Draft - Proposed revision in 'Red'

GOVERNMENT OF INDIA
OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
OPPOSITE SAFDURJUNG AIRPORT, NEW DELHI

CIVIL AVIATION REQUIREMENTS
SECTION 2- AIRWORTHINESS
SERIES 'E', PART VIII
ISSUE IV, DATED 30th MAY, 2008 **EFFECTIVE: FORTHWITH**

Subject: **Approval of Organizations - Category 'G' - Training Institutes.**

1. INTRODUCTION

1.1 Rule 61 stipulates that for grant of Aircraft Maintenance Engineer's (AME) licence, applicants who have passed a course from DGCA approved institutes will be granted one year relaxation in the total aeronautical maintenance experience required. It is, therefore, necessary that the approved institutes provide a high standard of training to their students. This part of CAR deals with the approval of Training Institutes under Rule 133B, for imparting ab-initio training to students in the field of Aircraft Maintenance Engineering for obtaining Basic licence in the following streams, and prescribes the minimum requirements for grant of approval and its continuity :-

(a) Mechanical stream (Aeroplane and Powerplants) - comprising of Light Aeroplanes (LA), Heavy Aeroplanes (HA), Piston Engine (PE) and Jet Engine (J E).

(b) Mechanical stream (Helicopters and Powerplants) - comprising of Rotary Wing Aircraft (RA), Piston Engine (PE) and Jet Engine (JE).

(c) Avionics stream -- comprising of Electrical System (ES), Instrument System (IS) and Radio Navigation System (RN).

1.2 The period of training in the approved training institute will be counted as maintenance experience for the purpose of computing total aeronautical experience required to become eligible for appearing in the AME licence examinations.

1.3 OBJECTIVES OF TRAINING

The training course in the field of aircraft maintenance engineering should be designed to give the students a comprehensive knowledge of aircraft and its systems, and the good maintenance practices to enable them to become skilled and competent maintenance professionals. The essential instructions must include the following, to enable them to pass the AME licence examination conducted by DGCA.

(i) Knowledge of Aircraft Manual (India), Civil Aviation Requirements, Airworthiness Advisory Circulars etc.

(ii) Theoretical and practical technical knowledge of design, construction, maintenance and operation of aircraft, engines, systems and aircraft materials used in construction of airframes, engines and accessories.

(iii) Knowledge of workshop practices and skill in the use of various equipments, general and special tools used in aircraft maintenance;

(iv) Knowledge of good maintenance practices, human factors and human performance, necessary judgment and competence required to assess the airworthiness of aircraft and its equipment.

2. APPLICABILITY

2.1 From 1st July 2008, all institutes (new and existing) shall meet the requirements of this CAR with regard to number of students admitted and syllabus of the course.

2.2 New institutes seeking approval under Category "G" are required to comply with this CAR with immediate effect.

2.3 Existing DGCA approved training institutes are required to comply with this CAR by 31st December 2008 for provisions with regard to facilities and infrastructure.

3. REQUIREMENTS FOR GRANT OF NOC

3.1 ELIGIBILITY REQUIREMENTS

3.1.1 NOC to AME training Institute can be granted only to:

a) a citizen of India; or

b) a society or trust registered in India; or

c) a company or a body corporate provided that:

i) it is registered and has its principal place of business within India;

ii) its chairman and at least two-thirds of its directors are citizens of India; and,

iii) its substantial ownership and effective control is vested in Indian nationals.

3.1.2 The proposed AME Training Institute should be approved by AICTE for imparting engineering degree in Aeronautical/Mechanical/Electrical/Electronics and Telecommunication branch.

3.2 Procedure for issue of NOC

3.2.1 An application on institute's letter head should be made to DGCA Hdqrs along with the following documents for seeking a date for giving a presentation for grant of NOC.

(a) Certificate from the banker or chartered accountant to confirm that the paid up capital of the AME Training Institute having Scope of approval in

(i) Mechanical stream (Aeroplane and Powerplants) – comprising of Light Aeroplanes (LA), Heavy Aeroplanes (HA), Piston Engine (PE) and Jet Engine (JE) - Rs 3.0 crores.

(ii) Mechanical stream (Helicopters and Powerplants) - comprising of Rotary Wing Arcraft (RA), Piston Engine (PE) and Jet engine (JE) - Rs 3.0 crores.

(iii) Avionics stream - comprising of Electrical System (ES), Instrument System (IS) and Radio Navigation System (RN) - Rs 3.0 crores.

(iv) Institutes desirous to have approval in both Mechanical and Avionics stream must have paid up capital of **Rs 10.0 crores**.

(b) A Detailed Project Report (DPR).

(c) Memorandum of Article of Association/Society or Trust.

(d) The location and size of the facility, the proposed faculty and infrastructure including training aids etc.

(e) Certificate from a local authority that the premises is located in Non-Residential area.

3.2.2 DGCA Hdqrs after the receipt of above documents shall give a date to the institute to give their presentation. The applicant will be required to make a presentation of the project to a committee appointed by the Director General to assess the application. The presentation should include the scope of the approval sought, the location and size of the facility, the proposed faculty and infrastructure including training aids etc. On satisfactory appraisal, an NOC in principle shall be issued to the applicant which will be valid for one year.

3.3 DGCA may require the proposal to be amended or decide not to issue the NOC in principle, if it feels that such proposal is not in interest of Aviation industry or the students.

3.4 The application for the approval of the institute signed by the Accountable Manager, should be submitted, after receipt of NOC to local airworthiness office along with the enclosures as detailed in Annexure I(Form CA-182).

3.5 The application should include a "Training Manual" and a certificate that the institute has complied with all the requirements laid down in this CAR.

3.6 The regional office will carry out inspection to monitor the progress of setting up the necessary infrastructure and will provide necessary guidance to meet the requirements of the CAR. However, a number of inspections may be carried out until satisfactory compliance of requirement is achieved. In case the compliance is not found to be as stated by the applicant, the further conformity inspections may be delayed /deferred to give sufficient time for compliance of regulations.

3.6.1 After satisfactory compliance by Regional office, the report shall be forwarded to Headquarters for further inspection by a team constituted by Dy. Director General (Airworthiness). Thereafter on satisfactory inspection the board may decide if the approval has to be given or not.

4 REQUIREMENTS FOR APPROVAL

4.1 The institute shall comply with the following requirements before approval is granted. Part approval in Mechanical or Avionics stream, semester wise approval or provisional approval shall not be granted.

4.2 A para-wise compliance of this CAR along with the Annexures shall be submitted by the applicant to the local airworthiness office. On receipt of application, the institute will be inspected by representatives of concerned Regional Director of Airworthiness office and DGCA Hqrs. A number of such inspections may be required to confirm the compliance with short comings.

4.3 Personnel Requirements

4.3.1 Accountable Manager :- The organisation shall nominate an accountable manager who has corporate authority for ensuring that all infrastructure and training requirements are financed and carried out to the standards required by this CAR. The accountable manager shall:

(i) ensure that all necessary resources are made available for providing training in accordance with this CAR to support the institute's initial and continued approval; and

(ii) demonstrate a basic understanding of this CAR.

4.3.1.1 In case of absence of Accountable Manager for more than 60 days, the DGCA approval to the Institute is deemed to be suspended till new suitably qualified person nominated by institute is accepted by Regional Director of Airworthiness.

4.3.2 Chief Instructor :- The institute shall nominate suitable persons as Chief Instructor and Deputy Chief Instructor. The nominated persons shall be examined and approved, if found suitable by a duly constituted board. The approval shall be granted by Regional Director of Airworthiness.

4.3.2.1 Qualifications and experience

The Chief Instructor/ Deputy Chief Instructor shall have the following minimum qualification and experience:

(a) Basic licence (BAMEL) in a stream related to the scope of the approval, or Degree in Engineering or equivalent qualification in the field of Aeronautical/ Mechanical/ Electrical/ Electronics/ Instrument engineering. He should also have passed Paper I (Regulations) of AME licence examination.

(b) For Basic licence holders, five years practical experience in aviation industry out of which a minimum two years in the field of instruction. For engineering graduates, two years practical experience in aviation industry out of which a minimum of one year in the field of instruction.

4.3.2.2.1 Chief Instructor and Deputy Chief Instructor(s) should together cover the entire scope of approval.

Note :- Experienced persons already functioning as Chief Instructor/ Dy. Chief Instructor/Instructor may continue to exercise the privileges of their approval.

4.3.2.3 In case of absence of Chief Instructor for more than 30 days, the DGCA approval to the Institute is deemed to be suspended till new suitably qualified person nominated by institute is approved by Regional Director of Airworthiness. During such absence, the accountable manger shall nominate a suitable person to act as C.I.

4.3.2.4 In case Chief Instructor wants to leave the institute, a notice of 45 days has to be given to the institute and a copy to be submitted to the Regional and local Airworthiness office.

4.3.3 Instructors :- The institute will employ adequate number of qualified andexperienced Instructors for imparting both theoretical and practical training to the students. The instructors will be approved by Chief Instructor. In addition to the required compliment of regular instructors, part time instructors may also be employed for imparting training on Engineering Drawing and computers.

4.3.3.1 <u>Qualifications and experience</u>

The Instructors should be knowledgeable and duly qualified to undertake the instruction in the assigned subjects. The institute should have balanced staff of

persons suitably qualified in all subjects listed in the syllabi. The instructors should have an aptitude for teaching and should be patient, enthusiastic and be able to keep discipline.

The instructors should have the following minimum qualifications:

(a) Basic license (BAMEL) in any category, or

Degree in Engineering in Aeronautical/ Mechanical/ Electrical/ Electronics/Instruments engineering, or

Diploma in any of the above disciplines, or

Bachelor of science with Physics, Chemistry and Maths/ Bachelor of science (Electronics)

(b) One years practical/instructional experience for holders of Engineering degree or BAMEL, and three years practical/instructional experience in aviation industry for others.

(c) Instructors assigned to teach paper I (Air Law, Airworthiness Requirements & Human Performance) should have passed paper I of AME licence examination.

(d) Instructors teaching Paper-III subjects should have passed paper-III of the relevant category or have adequate maintenance experience in the relevant category.

4.4 The overall ratio of whole-time instructors to students shall not be less than1:30 per subject. An instructor may teach more than one subjects but not more than two subjects. In general, a training school requires atleast two instructors for each range of subjects to ensure continuity of program in the event one instructor being absent. When circumstances permit the program can be made more interesting by having additional guest lecturers.

Institutes seeking approval in any stream shall employ the minimum instructors per every 30 students enrolled as given below:

Airframe Instructor - 1

Powerplant Instructor - 1

Materials, Workshop Practices Instructor - 1

Electrical, Instrument and Radio Instructor - 1 each

Computer Instructor, drawing instructor - 1 each

Workshop Demonstrators - 3

4.5. Duties and Responsibilities of Chief Instructor

4.5.1 The Chief Instructor shall be responsible for the conduct of training in accordance with the approved Training Manual and shall ensure that all the conditions of approval are complied with.

4.5.2 He shall ensure that appropriately qualified instructors are available in adequate number to cover specific subjects.

4.5.3 He shall ensure that each student admitted for the course possesses minimum qualifications and fulfills the criteria for admission as stipulated in the CAR and the approved training manual. The medical standards of the students as required for an AME shall be ensured.

4.5.4 He shall ensure that the aircraft, engines, items of equipment, mock-ups and other training aids are kept in clean and serviceable condition for demonstration and practical training.

4.5.5 He shall ensure that adequate quantity of reference books are available in the institute library. In addition, he shall ensure that each student is in possession of Aircraft Manual (India), Civil Aviation Requirements and other instructions and amendments thereof, issued by DGCA from time to time. The Chief Instructor shall also ensure that lesson plans and class room notes are prepared and issued to all students on various subjects. He shall also ensure that each student maintains his log book and shall certify the same.

4.5.6 He shall ensure that a high standard of instruction is maintained.

4.5.7 He shall be responsible for setting up question papers, conducting examinations, checking of papers, etc. and to conduct examinations of various semesters in a time bound and fair manner.

4.5.8 He shall ensure that records of proper attendance of each student are maintained.

4.5.9 He shall ensure that permanent record of all students admitted to the course and their progression through the various semesters of the course is maintained.

4.5.10 He shall be responsible for submitting reports on intakes and results of semester examinations to the local airworthiness office.

4.5.11 He shall ensure that all eligible candidates appear in Paper I, II and III of DGCA licence examination, as applicable and shall forward their application to CEO. He shall also issue photo identity card to all candidates issued with the computer number by CEO.

4.5.12 He shall maintain record of each candidate's results of DGCA licence examinations and submit reports to the local Airworthiness office after each session.

4.5.13 He shall make arrangements for on the job training (OJT) for students and monitor the performance of students during their OJT. He shall ensure that the students maintain daily logbooks during this period.

4.5.14 He shall issue the course completion certificate after successful completion of the course including the mandatory OJT.

4.5.15 He shall ensure that security clearance of foreign students is duly obtained through DGCA before admitting them for the course.

