Impellers.
  - (iv) Diffuser.
- (d) Axial Flow Compressor.
  - (i) Introduction.
  - (ii) Construction
  - (iii) Principles of Operation.
  - (iv) Compressor Stall and surge (only introduction).

- (e) Comparison of Axial Flow and Centrifugal Flow Compressor Engine
  - (i) Factors.
  - (ii) Material.
- (f) Antistall devices.
- (g) Effects of Stall and Surge.

**5. Combustion Chamber:**

AENG-B-V

- (a) Introduction.
- (b) Combustion system requirements.
- (c) Flow through typical Combustion Chamber
- (d) Combustion System layout.
- (e) Combustion Chamber Material and Defects.
- (f) Burners.

**6. Turbines:**

AENG-B-VI

- (a) Introduction.
- (b) Turbine Blading.
- (c) Energy transfer from Gas Flow to Turbine.
- (d) Vane and Blade profile.
- (e) Turbines operating Conditions.
- (f) Turbine installations.
- (g) Balancing and Testing of Turbines.
- (h) Turbine Faults.

**7. Exhaust System:**

AENG-B-VII

- (a) Introduction.
- (b) The Exhaust Unit
- (c) The Jet Pipe.
- (d) The Nozzle.
- (e) Variable Geometry Nozzle.

**8. Thrust Augmentation:**

AENG-B-VIII

- (a) Introduction.
- (b) Water injection.
- (c) Re-heat.

- (d) Principles of Re-heat:
  - (i) Thrust Production.
  - (ii) Variation of Nozzle area.
  - (iii) Specific Fuel Consumption.
- (e) After Burner Components.
- (f) Re-heat ignition System.
- (g) Re-heat Control.
- (h) Choice of ignition and Control System.

**9. Thrust Reversal:**

AENG-B-IX

- (a) Requirements of Thrust Reversal.
- (b) Layout and Operation of Typical Thrust Reversing System.
- (c) Safety Features.

**10. Turboprop and Turbofan Engines:**

Operating principles and general characteristics.

AENG-B-X

**11. V/Stol Engines:**

AENG-B-X1

- (a) Powerplant Arrangements :
  - (i) Composite Power Plant.
  - (ii) Vectored Thrust.
- (b) Engine Types:
  - (i) Lifting Engines.
  - (ii) Vectored Thrust Engines.
- (c) Advantages of Lift—Thrust Turbofan.
- (d) Large aircraft requirements and Supersonic aircraft requirements.

**12. Gas Turbine Fuels:**

AENG-B-XII

- (a) General Characteristics.
- (b) Vapour pressure.
- (c) Methods of reducing or eliminating fuel losses.
- (d) Aviation turbine fuels, AVTUR-AVTAG-AVCAT.

**13. Rocket Motors:**

AENG-B-XIII

- (a) Rocket performance.
- (b) Solid propellant Rocket Motors.
  - (i) Main Components.
  - (ii) Nozzles and nozzle cooling.

(iii) Thrust vector control.

(c) Liquid propellant Rocket Motor:

(i) Liquid propellant feed systems.

(ii) Combustion chamber and nozzle.

(iii) Liquid Rocket injectors.

(d) Introduction to other propulsion system like Nuclear Rockets and Electrical propulsion Units.

**14. Specific Engine System:**

AENG-B-XIV

(a) Fuel system of MFI—17 Aircraft.

(b) Fuel system of T—37 Aircraft.

(c) Hydraulic system of T—37 Aircraft.