4.5.16 He shall ensure that due facilities are provided to DGCA officers for inspection of the institute.

4.6 Requirements:

4.6.1 Facilities and Equipment Requirements:

(a) The institute should preferably have its own premises, or premises taken on long term lease (five years). The institute shall not be established in residential areas. They should be established in areas permitted by the local administrative authorities. For this purpose, an NOC from local administration authority shall be required or a documentary evidence in this case is also acceptable. The existing AME institutes shall shift their location from residential areas by 31st July 2010. A Quarterly progress made in this regard is to be submitted to DGCA Hdqrs.

(b) Adequate number of class rooms for theoretical classes shall be available. For initial approval, at least three class rooms, each properly equipped with training aids must be available.

(c) The class rooms shall be properly lighted, well ventilated, furnished and free from noise. The size of the rooms shall be appropriate to accommodate 30 number of students at a time. As a guideline, each room should be at least of 33 sq.mts area.

(d) The institute should have hangar/adequate covered area to park the Aircraft/Helicopter for demonstration and for performing practical exercises on the aircraft.

(e) The institute shall have well equipped workshops for the training of students in General Engineering and workshop practices. In addition separate areas shall be allotted for demonstrating welding, NDT, sheet metal work, electrical work, composite material repairs etc. (Appendix II).

(f) The institute shall have well equipped workshops in Mechanical and Avionics fields, commensurate with the scope of approval sought. (Appendix II)

(g) Each workshop shall be equipped with tools/equipment, used for General Engineering and for specific jobs.

4.6.2 In the interest of maintaining high instructional standards and for establishing proper rapport between the students and the teacher, the number of students in a batch or class shall not exceed 30.

4.6.3 In one academic year, induction of only two batches per stream is permitted. Each batch shall not have more than 30 students.

4.6.4 Institutes seeking approval in Mechanical stream (Aeroplane and Powerplant) should have at least one pressurized aeroplane fuselage with landing gear and most of the primary instruments and systems functioning. Alternately, the institute should have at least one light all metal/composite aeroplane complete with engine in running condition, instruments, landing gear etc. functioning and detailed mock-ups of all the aircraft systems, preferably replicas of actual aircraft systems are also acceptable. The aeroplane need not have C of A but should have systems in running condition for imparting practical training.

4.6.5 Institutes seeking approval in Mechanical stream (Helicopter and Powerplant), should have at least one helicopter with landing gear and most of the primary instruments and systems functioning. Alternately, the institute should have at least one light Helicopter with engine in running condition with rotor off, instruments, landing gear etc. functioning and a detailed mock up of all the helicopter systems, for ex. functioning of swash plates, collective and cyclic mixing unit etc., preferably replicas of actual helicopter systems are also acceptable. The Helicopter need not have C of A but should have systems in running condition for imparting practical training.

4.6.7 In case an institute seeks approval in Avionics stream, it must possess one pressurized aeroplane or an IFR certified helicopter adequately fitted with avionics, complete with engines running, landing gear and most of the primary instruments and systems functioning. Alternately, the institute should have a detailed mock up of all the aircraft avionics systems, preferably a replicas of Aircraft avionics systems, for ex. actual working of auto pilot and interfacing of the associated instruments/systems, simulation of instruments reading etc., are also acceptable.

4.6.8 Providing OJT to the students in the relevant stream is the responsibility of the organization and a proper system should exist and detailed in the training manual.

4.6.9 The institutes who do not have pressurized aeroplane or Helicopter complete with engines running and intend to provide OJT to the students shall make properly documented arrangements with approved aircraft maintenance organisations for practical demonstration of maintenance of complete aircraft, engines and relevant systems (OJT),. The practical training experience should be as specified in Appendix “V” of this CAR.

4.6.9.1 Institutes having their own aeroplane as required in Para 4.5.5/6/7 (without alternate arrangements) and the Aircraft/Helicopter engines are in running condition may provide OJT as per the scope of approval on the aeroplane owned by them. The students should be able to carry out the maintenance schedules and other checks as called for in AMM. The institutes shall have trained person(s) who should be able to ground run and demonstrate the systems of the aeroplane to the students. These person(s) may not be licensed AMEs or factory trained, but should be fully aware of the ground run up, maintenance and repair procedures to be followed on the aeroplane. The practical

training experience (OJT) should be as specified in Appendix "V" of this CAR.

4.6.10 Existing Institutes who have their own pressurized aircraft as required in Para 4.5.5/6/7 but the engines are not running should have an external power supply to demonstrate the various systems checks on the Aircraft, like fire warning, fuel quantity indications, generator on line, landing Gear extension and retraction, battery charging, warnings etc. These systems checks should be the same as those required before and during ground run procedure. These institutes are not allowed to provide OJT to their students in their premises on Jet engine. These institutes should ensure and give an evidence for their arrangement made with DGCA approved maintenance organizations for imparting OJT on the Jet Engine to all the students enrolled by the institute. In case any of the systems on the aircraft is not working then alternate detailed mock-up of the same system should be made available, till the system on the aircraft is made serviceable.

4.6.11 The institute shall have a library having a stock of books commensurate with the number of students. One set of books per 10 students should be procured by the institute for issue to the students as course text books. Adequate number of suggested reference books should also be made available in the library. The list of books recommended for the training institute is given in Appendix VIII. The Library should be equipped with photocopier and sufficient numbers of computers with access to internet facility for students.

4.6.12 The institute should have OHP and LCD projectors in each class room, for use by the trainees and instructors.

4.6.13 Sufficient training aids, demonstration equipment and study material should be available to facilitate complete comprehension of the instruction given. The detailed requirements are giving in Appendix II, III & IV.

4.7 Institutes desirous to seek approval in any of the Mechanichal stream shall have the following facilities for airframe or helicopter shop to accomplish the maintenance skills

4.7.1 BASIC WORKSHOP AND MAINTENANCE PRACTICES:
Fixed wing/ Rotary wing.

4.7.1.1 Introduction

a) Training in workshop practice should begin with exercises in the use of hand tools to make a series of simple shapes to specified dimensions from various metals. Each shape should be progressively more complicated with more precise tolerances. From the start, instructors should ensure that students develop the habit of handling basic hand or machine tools in the correct manner, and action should be taken to correct any bad or potentially dangerous practices before they become habitual. At all times, and particularly during the early stages of training, the importance of producing accurate and careful work must

be stressed. These exercises can be used to develop the trainees' inspection ability, i.e., the necessary judgment and sense of responsibility required to assess the accuracy of their own work and that of others.

b) The students should have the opportunity to remove and replace major components. Practice in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase.

4.7.1.2 Bench fitting

Cutting and filing: exercises in cutting metal with hacksaws; filing; drilling; drill grinding; thread cutting with taps and dies; and scraping.

Measurements: use of steel rule, dividers, calipers, micrometers, vernier, combination set, surface plate, and dial test indicator.

4.7.1.3 Forging, heat treatment, soldering and welding

Forging and hand simple specimens such as chisels, punches and others
Hardening and tempering carbon steel by using forge
Tin soldering, tin-plating, and use of proper flux
Silver soldering and brazing
Welding: oxyacetylene and metallic arc welding of different materials
Inspection of welded joints for flaws.

Note:- Forging and heat treatment can be out sourced/ or by audio visual demonstartion.

4.7.1.4 Sheet Metal Work

Sheet aluminium alloy: cutting, marking out, drilling, forming, bending, bending allowances, shrinking and flashing.

Forming sheet metal by pressing and rolling.

Riveting: types of rivets, riveting with hand tools, rivet spacing, countersinking and dimpling, use of pneumatic riveting hammer, blind riveting, inspection of rivets, removal of rivets, use of oversized rivet and rivet jackets.

Tube work: use of taper pins and tubular rivets.

Exercises in sheet metal patching and repair work.

Note:- Heat treatment of aluminium alloy and alloy rivets: use of salt baths and furnaces; annealing and solution treatment can be out sourced/ or by audio visual demonstartion.

4.7.1.5 Machine shop

Drilling: using machine drills and drill close tolerance holes in various materials; reaming holes to close tolerances; others

Turning exercise in turning steel, aluminium alloy and brass parts; use of lathe for thread cutting; others

Grinding: use of grinding wheels for tools sharpening

4.7.1.6 Wire and cable work

Inspection of aircraft cables for defects,
Splicing exercises

Swagging exercises: attachment of standard end fittings to flying control cables.

Demonstration of proof test on flying control cable.
Tension adjustment on control cables.

4.7.1.7 Tube work

Tube bending, with or without heat treatment; Tube flaring.
Fitting of different kinds of unions used in fuel, oil and hydraulic systems.
Inspection and testing of tubes and flexible hoses

4.7.1.8 Airframe/Helicopter familiarization

Airframe/helicopter structures: detailed examination of various types of wing and fuselage construction, including primary and secondary structures.

Use of forged, extruded, cast and sheet material.

Main joints: methods of riveting, spot welding, and adhesive bonding.

Doors and cut-outs, positions of inspection panels, removal of fairings, and methods of gaining access to all parts of structure.

Landing gear: examination of system

Flight Control Systems: examination of control system; checking of control surface movements and cable tensions; interconnections of autopilot to control systems; examination (by visiting airline, if

necessary) of power-operated control systems.

4.7.1.9 Ground handling of aircraft/helicopter

Pre-flight inspection with aircraft/helicopter on apron.

Starting and running of engines; observation of instrument readings; function check(s) of electrical components and radios; stopping of engines

Top Overhaul Exercise of Piston Engines

4.7.1.10 Compass swinging demonstration and automatic direction finder (ADF) loop swinging

Use of ground equipment for moving, lifting or servicing aircraft

4.7.1.11 Installation and testing of equipment

Removal replacement, in situ inspection, and function testing

Testing for Pitot, Static leaks

Errors and electrical faults of electrical equipment, instruments, autopilots, communication and navigation equipment as appropriate.

4.7.1.12 Small Aircraft/helicopter

Dismantling of aircraft/helicopter: removal , control surfaces, landing gear, wings/rotor blades, tail plane/tail rotor blades and fin, and seats

Note:- Removal and installation of Engine should be once in six months and demonstrated to all students at-least once.

Inspection: inspection of condition of fuselage alignment checks, freedom from distortion, and symmetry

Checking of wings and other airframe components for condition, and freedom from distortion

Reassembly of aircraft/helicopter: replace wings/rotor blades, empennage, control surfaces, and engine; check rigging angles of wings and tail plane; adjust flying controls and check control surface movements; replace landing gear and check alignment track

4.7.1.13 Wheels and tyres

Complete wheel assemblies: dismantling, inspection (including crack detection of wheels) and reassembly

Inner tubes: puncture repairs

Outer covers: inspection, identification of defects, and spot vulcanizing

Brake units: inspection and salvage of brake pads and discs

Inspection and testing of anti-skid devices

4.7.1.14 Control surfaces

Inspection and repair: repairs to metal-skinned ailerons, elevators and/or rotor blades.

Hinges and actuating mechanisms: inspection, and renewal of ball races.

Correction of mass balance after repair of controls surfaces/rotor blades.

Adjustment of balance tabs, and servo-tabs on aircraft (to correct for hinge moments and flying faults).

4.7.1.15 Multi-engined aircraft/helicopter

Simulated airline check:

Familiarization with maintenance schedule

Performance of sequence of major periodic inspection by the students, including signing of check sheets for each job done and recording of and, if possible, rectification of all defects.

Functional checks after replacement of components, including ground testing of hydraulic system with retraction of landing gear and function testing of electrical system; ground running of engines; weighing of the aircraft and calculation of centre of gravity.

4.7.2 BASIC WORKSHOP AND MAINTEANCNE PRACTICES:

REPAIR, MAINTENNANCE AND FUNCTION TESTING OF AIRCRAFT / HELICOPTER SYSTEMS / COMPONENT

4.7.2.1 Hydraulic systems

Demonstration of hydraulic system rig.

Removal and installation of typical components such as hydraulic pumps, regulators, selectors, control valves, accumulators and

actuators

Removal and examination of control and actuating devices from powered flying control systems.

Removal, examination and recharging of selection of landing gear shock struts, nose-wheel steering mechanisms, anti-shimmy devices and other landing gear components.

4.7.2.2 Pneumatic systems

Demonstration of pneumatic system rig, examination of typical components such as compressors, regulators, selectors and actuators.

Dismantling, reassembly and testing of representative selection of pneumatic components: selectors, thrust reversal rams, and others.

4.7.2.3 Environmental control systems

Demonstration of pressurization system models or rigs.

Removal and examination of selected components such as cabin superchargers, mass flow controllers, cabin pressure controllers, discharge valves and safety valves.

Demonstration and partial dismantling of cabin heating, cooling and humidifying devices. Dismantling, reassembly and testing of selected components.

Familiarization with the servicing and inspection of various types of pressure and mass flow control devices; heat exchangers, combustion heaters and electrical heaters; cold air units (air cycle machines), vapour cycle coolers, cabin temperature sensing and regulating devices; humidifying and dehumidifying equipment; crew and passenger emergency oxygen equipment.

4.7.2.4 Fire Control systems

Inspection, weighing and recharging of fire extinguisher bottles.

Demonstration of fire detection and extinguishing system principles by using simulators, individual components, and operation.

Practice in controlling aircraft and shop fires.

Familiarization with different types of alarm systems, extinguishers and their uses.

4.7.2.5 De-icing systems

Demonstration of rigs and individual de-icing system components.

Dismantling, reassembly and testing of air control devices for mechanical de-icing systems; repairs to inflatable leading-edge overshoes/boots.

Hot air systems: overhaul procedures for combustion heaters, and hot air control valves.

Repair schemes for air-to-air heat exchangers, and mixing valves.

Repair schemes for electrically heated overshoe, and spray-mats.

4.7.2.6 Miscellaneous systems

Demonstrations and inspection of vacuum systems, water/methanol, drinking and washing water systems.

Inspection and tests, as necessary, of fuel system components: cocks, line booster pumps, filters, and refueling valves.

Tests and repairs, as necessary, of safety equipment: inspection of dinghies, life jackets, survival kits, safety belts etc.

4.7.3 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

4.7.3.1 Aircraft/helicopter heavy maintenance check

Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; emptying and inserting fuel tanks, draining oil and other systems; selection and display of equipment; tools required.

Selected major operations: internal inspection of internal tanks; detailed examination of cabin structure followed by pressurization and leak rate test; change of main landing gear.

Adherence of aircraft maintenance manual and a typical airline major check schedule for each job.

Conclusion of Heavy Maintenance Check: replacement of components, function tests, restoration of internal and external finish, weighing and calculation of centre of gravity, preparation for flight test, and completion of documentation. Release to Service.

4.7.3.2 Aircraft or helicopter repair

Selection of repair scheme: damage to be studied and related to approved repair scheme as shown on manufacturers' drawing or structural repair manual (SRM).

Selection of material to be checked for compliance with specification, Embodiment of repairs according to prepared drawings or SRM, Testing to destruction of selected repair specimens to demonstrate strength of repair.

Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or undersized parts; chemical or electro-chemical treatments for the protection of metals; metal depositing processes; special methods of heat treatment; special methods of welding; advanced metal processing techniques, surface texture measurement).

Acceptance tests and final inspection. Completion of documentation.

4.8 The recommended facilities, tools and equipment required to accomplish the maintenance skills as described in Para 4.6 are given in appendix "II"

4.8 Institutes desirous to seek approval in any of the Mechanichal stream shall have the following facilities for ENGINE (Piston & Turbine) Shop to accomplish the maintenance skills

4.8.1 BASIC WORKSHOP AND MAINTENANCE PRACTICES:

ENGINE AND PROPELLER

4.8.1.3 Familiarization

- Practical explanation of the mechanical arrangement of the engines available for work and practice (e.g. 2-stroke and 4-stroke spark ignition and compression ignition engines); air cooled and water-cooled piston engines; piston aero engines for various types; turbojet, turbo-shaft, turbofan and turboprop aero engines; others

4.8.1.4 Initial inspection

- Examination of complete engine and propeller for identification to manufacturers' service publications
- Confirmation of external accessories and features

- Recognition of visible defects

- Ground run of engines (if possible) and recording of performance

- Ensured availability of manuals, workshop tools and equipment

- Identification of safety precautions to be observed

4.8.1.5 Dismantling

- Removal of accessories as appropriate (i.e. starters, generators and electrical equipment, pressure transmitters, transducers, thermocouples, magnetos, carburetors and apark plugs)

- Dismantling of core engine to a specified level according to manufacturers' service publications.

- Complete dismantling of smaller engines; removal of all accessories, manifolds, cylinders, pistons, connecting rods, crankshaft and bearings; cleaning and laying out of these components for inspection.

- Partial dismantling of larger engines; removal of accessories, reduction gear, cylinders, and pistons (without disturbing crankshaft or crankcase.

- Partial dismantling of gas turbines: removal of accessories, jet pipe assembly, and combustion chambers (without disturbing turbine/compressor assembly).

4.8.1.6 Inspection of dismantled engine

- Visual inspection in accordance to manufacturer's service publications.

- Dimensional checks in accordance with procedures given in manufacturers' manuals for deterioration in accordance to manufacturer's service publications on blades, vanes, shafts, bearings, and connecting rods for wear, ovality, twist and distortion.

- Checking of cylinder valves, pistons and piston rings as directed in overhaul manual: checking of fits and clearances; practice on repair schemes, as applicable.

- Non-destructive crack detection: electromagnetic, dye-penetrant, etc. on crankshafts and camshafts.

- Checking for cracks and distortion on exhaust manifolds, jet pipes, and

combustion chamber flame tubes.

- Inspection of gas turbine and turbo-supercharger compressor and turbine assemblies; inspection of blades for deposits, damage and distortion.

4.8.1.7 Repair and reconditioning of engine parts

- Repairs by machining and grinding; checks for fits and clearances; fitting of oversized and undersized parts.

- Castings: checks and rectification and cracks, porosity and corrosion.

- Rigid and flexible pipes and hoses: testing and reconditioning.

- Inspection and repair of gears, accessory drives, and torque mature components.

- Welding repairs to nickel alloy components. (e.g. jet pipes)

4.8.1.8 Reassembly

- Rebuilding of totally or partially dismantled engines (with particular attention to be paid to cleanliness, correct torquing and safety, correctness of working clearances, and accuracy of valve and ignition timing).

4.8.1.9 Engine test bed running and fault finding

- Installation of engine on test bed, checking of instrumentation, control runs, and fuel supplies.

- Fan testing of piston engines; calibration of test fan for test site, and engine type.

- Full “after overhaul” test programme as specified in the manufacturer’s approved test schedule, using a method appropriate to the type of engine: initial test, strip inspection, reassembly and final test.

- Interpretation of engine performance based on test results.

- Experience in starting, running and ground testing of aero engines.

- Inspection of power plant installed in aircraft.

- Fault finding and rectification.

4.8.1.10 Aircraft/Helicopter installation

- Preparation of power plant for installation in aircraft/helicopter: functional checks on controls and interconnections.
- Flow tests of fuel system.
- Checks on pyrametry and on fire warning system.
- Checks on engine bearers and alignment, Slinging and installation of powerplant.
- Ground running tests after installation.

4.8.1.11 Storage and transit of engines

- Protection against corrosion.
- Engine stands, crating, lifting and tie-down points, Storage bags/covers and use of desiccant.
- Preparation of engines for running after long-term storage.

4.8.1.12 Propeller maintenance tasks

- Practice in removal and replacement of propellers on engine propeller shaft.
- Dismantling and inspection of typical variable pitch propeller.
- Checking of blades and blade root bearings for damage and permissible repairs.
- Reassembly, resetting of blade angles, Blade torque loadings, static balance of propeller, and inspection.

4.8.2 BASIC WORKSHOP AND MAINTENANCE PRACTICES: ENGINE/ PROPELLER SYSTEMS/COMPONENTS AND FUNCTION TESTING

4.8.2.1 Components: Ignition

- Dismantling, reassembly and testing of various kinds of magnetos and distributors.
- Renewal of cables in an ignition harness.

- Continuity and insulation tests.

- Cleaning and testing of spark plugs.

- Inspection and testing of igniter equipment and turbine engines.

- Safety precautions associated with ignition equipment.

4.8.2.2 Components: Fuel and control

- Float and injection carburetors: partial dismantling and inspection; reassembly and flow tests; others.

- Propeller control devices, governors and feathering pumps: partial dismantling, reassembly and bench tests.

- Fuel pumps, oil pumps, oil coolers, gearboxes, flow, pressure and other tests as specified in manufacturer's manuals.

- Gas turbine fuel system components: pumps, pressure and flow control units, metering devices, automatic valves, and burners; partial dismantling to view and understand mechanism; reassembly testing; others.

4.8.3 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

4.8.3.1 Heavy maintenance check or overhaul of engine/propeller

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; draining oil and other systems; selection and display of equipment; tools required.

- Selected major operations (e.g. turbine blade inspection either by dismantling or by optical probe techniques)

- Adherence to the aircraft maintenance manual and to a typical airline check or overhaul schedule for each job.

- Conclusion of Heavy Maintenance Check or overhaul: replacement of components, function test, restoration of internal and external finish, preparation for engine run, and completion of documentation.

4.8.3.2 Engine/propeller repair

- Selection of repair scheme : damage to be studied and related to

approved repair scheme as show on manufacturers' drawings or repair manual, Selection of material to be checked for compliance with specification.

- Embodiment of repairs according to prepared drawings or repair manual.

- Testing to destruction of selected repair specimens to demonstrate strength of repair

- Experience in workshop processes as applicable to repair and reconditioning of aircraft parts (e.g. enlargement or reduction of dimensions to accept oversized or undersized parts; chemical or electrochemical treatments for the protection of metals; metal depositing process; special methods of heat treatment; special methods of welding; advanced metal processing techniques; surface texture measurement).

- Acceptance tests and final inspection engine run; Completion of documentation.

4.9 The recommended facilities, tools and equipment required to accomplish the maintenance skills as described in Para 4.8 are given in appendix "III"

4.10 Institutes desirous to seek approval in Avionics stream shall have the following facilities for AVIONICS (ELECTRICAL, INSTRUMENT, RADIO) Shop to accomplish the maintenance skills

ELECTRICAL

4.10.1 Lead acid batteries

- Checking of battery condition, adjustment of specific gravity of electrolyte, battery charging practice; capacity, discharge and insulation test; others

- Overhaul procedures, including leak test of cells and cell replacement, Safety precautions

4.10.2 Nickel cadmium batteries

- Checking of battery condition: determining state of charge, cell balancing, charging, etc.

- Checking of electrolyte level and insulation tests.

- Safety precautions.

- Cell replacement.

- Deep cycling of nickel cadmium units.

4.10.3 Wire and cable work

- Making up of wire lengths and specimen cable looms: soldering and crimping ends, identification of cables, using routing charts, and fitting plugs and sockets.

- Cable tracing practice: continuity and insulation checks on cable runs.

- Practice in aircraft wiring as carried out during modification or repair work: full tests of circuit.

4.10.4 Bonding, continuity and insulation testing

- Bonding checks: use of bonding tester.

- Continuity and insulation tests on aircraft circuit; use of Megger testers.

- Millivolt drop checks at cable joints and terminal ends.

4.10.5 Generators and electric motors

- Dismantling, examination and reassembly

- Demonstration of generator test

4.10.6 Voltage regulators, cut-outs and relays

- Partial dismantling, followed by examination and reassembly, of carbon pile and other types of voltage regulators

- Dismantling, examination and reassembly of accumulator cut-outs, reverse current relays, solenoids and relays from various circuits, and thermal circuit breakers

4.10.7 Generators and alternators

- Strip inspection: undercutting of commutators, checks for brush wear, brush spring loading and brush bedding

- Testing of generator elements: armature testing, continuity tests on field coils, armature shaft alignment, and wear of ball races and housings

- Reassembly and insulation test of generator

- Testing of generators and alternators on test rig

- Voltage regulators: overhaul procedure, correction of basic setting and adjustments making

- Adjustment and rig testing of cut-outs and relays

- Current balancing adjustments of DC power circuits on simulator of multi-engined aircraft electrical system

- Electromagnatic relays: inspection and polishing of contacts, setting and adjustment, and millivolt drop tests on test rig

- Constant speed drivers (CSD): removal from alternator and testing

- Integrated drive generator (IDG): dismantling, inspection, and overhaul

4.10.8 Electric motors

- Starters motors for piston and turbine aero engines: dismantling, examination for condition and wear, check for brush gear and commutator, check of clutches and geared drives;

- Dismantling, inspection, reassembly and test of motors for fuel line pumps, hydraulics, propeller feathering, and windscreen wipers

- Linear and rotary actuators; dismantling, reassembly, and bench testing

4.10.9 Inverters and converters

- Rotary inverters and converters: dismantling and check for brushes and commutators, cleaning and testing of armature, and reassembly and adjustment

- Testing: checking for inputs and output voltages; adjustment of frequency control

- Static inverters and converters: inspection, adjustment and testing of output voltage and frequency

4.10.10 Equipment

- Magnetos: overhaul and test procedure for high and low tension systems
- Spark/igniter plug testing, ignition lead testing and inspection, and booster coil testing
- Engine high-energy ignition units: overhaul and test procedure
- Safety precautions

4.10.11 Electrical circuit equipment

- Examination and partial overhaul of a wide range of miscellaneous electrical components such as transducers, magnetic amplifiers, rectifiers, transformers, Wheatstone bridge and other balancing devices, and sensing elements
- Adherence of all testing in accordance with manufacturers' instructions
- Dismantling (as appropriate), examination and reassembly of electrical components, including converters, inverters, switchgears, heating units, and actuators

4.11 INSTRUMENTS

4.11.1 Pressure indication

- Mechanically-operated gauges (e.g. Bourdontube gauges): partial dismantling, examination, strip inspection, reassembly and calibration with deal weight tester
- Pressure transducers, electrically-operated transmitters, ratio metres, etc.: strip inspection, reassembly and calibration
- Electrically-operated gauges: strip inspection, reassembly and calibration

4.11.2 Flight instruments

- Calibration checks of flight instruments
- Pitot heads and static vents: maintenance checks

- Altimeters: dismantling, inspection, reassembly and calibration checks

- Air speed indicators (ASI): dismantling, inspection reassembly and calibration checks

- Machmeters: dismantling, inspection, reassembly and calibration checks

- Rate-of-climb indicators: dismantling, inspection, reassembly and calibration checks.

4.11.3 Gyroscopic instruments

- Air-driven gyroscopic instruments: partial dismantling, examination and reassembly

- Electrically-driven gyroscopic instruments: partial dismantling, examination and reassembly

- Artificial horizon: dismantling, inspection and reassembly

- Directional gyro: dismantling, inspection and reassembly

- Turn and bank indicator: dismantling, inspection and reassembly

- Calibration checks on gyroscope test turntable

4.11.4 Engine speed indication (ESI)

- ESI generators (DC and AC types): partial dismantling, inspection and reassembly

- ESI gauges: partial dismantling, inspection and reassembly

- Engine speed synchronizing gear: examination and demonstration and principles

- Generators and gauges: dismantling, inspection, reassembly and calibration checks

4.11.5 Thermometers and temperature indication

- Engine temperature thermocouples: demonstration of cylinder head, jet-pipe temperature and other types

- Radiometer temperature gauges: partial dismantling, examination and reassembly of transmitter and indicator units.

- Dismantling, reassembly and testing of temperature, and measuring instruments of various kinds

- Tests on various kinds of temperature sensing units (e.g. fire and overheating detectors, cabin air-duct stats, and inching controls for cooler shtters)

- Use of portable test kits for checking gas turbine powerplant thermocouple installations

4.11.6 Fuel contents indication

- Float-operated desynn contents gauges : examination and demonstration of operation dismantling, inspection, reassembly and test

- Capacitance type contents gauges: examination and demonstration of operation reassembly and test.

- Flowmeters: dismantling, inspection, reassembly and test.

4.11.7 Compass systems

- Magnetic compasses: friction and damping tests, practice compass swing, and compensation.

- Remote compass: examination and demonstration.

- Tests of compass swinging site.

- Swing of compass in available aircraft: compensation practice.

- Remote compass: partial dismantling, inspection, reassembly and test.

4.11.8 Miscellaneous instruments

- Examination and demonstration of other types of instruments (flowmeters, navigation and landing aid presentations).

4.12 AUTOFLIGHT

4.12.1 Autopilots

- Examination and demonstration of autopilot mock-up and components

4.12.2 Flight control systems

- Autopilots (electrical or electronic): dismantling, examination of components, reassembly, and installation in aircraft or on simulator by following manufacturer's test programme; practice with portable test kit.

- Autopilots (pneumatic or hydraulic actuation): dismantling of component parts, reassembly, installation in aircraft or simulator, and function tests.

- Examination and testing of elements of flight director systems, automatic flare and automatic landing systems, as required.

4.13 RADIO

4.13.1 Radio workshop: fundamental techniques

- Safety precautions associated with radio equipment hazards: high voltages, radio frequency (RF) emissions and microwave emissions, electrostatic discharge, etc.

- Wiring and cabling: demonstration and practice in wiring and soldering radio circuits.

- Multimeters, Megger and bonding testers: demonstrations and practice.

- Identification and inspection of antenna: external wire aerials, blade, rod and rail aerials, D/F loops, and suppressed aerials; viewing on aircraft, and inspection for physical condition.

- Aerial masts, static dischargers, etc.: inspection and servicing.

- Chassis: sheet metalwork using drawings.

- Simple receiver assembly kit: study of circuit, demonstration of assembly, operation and testing.

- Measurements and experiments with circuit demonstration units

simulating the following system elements;

- TRF receiver
- Intermediate frequency amplifier
- Frequency converter
- Superheterodyne alignment
- Buffer-doubler amplifier
- RF amplifier
- Modulation
- Transmission lines
- Reactance tube modulators
- Interference (filtering and shielding)

- Troubleshooting practice

4.13.2 Demonstration of test procedures on airborne equipment

- Identification: identity and location of principal types of airborne communication and navigation equipment: racking systems, power supplies, antennae and other interconnections.

- Demonstrations of bench tests on sample equipment, including use of screened rooms.

4.13.3 Wiring, cabling and soldering techniques

- Wiring: practice in stripping insulation; splicing; wiring to lugs; terminals and tube sockets; and dismantling, soldering and reassembly of connectors.

- Cables: lacing of wires to form a cable, termination and soldering of cable ends, and serving of coaxial cables.

- Soldering: practice with different sizes of soldering irons, different grades of solder, fluxes and types of connectors.

- Microminiature precision soldering techniques.

- Handling of electrostatic sensitive devices.

4.13.4 Instrumentation

- Multimeter: practice in measuring and calculating series and parallel resistance; voltage and current measurements on various circuits; others.

- Megger: continuity and insulation tests on aircraft cable assemblies structure; practice with circuit boards; others.

- Simple valve voltmeter.

- Frequency metres, absorption and beterodyne: practice in frequency measurement.

- "Q" metres: practice in measuring L, R, C and Q

- Signal generators: demonstration of cathode ray oscilloscope; demonstration of use of examine wave-forms, wave envelopes, and DC measurements.

4.13.5 Antennae

- External wire aerials: splicing, tensioning and making connections

- Static dischargers: inspection servicing and renewal procedures

- Fiberglass and resin laminate aerial masts: maintenance and repair of dielectric covers.

- DF loops: inspection, routine maintenance, ground calibration, and preparation of correction chart.

- Reflectors and directors: care and maintenance.

4.14 REPAIR, MAINTENANCE AND FUNCTION TESTING OF AIRCRAFT SYSTEMS/COMPONENT: AVIONICS

4.14.1 Airborne and test equipment practice

- Use of representative airborne radio and radar equipment and practice in servicing, installation and overhaul according to procedures laid down in the manufacturers' approved manuals.

- Removal and replacement of equipment from aircraft racks, checks on power supplies, and remote controls.

- Routine maintenance inspections of equipment in situ.

- Operational checks.

- Bench tests, measurement of performance characteristics, tuning adjusting, fault finding, aligning and repairing.

- Understanding and use of remote specialist communications, navigation and radio test equipment for both ramp and workshop.

- Understanding and use of system built-in test equipment (BITE), including comprehension of output data.

- Power supplies, installation and wiring, signal tracing and use of cathode ray oscilloscope (CRO).

- Audio amplifier, installation and wiring, fault tracing and rectification.

4.15 JOB/TASK DOCUMENTATION AND CONTROL PRACTICES

4.15.1 Aircraft heavy maintenance check: Avionics

- Preparation for Heavy Maintenance Check: documentation (task/job cards), logbooks, defect records, modification instructions; selection and display of equipment; tools required.

- Selected heavy maintenance operations.

- Compliance to the aircraft maintenance manual and typical airline major check schedule for each job.

- Conclusion of Heavy Maintenance Check: replacement of components; function tests; preparation for flight test completion of documentation.

4.15.2 Aircraft repair or modification: Avionics

- Selection of repair scheme or modifications: damage to be studied and related to approved repair scheme as shown on manufacturers' drawings

- Selection of material (to be checked for compliance with specification).

- Embodiment or repairs according to prepared drawings or manufacturers' manuals.

- Testing to destruction of selected repair specimens to demonstrate strength of repair.

- Experience in workshop processes as applicable to testing, repair and reconditioning of aircraft parts.

- Acceptance tests and final inspection.

- Completion of documentation.

4.16 The recommended facilities, tools and equipment required to accomplish the maintenance skills as described in Para 4.10 for AVIONICS (ELECTRICAL, INSTRUMENT, RADIO) are given in **Appendix "IV"**

4.17 **On-Job Practical Training**

4.17.1 For completion of the course, six months On the Job Training (OJT) shall be mandatory. This six months OJT may be given in a continuous period or may be divided into two segments of three months each. For imparting practical training on aircraft maintenance to the trainees, facilities acceptable to DGCA and as specified in Appendix V must exist.

4.17.2 The institutes shall make suitable arrangements with DGCA approved maintenance organisations having an airworthy and operating aircraft/engine/relevant system engaged in major maintenance for practical on the job training at the end of the course.

4.17.3 Institutes(new/existing) having their own aircraft as required in Para 4.5.5/6/7 (without alternate arrangements) may give OJT, on the aeroplane /helicopter owned by them. The students should be able to carry out the maintenance schedules and other checks as called for in the AMM. The institutes shall have trained person(s) who should be able to ground run and demonstrate the systems of the aircraft to the students. These person(s) may not be licenced AMEs or factory trained, but should be fully aware of the ground run up, maintenance and repair procedures to be followed on the type of aircraft possessed by the institute. The institutes shall ensure that all safety precautions and standard maintenance practices are followed and requirements spelt out in Appendix VIII are fulfilled in toto.

5. Preparation of Training Manual

The institute shall prepare a Training Manual detailing the training policy and procedures which will be approved by DGCA. The Training Manual should contain the information given in Appendix VII for reference. The Training manual contents in no case shall override the CAR/Aircraft Rules and instructions issued by DGCA from time to time.

6. QUALIFICATIONS FOR ADMISSION

61 For AME training course, the candidates shall have passed minimum 10+2 class with aggregate of 50% marks in Physics and Mathematics;
or
a three years diploma in engineering;
or
a higher qualification in science with Physics and Mathematics.
Institutes are encouraged to lay down their own higher standards for admission.

6.2 The trainees shall be subjected to a medical examination before they are admitted to the training institute by a doctor possessing at least an MBBS degree. Candidates shall not have any physical disabilities or colour blindness, which may interfere in discharging the duties as an AME. (Refer CAR, SEC 2, Series L Part VIII)

7. PERIOD OF TRAINING

7.1 The period of training in the approved institute will be counted for the purpose of computing total aeronautical maintenance experience required for becoming eligible for appearing in the AME licence written examination.

7.2 The minimum duration of the training for various streams shall be as follows:

(a) "LA, PE, HA & JE" Mechanical stream – Aeroplane and Powerplant
Three years including six months OJT

(b) "RA, JE & PE" Mechanical stream – Helicopter and Powerplant
Three years including six months OJT

(c) "ES, IS & RN" Avionics stream-
Three years including six months OJT

7.2.1 Institutes may at their discretion increase the duration of the course before commencement of the batch, in order to cover the prescribed syllabus with additional thoroughness. This procedure shall be documented in the training manual approved by DGCA.

7.2.2 No Objection Certificate (NOC) is not required from Director General of Civil Aviation, In case a student wants to migrate from one institute to another.

7.3 All semesters in training institute shall contain both theoretical and practical classes in equal proportion. The period assigned for OJT shall be exclusively practical oriented.

7.4 During the entire period of training, each student shall maintain a log book indicating the practical training he has undergone. The log book shall be signed by an instructor of the institute or the QCM of the organisation where he has undergone the practical training.

7.5 The courses shall start in the month of July each year to ensure that the students are eligible for the October examination session of the following year. The list of admitted students in a batch should be forwarded to CEO, latest by first week of September, for allotment of Computer number to the students.

7.6 The number of students in each batch shall commensurate with the infrastructure available and shall not exceed 30. However, no institute shall have more than two batches in each stream, in an academic year.

7.7 During any semester the practical training shall not be normally less than 50% of total training time. Any variation in period or scope of training will have prior approval of DGCA.

7.8 Institutes should up grade their facilities with induction of new batches.

8. SEMESTER EXAMINATIONS

8.1 After completing each semester the candidate shall be subjected to an examination. Before a candidate is allowed to appear for the examination, he should have been present for at least 80% of the training period. The examination shall be conducted semester-wise every six months.

8.2 Examination papers shall be set, invigilated and checked by competent examiners designated by the Chief Instructor. Examinations shall be held at the end of each semester.

8.3 The examination papers shall be combination of quiz-type and essay-type questions.

8.4 Candidates who are successful in the semester examination shall be issued with a mark sheet by the institute giving details of the marks obtained in each subject. After successful completion of the course including OJT, the institute shall award a certificate, the format of which will be approved by DGCA. A sample of certificate is annexed in Appendix VI.

8.5 DGCA representatives may at their discretion associate with the examination to ensure that the standard of questions and fair examination practices are followed.

8.6 To be declared successful in the course, the candidates must obtain a minimum 70% in each paper of semester examinations conducted by the institute.

8.7 Candidates may be promoted to the next semester after completion of previous semester(s). Candidates who are not successful in passing some subjects of a semester may be re-examined for those subject(s) until they pass the complete semester. For such students the application must be forwarded for DGCA AME licence examination only after he has successfully passed the required semester examinations.

8.8 The syllabus for various semesters of the Basic licence course shall be drafted to cover various modules of DGCA licensing system as given in Appendix VI.

9. AME licence examination conducted by DGCA

91 AME licence examinations are conducted by DGCA three times in a calendar year i.e., in the months of February, June and October. The eligibility criteria for appearing in DGCAAME licence examinations shall be as given below

(i) The students who have completed one year of approved training curriculum and successfully passed 1st and 2nd semester of the institute examination shall be allowed to appear in Paper I (Air Law, Airworthiness Requirements & Human Performance) or equivalent modules of AME/basic license examination.

(ii) The students who have completed two years of approved training curriculum and successfully passed 3rd and 4th semester of the institute examination shall be allowed to appear in Paper II (Aircraft Engineering) or equivalent modules of AME/basic license examination.

(i) The students who have completed two and a half years of the approved training curriculum and successfully passed 5th semester of the institute examination will be allowed to appear in Paper III or equivalent modules of AME/ basic license examination. A student will be allowed to appear for a maximum of two categories or equivalent modules of AME/ basic license examination in a session.

(ii) The students may appear in the remaining categories of relevant stream after successfully undergoing OJT.

10. Training Records

10.1 Student Record

The Chief Instructor shall ensure that a file is maintained for each student, wherein the following records shall be preserved on permanent basis:

(a) The name and address and photograph of the student.

(b) The batch and the stream in which the student is admitted.

(c) The commencement and conclusion dates of the course.

(d) Copies of certificates of the education qualifications – and medical record.

(e) Attendance records of students.

(f) Record of all practical tests/skill tests.

(g) Computer number of the students allotted by CEO.

(h) Semester wise performance and examination records.

(i) A photocopy of the identity card issued to the students by the institute.

(j) The duration and details of experience and OJT since induction.

(k) A copy of final certificate issued by the institute.

(l) The security clearance of the student, if applicable.

10.2 Institute Records

The following records shall be maintained for a period of five years after the completion of course.

(a) The records of the employment of the instructor subject wise.

(b) Question papers and answer sheets of each student semester wise.

(c) List of the computer numbers allotted to the students by CEO batch wise.

(d) List of DGCA approved organizations having tie up with the institute to provide OJT.

(e) List of organizations having tie up with the institute to provide some elements of practical training as permitted by CAR.

(f) Paper-wise performance of the students in DGCA licence examination.

11. GRANT OF APPROVAL

11.1 Upon satisfactory compliance with the requirements given in this CAR and any other instructions issued by DGCA from time to time, a Certificate of Approval will be issued to the institute. Normally the validity of approval granted to the institute will be for one calendar year. The certificate should be displayed at prominent place and a copy kept in the training manual.

11.2 The approval granted to an institute shall be deemed to be suspended if, at any time, it is found that the institute does not meet the requirements stipulated above. In such case, the institute should immediately intimate the local airworthiness office and submit an action plan to ensure compliance with the requirements. In such case the total period/duration of the course will be extended by the period the approval remain suspended.

11.3 The certificate shall be surrendered when the institute is no longer approved.

11.4 The institute shall carry out an internal audit of their facilities and submit a report to local airworthiness office at least two months before the expiry of the approval. The local airworthiness office shall also conduct an inspection of the facilities of the institute to ensure compliance with this CAR before effecting renewal of the approval.

11.5 The institute shall have a dedicated website in which it will publish information about the scope of DGCA approval, admission policy, infrastructure available, chargeable fees, course duration, OJT and various other terms and conditions. The website shall be kept updated to provide correct information to the student at all times.

11.6 Whenever AME Institute publish / advertise their admission related information for AME course, they should not mix it with B.Tech Degree course or any other degree / Diploma course, in case the institute is also approved by some other University / Technical Board /Institute for such course. Further, it is reiterated that in case any AME institute is propagating false information to the public through newspaper, notices or by any other means, it will not be allowed to take further intake of fresh batch of AME students and in due course, approval will be withdrawn.

12. CONTINUANCE / RENEWAL OF APPROVAL

12.1 Facilities, human resources, training and examination standards shall be maintained at standards not lower than those originally approved.

12.2 The institute shall carry out an internal audit of their facilities and submit a report to local airworthiness office at least two months before the expiry of the approval. The local airworthiness office shall also conduct an inspection of the facilities of the institute to ensure compliance with this CAR before effecting renewal of the approval.

12.3 For renewal of Approval of AME Training Institute , the Accountable Manager shall provide Lease Agreement showing, the validity of lease of premises as per the law for the period of renewal being sought by the institute in case the premises has been on lease.

12.4 Prior written permission shall be obtained from the Director General of Civil Aviation in respect of any material changes in the organization or shifting of premises from one location to another. In case of change of location, the institute will be liable to establish all the facilities required as per this CAR at new location and seek fresh approval.

12.5 Facilities shall be offered to the representatives of DGCA to inspect the institute or attend any course for the purpose of monitoring the standard of training. A minimum of two months prior information shall be given to the Director General of Civil Aviation whenever new courses are started or existing approved courses are modified. DGCA may require any amendment to the content or duration of course.

12.6 The institutes which consistently show results less then 10% in terms of number of candidates passing in the DGCA licence examination, in consecutive three sessions, shall not be allowed to intake fresh batches of students until the percentage of their candidates passing the DGCA licence examination improves. The results of such training schools shall be made public and placed on DGCA.

(K Gohain)
Director General of Civil Aviation

APPENDIX 'I'

FORM CA-1 82 (Training institutes)

OFFICE OF THE DIRECTOR GENERAL OF CIVIL AVIATION
TECHNICAL CENTRE ,OPPOSITE SAFDARJUNG AIRPORT,NEW DELHI

(Application for approval of training institute)

1. Name and Address of the institute :
2. Category(s) for which Approval is required : "G"
3. Brief Details of the nature of training for which approval is sought :
4. Location of the institute :
5. Number of employees (inclusive of instructors and inspection staff) :
6. Name and qualifications of Chief Instructor and instructors :
7. List of Inspection equipment (including special equipment available)
8. Existing DGCA authority, if any :
9. Para-wise compliance report signed by accountable Manager :
10. Whether a Training Manual of the institute is attached (write Yes or No)
11. Details of Fees remitted

Date :

(Signature of the applicant)

Note : Extra sheets may be attached to furnish additional information, if any.

APPENDIX 'II'

PRACTICAL MAINTANCE SKILLS: AIRFRAME --- FACILITIES, TOOLS AND EQUIPMENT

This appendix provides guidance for the kind of facilities, tools and equipment that are likely to be needed to meet the Training Objective of Para 4.6.

1. METALWORK AND SHEET METAL WORK WITH HAND TOOLS

1.1 For basic skills training, the training workshop should be equipped with sturdy benches mounted with vices at approximately 2-m intervals, one vice per student. Other items required include:

a) powered grinding wheel for tool sharpening
b) powered drilling machine
c) large surface table for precision marking–off
d) Compressor air supply suitable for use with pneumatic hand tools
e) Powered hacksaw for cutting stock material
f) Sheet metal guillotine
g) Chalkboard / whiteboard for workshop instruction and work schedule

1.2 For airframe/helicopter skills training, the workshop should ideally include the following:

a) A complete pressurized aircraft of all-metal construction with retractable landing gear, complete with engines in running order, and suitable for practicing repair and inspection duties
b) Hydraulic lifting jacks, trestles, fuselage cradles, lifting slings, cables and steering bars, dihedral and incidence boards, and work and tools suitable for aircraft types provided
c) Desk for manuals and notices
d) Display board for inspection worksheets
e) Ground electrical power trolley
f) Apron–type fire extinguisher trolley
g) Hangar access equipment such as benches, trestles, ladders, chocks.
h) Mobile lifting equipment, i.e. small crane or overhead gantry
i) Spray guns for aircraft paint and dope
j) Oil and fuel replenishing browsers
k) Cable swaging machine
l) Mobile hydraulic test trolley
m) Landing gear oleo cylinders and retraction jacks, and wheel and brake units
n) Hydraulic pumps (both fixed and variables delivery)
o) Flying control surface hydraulic actuators
p) Flap / slat drive motors gearboxes and screw jacks
q) Airflow control valves and actuators.
r) Air cycle machines (cold air units)
s) Flying control pulley, lever assemblies, tensioners and spring tab units

t) Seat and safety equipment

1.3 Personal tool kit. Students should have their own tools and a toolbox. This may be issued on a shop basis, i.e. a kit issued in the basic metalwork shop and be retained by the shop when the students progress to the next phase, or students may be issued, and retain on a permanent basis, a personal basic kit which is their own property until completion of their training. Some schools may require students to purchase their own tools their kit becoming more complete as their training advance. The following items are suggested for basis metalwork.

a) Measuring and marking-off tools

- 30-cm steel rule graduated in fractions of inches and millimeters
- Outside and inside calipers
- Try square
- Set of feeler gauges
- 15-cm dividers
- Scriber

b) Fitter's tools

- Round-nose and side-cutter pliers
- 15-cm long screwdriver
- Hacksaw
- Selection of files of different sections, lengths and cuts
- Hand drill and a set of small diameter drills
- Set of center and and pin punches - Ball-pen and cross pane hammers - 20-cm flat chisel and a sey of small chisels (including flat , cross cut and round nose)
- plastic or hide- faced hammer
- sheet metal snips
- various sizes and types of screw drivers
- set of double – ended , open ended and ring spanners of appropriate range in sizes and appropriate type (American, BSF, Unified , or Metric) to suit available airframes
- set of sockets wrenches with handles and accessories to suit available airframes

2 METALWORK WITH MACHINE TOOLS

2.1 Workshop equipment : It is not important for AMEs to acquire a high degree of skill as machine tool craftsman but they should understand the principles of turning, screw cutting etc. For this reason, it is generally sufficient to have one or two center lathes while a capstan or turret lathe is not essential. A small machine shop can be incorporated in the basic metal workshop or can be housed separately, according to the premises available. It is suggested that machine tools provided should generally be the simple, robust types suitable for training and might include the following . :

a) Sensitive drill machines
b) Surface grinding machine
c) Buffing machine
d) Center lathe
e) Horizontal milling machine

2.2 Trainees will not normally need any specific personal tool kit. Other items may be included to suit local needs.

3 AIRFRAME/HELICOPTER FAMILIARISATION WORKSHOP

Shop equipment in the airframe workshop is determined according to the requirements of the technicians undergoing training . In general, it is desirable that the licensed AME students should have the opportunity to remove and replace major components. Practice in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase. The requirements for the training of licensed AME are as follows:

a) Ideally, a complete aircraft of all metal construction with retractable landing gear, complete with engine in running order.
b) Alternately an all metal fuselage, wings and control surfaces of stressed skin type suitable for practicing repairs and inspection duties.
c) Hydraulic lifting jacks, trestles, fuselage cradles, lifting slings, cables and steering bars, dihedral and incidence boards and tools suitable for aircraft types provided.
d) Desks for manuals and notices.
e) Display boards for inspection worksheets.
f) Ground electrical power trolley.
g) Apron type fire extinguisher trolley.
h) Hangar access equipment such as benches, trestles, ladders, chocks etc.
i) Mobile lifting equipment i.e., small crane or overhaul gantry.
j) Spray gun for aircraft paint and dope.
k) Oil and fuel replenishing bowsers.
l) Cable swaging machine.
m) Mobile hydraulic test trolley.
n) Test boards designed to represent sections of typical aircraft cables, air and fluid systems. These should be complete with rigging instructions so that student's errors are known upon completion of training.

4 SPECIALIST ACTIVITIES: WOOD AND FABRIC ,WELDING, AND COMPOSITES

4.1 Introduction

Equipment in the training areas for these specialist activities depends on the training requirements

4.2 Wood work and fabric workshop

Reserved

4.3 WELDING

4.3.1 The purpose of a short course on welding is to impart enough knowledge of welding techniques to enable students to assess the airworthiness of welded joints and structures. It is not intended to produce skilled welders. The welding shop must be chosen and equipped to comply with the safety regulations for oxyacetylene and other types of welding. Metal–screened working bays with metal work benches should be built according to the number of work stations required

4.3.2 Welding equipment might include the following

a) Set of oxyacetylene welding equipment
b) Electric or arc welder
c) Electric TIG or MIG welder
d) Eye face shield, goggles, leather gloves and aprons
e) Electrodes, welding rods and welding fluxes
f) Electric resistance welder for spot welding (may be stored in sheet metal shop)

5.4 Fiberglass and reinforced plastic workshop

5.4.1 Many aircraft are fitted with secondary structures constructed from fiber or glass materials. (Indeed, some aircraft even have their primary structures made of fiber or glass material) From the training point of view, only secondary structures should be of concern. The repair of structures is a complex and specialized operation that requires expertise often available only from the aircraft manufacture.

5.4.2 As far as space, a dust free, humidity controlled atmosphere, lighting and doors are concerned the workshop should follow the general pattern of the fabric shop. Fire proof storage facilities for highly inflammable and corrosive resins and activators are also required. The correct type of extinguishers must be available. The following tools should be provided for the fiberglass and reinforced plastic workshop

a) Laying up tables
b) brushes and spatulas
c) Scissors and cutters
d) Sanders
e) Measuring Cup
f) Heat lamp
g) Pots and trays

APPENDIX 'III'

PRACTICAL MAINTENANCE SKILLS: ENGINE AND PROPELLER – FACILITIES, TOOLS AND EQUIPMENT

1. INTRODUCTION

This appendix provides guidance for the kind of facilities Tools and equipment that are likely to be needed to meet the Training Objectives of Para 4.8.

2. For engine skill training, the workshop should ideally the following:

a) Sectioned engines (piston or turbine, according to the needs of the com

b) Solvent washing plant for cleaning parts

c) Mobile lifting gantry for hoisting engines and heavy equipment.

d) Engine slings and work stands for each type of engine in the shop

e) Manufacturer's tool kits for each type of engine (including extractors, assembly jigs, etc.) used for the complete dismantling of engines.

f) Electromagnetic (magnetic particle) crack detection equipment.

g) Medium-sized surface table with vee-blocks detection Equipment.

h) Propeller assembly bench with tools for measuring blade torque.

i) Propeller manufacturer's tool kit for each type of propeller used.

j) Example of contemporary propeller controllers.

k) Example of various types of magnetos.

l) Example of various high-energy and other types of gas turbine igniter.

m) Example of various types of carburetor and petrol Injection equipment

n) Example of turbocharger.

3. ENGINE FAMILIARIZATION WORKSHOP

3.1 The supply or provision of engines in the airframe workshop is determined according to the requirements of the technicians undergoing training (e.g. piston or turbine engines). In general it is desirable that licensed Aircraft Maintenance (Technician/Engineer/Mechanic) (AME) students should have the opportunity to remove and replace major components. Practise in inspection functions during simulated repair or maintenance activities is considered an important training element in this phase. The requirements for the training of licensed AMEs are as follows;

a) A complete piston engine and a turbine engine.
b) Engine test bed or airframe on which the engine can be operated.
c) Mobile lifting equipment (i.e., a small crane or over-head gantry lifting slings) and tools suitable for engine types provided.
d) Desk for manuals and notices.
e) Display board for inspection work sheets.
f) Access and storage equipment such as benches, trestles, shelves, etc.
g) Oil and fuel replenishing bowsers.
h) Test board designed to represent sections of typical aircraft/engine cable, air and fluid system. These should be complete with rigging instructions so that student errors are detected immediately.

APPENDIX 'IV'

PRACTICAL MAINTENANCE SKILLS: AVIONICS — ELECTRICAL, INSTRUMENTS, AUTOFLIGHT AND RADIO – FACILITIES, TOOLS AND EQUIPMENT

1. Introduction

General Facilities for all avionics training school are as given in Appendix-II. In addition specific facilities are required relevant to Avionics stream . This appendix provides guidance for the kind of facilities, tools and equipment that are needed to meet the training objectives for institutes seeking approval in Avionics stream.

2.Avionics Workshop: Electrical

2.1 Shop equipment:- The electrical shop should be equipped with demonstration mock ups representing typical aircraft circuits. If made realistically, these can be of value for practicing adjustments and troubleshooting as well as for demonstration. All areas of engine shop should have adequate benches, racks, shelves and storage bins; electric p ower points and piped compressed air to operate powered hand tools; factory safety precautions with fire warnings and extinguishing provisions. Benches should be smooth topped and have sufficient vices and power points (for soldering irons) to suit the class size planned. The following major equipment items should also be available:

a) workshop test units for testing electrical machines (universal types are available for testing a wide variety of generators and motors)
b) appropriate special tools and test meters (necessary because of the considerable range and variety of electrical equipment on the modern aircraft)
c) battery charging plant, preferably housed in a separate, well ventilated charging room. For lead acid batteries, the charging plant should be of the series type suitable for charging several batteries at different rates.

Note- For charging lead acid and nickel cadmium batteries , a separate and totally isolated charging rooms and equipments will be required for each type. For nickel cadmium batteries , a constant current charger and battery analyzer must be specified

2.2 Personal tool kit

Students should have their own tools and tool box. This may be issued on a shop basis i.e., a kit in the electrical shop may contain only tools required for training in this shop and be retained by the shop when the students progress to the next phase, or students may be issued, and retain on permanent basis, a personal basic kit which is their own property until the completion of their training. Some schools may require students to purchase their own tools, their kits becoming more complete as their training advances. The following items are required for basic electrical work:

a) one electric 5-mm point temperature controlled soldering iron (soldering copper)

b) one wire stripper for removing insulation
c) a selection of small screw drivers (including a Phillips)
d) one adjustable hook wrench (18 to 50 mm)
e) one set of Allen Keys

2.3 The exercises with components should be designed to develop skills in dismantling, inspection, decision making and assembly. The following types of components should be available and used as appropriate according to the potential need of the trainees:

a) Lengths of the aircraft cabling with typical plugs , sockets , bulk head sealing bungs, grommets etc., for practicing wire work and making up looms
b) A selection of switches, fuses, thermal circuit breakers, wire connecting devices, junction boxes and other electrical system elements
c) Specimens of airborne batteries (both lead acid and nickel cadmium): sectioned, serviceable and chargeable.
d) DC generators and AC alternators (constant speed drives)
e) Voltage regulators, generator control units (GCU) and other types of current limiting devices (i e., vibrator types and variable resistance types)
f) Various types of DC and AC motors, including engine starters, continuously rated motors, rotary and linear actuators.
g) Static and rotary inverters and specimens of other types of current conversion devices, such as transformer current rectifier units (TRUs)
h) Specimens of various types of airborne electrical instruments, including instruments embodying principles of the voltmeter, ammeter, ohmmeter, Wheatstone bridge, thermocouple, ratio meter, servos and synchros etc.
i) Specimens of aircraft electrical heating devices, such as pitot heads, thermal deicing shoes etc.
j) Specimens of aircraft lighting appliances, such as cabin fluorescent lamps, landing lamps, navigation lights etc.

2 AVIONIS WORKSHOP: INSTRUMENT

3.1 Workshop equipment.

The shop should be a “clean area” i.e., it should be protected from dust, workshop fumes and industrial contaminants. Ideally, a separate building or room with filtered ventilation is desirable and in a very humid climates air-conditioning is essential. Benches should be topped with smooth hard wood or covered with a Formica top. If air conditioning is not installed, it may be necessary to provide sealed cabinets with silica gel (for air drying) for storage of some of the test equipments and instrument specimens.

3.2 The instrument shop should be equipped with demonstration mock-ups representing typical aircraft circuits. If made realistically, these can be of value for practicing adjustments and troubleshooting as well as for demonstration. Benches should be smooth topped and have sufficient vices and power points (for soldering irons) to suit the class size planned. The following major equipment items should also be available:

a) Dead weight tester for pressure gauges.
b) Altimeter test chamber with sub standard instrument.

c) Mock-up air speed indicator (ASI) system for leak test practice.
d) Gyroscopic instrument test table.
e) Mock up for compass swinging practice (ie., an old aircraft or a specially made trolley which can be used on an outdoor site selected as compass base
f) Bridge Megger for insulation testing of electrical items.

3.3 The personal basic tool kits of students should be supplemented by the following items

a) one set of watch makers screw drivers
b) one set of miniature spanners
c) one set of Allen keys (appropriate sized)
d) one set of Bristol spline keys
e) one electric temperature controlled soldering iron with fine point (similar to that issued in electrical shop)

3.4 The exercises with components should be designed to develop skill in dismantling, inspection, decision making and assembly. The following types of components should be available and used as appropriate according to the potential need of the trainees:

a) Boost or manifold pressure gauge
b) Hydraulic pressure gauge
c) Engine oil pressure gauge (Bourdon tube type)
d) Engine oil pressure gauge (electrical type)
e) ASI
f) Pitot static head
g) Altimeter (simple and sensitive type)
h) Rate of climb indicator
i) Turn and slip indicator (air driven and electrical type)
j) Directional gyroscope (air driven and electrical type)
k) Artificial horizon (air driven and electrical type)
l) Engine speed indicator (DC and AC types)
m) Oil thermometer (physical and electrical type)
n) Cylinder head or jet pipe thermo couple
o) Fuel content gauge (float operated and capacitance type)
p) Magnetic compass
q) Simple type autopilot

4 AVIONICS WORKSHOP : AUTOPILOT, NAVIGATION AND RADIO

4.1 The shop should be a “clean area” i.e., it should be protected from dust, workshop fumes and industrial contaminants. The shop could be combined with the instrument shop. Ideally, a separate building or room with filtered ventilation is desirable and in a very humid climates air-conditioning is essential. Benches should be topped with smooth hard wood or covered with a Formica top. If air conditioning is not installed, it may be necessary to provide sealed cabinets with silica gel (for air drying) for storage of some of the test equipments and instrument specimens.

4.2 The following test equipments items should also be available:

a) Variable stabilized power supply unit
b) Signal generator (high grade)
c) Signal generator for bench
d) Signal generator(UHF/VHF)
e) Audio frequency oscillators
f) Spectrum analyzer
g) Cathode ray oscilloscope
h) Frequency meters
i) Moving coil , volt-ohm-milliammeter and multi meters
j) Variac
k) Digital analyzer
l) IC/Microprocessors
m) Digital voltmeter/ ohmmeter/ammeter
n) Logic probe
o) RLC bridge
p) Voltage standing wave meters
q) Absorption and thermocouple watt meter

4.3 The work shop should be equipped with demonstration mock-ups representing typical aircraft circuits. The following equipment may be of value for practicing adjustments and troubleshooting as well as for demonstration.

a) High frequency transmitter receiver (HF)
b) Very High frequency transmitter receiver (VHF)
c) automatic direction finder system
d) Very High frequency omnidirectional radio range / instrument landing system (VOR/ILS) system (including glide scope and marker receivers)
e) Distance measuring equipment system
f) Air traffic control transponder system (including altitude reporting mode)
g) Radio altimeter
h) Weather radar
i) DVOR
j) Navigation indicators capable of presenting combined navigation information, typically a radio magnetic indicator (RMI) and horizontal situation indicator (HSI) wired for both compass and various radio navigation inputs.
k) Instrument systems with electronic amplifiers (e.g. capacitance type fuel content gauges, cabin temperature controllers, and automatic pilots)

4.4 The radio section of the work shop needs a screened room or “cage” to prevent undue radiation from equipment undergoing testing and to provide an interference free region for fine measurement. Although it is desirable to have this room adjoining radio work shop, they should not be close to the sources of interference, such as an electric overhaul shop or spark plug testing equipment. As a further safeguard against interference all power supplies to the radio work shop should be filtered and outgoing interference should be suppressed by adequate screening of aerial cables and artificial aerials. Alternatively, if a screened room is un-available, for certain types of equipments, it is possible to use a field simulator specified by the manufacturer. (A metal box in which the respective antenna is placed to eliminate unwanted radiations and interference). The following power supply will be required

a) AC main supply for lighting, heating, air conditioning, mains rectifiers, test instruments, soldering irons etc., (This will be at the standard voltage of the locality and the supply should be wired throughout in screened conduit)

b) 30-volt DC supply, surge free and of adequate capacity for the size of the workshop. (A ring main supply from lead acid or alkaline cells, ripple free and filtered is suitable or a main rectifier /regulator can be used)

c) 15-volt DC supply, also surge free

d) 115–volt, 400 cycles, single phase, AC supply (This should be frequency monitored and can be taken from a static inverter)

e) 115–volt, 400 cycles, three phase AC supply, frequency monitored and wired to the working benches by screened cable

f) 26-volt, 400 cycles, single phase, AC supply taken from 115-volt AC supply through a transformer or from the 26-volt AC output from the static inverter

g) Compressed air and vacuum supplies

4.5 The personal basic tool kits of students should be same as specified for instrument workshop but may be supplemented to suit local needs.

4.6 The exercises with components and system demonstration rigs should be designed with a view to developing skills in inspection fault finding and decision making.

APPENDIX "V"

Applied On The Job practical training : Experience (OJT)

1. Introduction :

Experience of this course takes the form of a series of supervised abilities by applying the knowledge , skill and attitude learned so far. The exercises should consist of simulated (or real , if fully supervised) maintenance tasks based on actual sample maintenance programme extracts as well as on compliance with regulations , operator or approved maintenance organisation (AMO) procedures and amendments. If this phase of the training can be on the job at an operator or AMO , then this part of the curriculum should be omitted at the training school. Instead it can be given at the organisation where the trainees can receive the required practical trainee under the guidance and supervision of an Aircraft Maintenance Engineer(AME) instructor . In the later case ,however it will expedite the trainee's training if , in addition to "real" maintenance exercises , hypothetical situations are set up as practical exercises when time allows

2. The simulated or assumed operating conditions for each exercise must be clearly specified by the instructor. The exercises should be made as realistic as possible .Past maintenance records etc. can be used (e.g. case studies) and answers arrived at by the trainees should be compared to what actually took place. A group discussions after each exercise will be beneficial in eliminating possible misconceptions

3. The OJT should be devided into Line and Base modules

4. TRAINING OBJECTIVES

- Conditions : The trainee will be provided with appropriate hangar or workshop facilities ; tools(both hand and machine); materials; an aircraft or components as applicable; aircraft maintenance manuals; AMO tasks or job cards and procedure documents.
- Performance : The trainee will practice removal , replacement , dismantling , inspection , decision making regarding repair or replacement, re assembly and function testing of fault finding equipment , using both engineering drawings as well as manufacturers' maintenance , overhaul and repair tests(real or simulated)
- Standard of accomplishment : During this experience phase of training ,the standard is a function of the variety of exercises completed and the time spent in work shop training . The trainee / students may work individually or in team on the exercises so that they have " ownership " of the standard. If necessary , they should practice and repeat increasingly complex exercises to develop greater skills within their respective area of competence. Finally, they should function test the units or systems either on a test bed or on the aircraft it self

5 APPLIED PRACTICAL LINE MAINTENANCE OPERATION :AIRFRAMR/ENGINE / AVIONICS

The required materials and publications include the following :

a) Extract from the approved maintenance programme
b) Appropriate aircraft ,engine or part there of
c) Aircraft maintenance manual (AMM)
d) Operators' minimum equipment list (MEL)
e) Operators maintenance control manual
f) AMO tasks or job cards
g) Operator's technical log
h) Associated technical tools or test equipment

Operating conditions defined by the instructor should include not to be limited to the following:

a) Simulated aircraft departure time
b) Simulated aircraft maintenance state and age
c) Availability of spare parts
d) Availability of role play flight crew for questioning
e) Statement if a defect is found, trainee must make decision to repair, replace or defer
f) Recording of work in accordance with AMO and operator manuals and with DGCA regulations
g) Simulated conditions of the maintenance facility

Exercises should be designed to give trainees practices in the following

a) Manual and diagnostic skills
b) Compilation of necessary additional work or job cards
c) Understanding of flight crew entries in the technical logs
d) Verbal briefing and de-briefing of flight crew
e) Correct use of manuals such as the AMM or MEL
f) Making of accurate and complete entries in the technical logs, work or job cards.

6 APPLIED PRACTICAL BASE MAINTENANCE OPERATION : AIRFRAME/ ENGINE / AVIONICS

Operating conditions defined by the instructor should include but not be limited to the following:

a) Simulated stage of aircraft check completion
b) Simulated aircraft maintenance state and age
c) Availability of spare parts and materials
d) Availability of role play maintenance personnel for questioning
e) Statement if a defect is found, trainee must make decision to repair, replace or defer

f) Recording of work in accordance with AMO and operator manuals and with DGCA regulations
g) Simulated conditions of the maintenance facility

Exercises should be designed to give trainees practices in the following

a) Manual and inspection skills
b) Assessment of damage, corrosion etc
c) Determination of appropriate repair /rectification action
d) Compilation of necessary additional work or job cards
e) Verbal briefing and de briefing of maintenance personnel
f) Correct use of manuals such as AMM or structural repair manuals (SRM)
g) Making of accurate and complete entries in the work or job cards

APPENDIX "VI"

SYLLABUS OF DGCA AME LICENCE EXAMINATION

The revised syllabus for various DGCA papers of AME licence exam is detailed below.		
Sr. No.	**Name of Paper**	**Detailed Syllabus of Paper**
1.	**Paper – I A**	**Air Law, Airworthiness Requirements**
2.	**Paper – I B Human Factors**	**HUMAN PERFORMANCE**
		B.1.1 General • The need to take human factors into account; • Incidents attributable to human factors/human error;
		B1 .2 Human Performance and Limitations • Vision; • Hearing; • Information processing; • Attention and perception; • Memory; • Claustrophobia and physical access.
		B1 .3 Social Psychology • Responsibility: individual and group; • Motivation and de-motivation; • Peer pressure; • 'Culture' issues; • Team working; • Management, supervision and leadership.
		B1 .4 Factors Affecting Performance • Fitness/health; • Stress: domestic and work related; • Time pressure and deadlines; • Workload: overload and underload; • Sleep and fatigue, shiftwork; • Alcohol, medication, drug abuse.

		B1 .5 Physical Environment • Noise and fumes; • Illumination; • Climate and temperature; • Motion and vibration; • Working environment.
		B1 .6 Tasks • Physical work; • Repetitive tasks; • Visual inspection; • Complex systems.
		B1 .7 Communication • Within and between teams; • Work logging and recording; • Keeping up to date, currency; • Dissemination of information.
		B1 .8 Human Error • Error models and theories; • Types of error in maintenance tasks; • Implications of errors (i.e accidents) • Avoiding and managing errors.
		B1 .9 Hazards in the Workplace • Recognising and avoiding hazards; • Dealing with emergencies.
03	**Paper – II General Engineering and Maintenance Practices**	**P2 .1 MATERIALS AND HARDWARE**
		P2.1.1 Aircraft Materials — Ferrous (a) • Characteristics, properties and identification of common alloy steels used in aircraft; • Heat treatment and application of alloy steels; (b) • Testing of ferrous materials for hardness, tensile strength, fatigue strength and

		P2.1.2 Aircraft Materials — Non-Ferrous (a) • Characteristics, properties and identification of common non-ferrous materials used in aircraft; • Heat treatment and application of non-ferrous materials; (b) • Testing of non-ferrous material for hardness, tensile strength, fatigue strength and impact resistance
		P2.1.3 Aircraft Materials — Composite and Non-Metallic P2. 1.3.1 Composite and non-metallic other than wood and fabric (a) • Characteristics, properties and identification of common composite and non-metallic materials, other than wood, used in aircraft; • Sealant and bonding agents. (b) • The detection of defects/deterioration in composite and non-metallic material. • Repair of composite and non-metallic materials.
		P2.1.3.2 Wooden structures (optional) • Construction methods of wooden airframe structures; • Characteristics, properties and types of wood and glue used in aeroplanes; • Preservation and maintenance of wooden structure; • Types of defects in wood material and wooden structures; • The detection of defects in wooden structure;
		P2.1.3.3 Fabric covering (optional) • Characteristics, properties and types of fabrics used in aeroplanes; • Inspections methods for fabric; • Types of defects in fabric; • Repair of fabric covering.

		P2.1.4 Corrosion (a) • Chemical fundamentals; • Formation by, galvanic action process, microbiological, stress; (b) • Types of corrosion and their identification; • Causes of corrosion; • Material types, susceptibility to corrosion.
		P2.1.5 Fasteners P2.1.5.1 Screw threads • Screw nomenclature; • Thread forms, dimensions and tolerances for standard threads used in aircraft; • Measuring screw threads;
		P2.1.5.1 Bolts, studs and screws • Bolt types: specification, identification and marking of aircraft bolts, international standards; • Nuts: self locking, anchor, standard types; • Machine screws: aircraft specifications; • Studs: types and uses, insertion and removal;
		P2.1.5.2 Locking devices • Tab and spring washers, locking plates, split pins, pal-nuts, wire locking, quick release fasteners, keys, circlips, cotter pins.
		P2.1.5.3 Aircraft rivets • Types of solid and blind rivets: specifications and identification, heat treatment.
		P2.1.5.4 Pipes and Unions (a) • Identification of, and types of rigid and flexible pipes and their connectors used in aircraft; (b) • Standard unions for aircraft hydraulic, fuel, oil, pneumatic and air system pipes.

		P2.1.5.5 Springs • Types of springs, materials, characteristics and applications.
		P2.1.6 Bearings • Purpose of bearings, loads, material, construction; • Types of bearings and their application.
		P2.1.7 Transmissions • Gear types and their application; • Gear ratios, reduction and multiplication gear systems, driven and driving gears, idler gears, mesh patterns; • Belts and pulleys, chains and sprockets.
		P2.1.8 Control Cables • Types of cables; • End fittings, turnbuckles and compensation devices; • Pulleys and cable system components; • Bowden cables; • Aircraft flexible control systems.
		P2.1.9 Electrical Cables and Connectors • Cable types, construction and characteristics; • High tension and co-axial cables; • Crimping; • Connector types, pins, plugs, sockets, insulators, current and voltage rating, coupling, identification codes.
		P2.2 MAINTENANCE PRACTICES

		P2.2.1 Safety Precautions-Aircraft and Workshop • Aspects of safe working practices including precautions to take when working with electricity, gases especially oxygen, oils and chemicals. • Also, instruction in the remedial action to be taken in the event of a fire or another accident with one or more of these hazards including knowledge on extinguishing agents.
		P2.2.2 Workshop Practices • Care of tools, control of tools, use of workshop materials; • Dimensions, allowances and tolerances, standards of workmanship; • Calibration of tools and equipment, calibration standards.
		P2.2.3 Tools • Common hand tool types; • Common power tool types; • Operation and use of precision measuring tools; • Lubrication equipment and methods. • Operation, function and use of electrical general test Equipment.
		P2.2.4 Avionic General Test Equipment • Operation, function and use of avionic general test equipment.

		P2.2.5 Engineering Drawings, Diagrams and Standards • Drawing types and diagrams, their symbols, dimensions, tolerances and projections; • Identifying title block information; • Microfilm, microfiche and computerised presentations; • Specification 100 of the Air Transport Association (ATA) of America; • Aeronautical and other applicable standards including ISO, AN, MS, NAS and MIL; • Wiring diagrams and schematic diagrams.
		P2.2.6 Fits and Clearances • Drill sizes for bolt holes, classes of fits; • Common system of fits and clearances; • Schedule of fits and clearances for aircraft and engines; Limits for bow, twist and wear; • Standard methods for checking shafts, bearings and other parts.
		P2.2.7 Electrical Cables and Connectors • Continuity, insulation and bonding techniques and testing; • Use of crimp tools: hand and hydraulic operated; • Testing of crimp joints; • Connector pin removal and insertion; • Co-axial cables: testing and installation precautions; • Wiring protection techniques: Cable looming and loom support, cable clamps, protective sleeving techniques including heat shrink wrapping, shielding.
		P2.2.8 Riveting • Riveted joints, rivet spacing and pitch; • Tools used for riveting and dimpling; • Inspection of riveted joints.

		P2.2.9 Pipes and Hoses • Bending and belling/flaring aircraft pipes; • Inspection and testing of aircraft pipes and hoses; • Installation and clamping of pipes.
		P2.2.10 Springs • Inspection and testing of springs.
		P2.2.11 Bearings • Testing, cleaning and inspection of bearings; • Lubrication requirements of bearings; • Defects in bearings and their causes. • 28.11.2003 L 315/1 00 Official Journal of the European Union EN
		P2.2.12 Transmissions • Inspection of gears, backlash; • Inspection of belts and pulleys, chains and sprockets; • Inspection of screw jacks, lever devices, push-pull rod systems.
		P2.2.13 Control Cables • Swaging of end fittings; • Inspection and testing of control cables; • Bowden cables; aircraft flexible control systems.
		P2.2.14 Material handling P2.2.14.1 Sheet Metal • Marking out and calculation of bend allowance; • Sheet metal working, including bending and forming; • Inspection of sheet metal work. P2.2.14.2 Composite and non-metallic • Bonding practices; • Environmental conditions • Inspection methods

		P2.2.15 Welding, Brazing, Soldering and Bonding (a) • Soldering methods; inspection of soldered joints. (b) • Welding and brazing methods; • Inspection of welded and brazed joints; • Bonding methods and inspection of bonded
		P2.2.16 Aircraft Weight and Balance (a) • Centre of Gravity/Balance limits calculation: use of relevant documents; (b) • Preparation of aircraft for weighing; • Aircraft weighing;
		P2.2.17 Aircraft Handling and Storage • Aircraft taxiing/towing and associated safety precautions; • Aircraft jacking, chocking, securing and associated safety precautions; • Aircraft storage methods; • Refuelling/defuelling procedures; • De-icing/anti-icing procedures; • Electrical, hydraulic and pneumatic ground supplies. • Effects of environmental conditions on aircraft handling and operation.

		P2.2.18 Disassembly, Inspection, Repair and Assembly Techniques (a) • Types of defects and visual inspection techniques. • Corrosion removal, assessment and re-protection. (b) • General repair methods, Structural Repair Manual; • Ageing, fatigue and corrosion control programmes; (c) • Non destructive inspection techniques including, penetrant, • radiographic, eddy current, ultrasonic and boroscope methods. (d)
		P2.2.19 Abnormal Events (a) • Inspections following lightning strikes and HIRF penetration. (b) • Inspections following abnormal events such as heavy landings and flight through turbulence.
		P2.2.20 Maintenance Procedures • Maintenance planning; • Modification procedures; • Stores procedures; • Certification/release procedures; • Interface with aircraft operation; • Maintenance Inspection/Quality Control/Quality Assurance; • Additional maintenance procedures. • Control of life limited components
		P2.3 ELECTRICAL FUNDAMENTALS

		P2.3.1 Electron Theory 1 1 1 Structure and distribution of electrical charges within: atoms, molecules, ions, compounds; Molecular structure of conductors, semiconductors and insulators.
		P2.3.2 Static Electricity and Conduction 1 2 2 Static electricity and distribution of electrostatic charges; Electrostatic laws of attraction and repulsion; Units of charge, Coulomb's Law; Conduction of electricity in solids, liquids, gases and a vacuum.
		P2.3.3 Electrical Terminology 1 2 2 • The following terms, their units and factors affecting them: ---- potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.
		P2.3.4 Generation of Electricity 1 1 1 • Production of electricity by the following methods: light, heat, friction, pressure, chemical action, magnetism and motion.
		P2.3.5 DC Sources of Electricity 1 2 2 • Construction and basic chemical action of: primary cells, • secondary cells, lead acid cells, nickel cadmium cells, other • alkaline cells; • Cells connected in series and parallel; • Internal resistance and its effect on a battery; • Construction, materials and operation of thermocouples; • Operation of photo-cells.

		P2.3.6 DC Circuits • Ohms Law, Kirchoff's Voltage and Current Laws; • Calculations using the above laws to find resistance, voltage and current; • Significance of the internal resistance of a
		P2.3.7 Resistance/Resistor (a) • Resistance and affecting factors; • Specific resistance; • Resistor colour code, values and tolerances, preferred values, wattage ratings; • Resistors in series and parallel; • Calculation of total resistance using series, parallel and series parallel combinations; • Operation and use of potentiometers and rheostats; • Operation of Wheatstone Bridge. (b) • Positive and negative temperature coefficient conductance; • Fixed resistors, stability, tolerance and limitations, methods of construction; • Variable resistors, thermistors, voltage dependent resistors; • Construction of potentiometers and rheostats;
		P2.3.8 Power • Power, work and energy (kinetic and potential); • Dissipation of power by a resistor; • Power formula; • Calculations involving power, work and

		P2.3.9 Capacitance/Capacitor • Operation and function of a capacitor; • Factors affecting capacitance area of plates, distance between plates, number of plates, dielectric and dielectric • constant, working voltage, voltage rating; • Capacitor types, construction and function; • Capacitor colour coding; • Calculations of capacitance and voltage in series and parallel circuits; • Exponential charge and discharge of a capacitor, time • constants; Testing of capacitors.
		•
		P2.3.12 DC Motor/Generator • Basic motor and generator theory; • Construction and purpose of components in DC generator; • Operation of, and factors affecting output and direction of current flow in DC generators; • Operation of, and factors affecting output power, torque, speed and direction of rotation of DC motors; • Series wound, shunt wound and compound motors; • Starter Generator construction.
		P2.3.13 AC Theory • Sinusoidal waveform: phase, period, frequency, cycle; • Instantaneous, average, root mean square, peak, peak to peak current values and calculations of these values, in relation to voltage, current and power • Triangular/Square waves; • Single/3 phase principles.

		P2.3.14 Resistive (R), Capacitive (C) and Inductive (L) Circuits • Phase relationship of voltage and current in L, C and R • circuits, parallel, series and series parallel; • Power dissipation in L, C and R circuits; • Impedance, phase angle, power factor and current calculations; • True power, apparent power and reactive power calculations.
		P2.3.15 Transformers • Transformer construction principles and operation; • Transformer losses and methods for overcoming them; • Transformer action under load and no-load conditions; • Power transfer, efficiency, polarity markings; • Calculation of line and phase voltages and currents; • Calculation of power in a three phase system; • Primary and Secondary current, voltage, turns ratio
		P2.3.16 Filters • Operation, application and uses of the following filters: • low pass, high pass, band pass, band stop.
		P2.3.17 AC Generators • Rotation of loop in a magnetic field and waveform produced; • Operation and construction of revolving armature and revolving field type AC generators; • Single phase, two phase and three phase alternators; • Three phase star and delta connections advantages and uses; • Permanent Magnet Generators.

		P2.3.18 AC Motors • Construction, principles of operation and characteristics of: AC synchronous and induction motors both single and polyphase; • Methods of speed control and direction of rotation; • Methods of producing a rotating field: capacitor, inductor, shaded or split pole.
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		P2.4.1.2 Transistors (a) • Transistor symbols; • Component description and orientation; • Transistor characteristics and properties. (b) • Construction and operation of PNP and NPN transistors; • Base, collector and emitter configurations; • Testing of transistors. • Basic appreciation of other transistor types and their uses. • Application of transistors: classes of C); • Simple circuits including: bias, decoupling, feedback and stabilisation; • Multistage circuit principles: cascades, push-pull, oscillators, multivibrators, flip-flop circuits.

		P2.4.1.3 Integrated Circuits (a) • Description and operation of logic circuits and linear circuits/operational amplifiers. (b) • Description and operation of logic circuits and linear circuits; • Introduction to operation and function of an operational amplifier used as: integrator, differentiator, voltage follower, comparator; • Operation and amplifier stages connecting methods: resistive capacitive, inductive (transformer), inductive resistive (IR), direct; • Advantages and disadvantages of positive and negative feedback.
		P2.4.2 Printed Circuit Boards • Description and use of printed circuit boards.

		P2.4.3 Servomechanisms (a) • Understanding of the following terms: Open and closed loop systems, feedback, follow up, analogue transducers; • Principles of operation and use of the following synchro system components/features: resolvers, differential, control and torque, transformers, inductance and capacitance transmitters. (b) • Understanding of the following terms: Open and closed loop, follow up, servomechanism, analogue, transducer, null, damping, feedback, deadband; • Construction operation and use of the following synchro system components: resolvers, differential, control and torque, E and I transformers, inductance transmitters, • capacitance transmitters, synchronous • Servomechanism defects, reversal of synchro leads, hunting.
		P2. 5. DIGITAL TECHNIOUES ELECTRONIC INSTRUMENT SYSTEMS
		P2.5.1 Electronic Instrument Systems • Typical systems arrangements and cockpit layout of electronic instrument systems.

		P2.5.2 Numbering Systems • Numbering systems: binary, octal and hexadecimal; • Demonstration of conversions between the decimal and binary, octal and hexadecimal systems and vice versa.
		P2.5.3 Data Conversion • Analogue Data, Digital Data; • Operation and application of analogue to digital, and digital to analogue converters, inputs and outputs, limitations of various types.
		P2.5.4 Data Buses • Operation of data buses in aircraft systems, including knowledge of ARINC and other specifications.
		P2.5.5 Logic Circuits (a) • Identification of common logic gate symbols, tables and equivalent circuits; • Applications used for aircraft systems, schematic diagrams. (b) • Interpretation of logic diagrams.

		P2.5.6 Basic Computer Structure (a) • Computer terminology (including bit, byte, software, hardware, CPU, IC, and various memory devices such as RAM, ROM, PROM); • Computer technology (as applied in aircraft systems). (b) • Computer related terminology; • Operation, layout and interface of the major components in a micro computer including their associated bus systems; • Information contained in single and multiaddress instruction words; • Memory associated terms; Operation of typical memory devices; • Operation, advantages and disadvantages of the various data storage systems.
		P2.5.7 Microprocessors • Functions performed and overall operation of a microprocessor; • Basic operation of each of the following microprocessor elements: control and processing unit, clock, register, arithmetic logic unit. P2.5.8 Integrated Circuits • Operation and use of encoders and • Function of encoder types; • Uses of medium, large and very large scale integration.
		P2.5.9 Multiplexing • Operation, application and identification in logic diagrams of multiplexers and demultiplexers.

ISSUE IV

		P2.5.10 Fibre Optics • Advantages and disadvantages of fibre optic data transmission over electrical wire propagation; • Fibre optic data bus; • Fibre optic related terms; • Terminations; • Couplers, control terminals, remote terminals; • Application of fibre optics in aircraft
		P2.5.11 Electronic Displays • Principles of operation of common types of displays used in modern aircraft, including Cathode Ray Tubes, Light Emitting Diodes and Liquid Crystal Display.
		P2.5.12 Electrostatic Sensitive Devices • Special handling of components sensitive to electrostatic discharges; • Awareness of risks and possible damage, component and personnel an ti-static protection devices.
		P2.5.13 Software Management Control • Awareness of restrictions, airworthiness requirements and possible catastrophic effects of unapproved changes to software programmes.
		P2.5.14 Electromagnetic Environment • Influence of the following phenomena on maintenance practices for electronic system: • EMC-Electromagnetic Compatibility EM I- Electromagnetic Interference HIRF-High Intensity Radiated Field Lightning/lightning protection

		P2.5.15 **Typical Electronic/Digital Aircraft Systems** • General arrangement of typical electronic/digital aircraft systems and associated BITE(Built In Test Equipment) testing such as: • ACARS-ARINC Communication and Addressing and Reporting System • ECAM-Electronic Centralised Aircraft Monitoring • EFIS-Electronic Flight Instrument System • EICAS-Engine Indication and Crew Alerting System • FBW-Fly by Wire • FMS-Flight Management System • GPS-Global Positioning System • IRS-Inertial Reference System • TCAS-Traffic Alert Collision Avoidance
	Paper III Airframe	P3.1 BASIC AERODYNAMICS
		P3.1.1 **Physics of the Atmosphere** • International Standard Atmosphere (ISA), application to aerodynamics.
		P3.1.2 **Aerodynamics** • Airflow around a body; • Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; • The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, • angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio; • Thrust, Weight, Aerodynamic Resultant; • Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall; • Aerofoil contamination including ice, snow,

		P3.1.3 **Theory of Flight** • Relationship between lift, weight, thrust and drag; Glide ratio; • Steady state flights, performance; • Theory of the turn; • Influence of load factor: stall, flight envelope and structural limitations; • Lift augmentation.
		P3.1.4 **Flight Stability and Dynamics** • Longitudinal, lateral and directional stability (active and passive).
		P3.2 TURBINE AEROPLANE AERODYNAMICS, STRUCTURES AND SYSTEMS
		P3.2.1 **Theory of Flight** P3.2.1.1 *Aeroplane Aerodynamics and Flight Controls* Operation and effect of: • roll control: ailerons and spoilers; • pitch control: elevators, stabilators, variable incidence stabilisers and canards; • yaw control, rudder limiters; • Control using elevons, ruddervators; • High lift devices, slots, slats, flaps, flaperons; • Drag inducing devices, spoilers, lift dumpers, speed brakes; • Effects of wing fences, saw tooth leading edges; • Boundary layer control using, vortex generators, stall wedges or leading edge devices; • Operation and effect of trim tabs, balance and antibalance • (leading) tabs, servo tabs, spring

		P3.2.1.2 *High Speed Flight* • Speed of sound, subsonic flight, transonic flight, supersonic flight, Mach number, critical Mach number, compressibility buffet, shock wave, aerodynamic heating, area rule; • Factors affecting airflow in engine intakes of high speed aircraft; • Effects of sweepback on critical Mach
		P3.2.2 **Airframe Structures — General Concepts** (a) • Airworthiness requirements for structural • Structural classification, primary, secondary and tertiary; • Fail safe, safe life, damage tolerance • Zonal and station identification systems; • Stress, strain, bending, compression, shear, torsion, tension, hoop • Drains and ventilation provisions; • System installation provisions; • Lightning strike protection provision. • Aircraft bonding (b) • Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; • Structure assembly techniques: riveting, bolting, bonding; • Methods of surface protection, such as chromating, anodising, painting; • Surface cleaning. • Airframe symmetry: methods of alignment and symmetry checks.

		P3.2.3 **Airframe Structures — Aeroplanes** P3.2.3.1 *Fuselage* • Construction and pressurisation sealing; • Wing, stabiliser, pylon and undercarriage attachments; • Seat installation and cargo loading system; • Doors and emergency exits: construction, mechanisms, operation and safety devices; • Windows and windscreen construction and mechanisms.
		P3.2.3.2 *Wings* • Construction; • Fuel storage; • Landing gear, pylon, control surface and high lift/drag attachments.
		P3.2.3.3 *Stabilisers* • Construction; • Control surface attachment.
		P3.2.3.4 *Flight Control Surfaces* • Construction and attachment; • Balancing — mass and aerodynamic.
		P3.2.3.5 *Nacelles/Pylons* • Construction; • Firewalls; • Engine mounts.
		P3.2.4 **Air Conditioning and Cabin Pressurisation** P3.2.4.1 *Air supply* • Sources of air supply including engine bleed, APU and ground cart
		P3.2.4.2 *Air Conditioning* • Air conditioning systems; • Air cycle and vapour cycle machines; • Distribution systems; • Flow, temperature and humidity control system.

		P3.2.4.3 *Pressurisation* • Pressurisation systems; • Control and indication including control and safety valves; • Cabin pressure controllers.
		P3.2.4.4 *Safety and warning devices* • Protection and warning devices.
		P3.2.5 **Instruments/Avionic Systems** P3.2.5.1 *Instrument Systems* • Pitot static: altimeter, air speed indicator, vertical speed indicator; • Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; • Compasses: direct reading, remote reading; • Angle of attack indication, stall warning systems; • Other aircraft system indication.
		P3.2.5.2 *Avionic Systems* • Fundamentals of system lay-outs and operation of; • Auto Flight (ATA 22); • Communications (ATA 23);
		P3.2.6 **Electrical Power (ATA 24)** • Batteries Installation and Operation; • DC power generation; • AC power generation; • Emergency power generation; • Voltage regulation; • Power distribution; • Inverters, transformers, rectifiers; • Circuit protection. • External/Ground power;

		P3.2.7 **Equipment and Furnishings (ATA 25)** (a) • Emergency equipment requirements; • Seats, harnesses and belts. (b) • Cabin lay-out; • Equipment lay-out; • Cabin Furnishing Installation; • Cabin entertainment equipment; • Galley installation; • Cargo handling and retention equipment; • Airstairs.
		P3.2.8 **Fire Protection (ATA 26)** (a) • Fire and smoke detection and warning • Fire extinguishing systems; • System tests. (b) • Portable fire extinguisher
		P3.2.9 **Flight Controls (ATA 27)** • Primary controls: aileron, elevator, rudder, .. • Trim control; • Active load control; • High lift devices; • Lift dump, speed brakes; • System operation: manual, hydraulic, pneumatic, electrical, fly-by-wire; • Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks systems; • Balancing and rigging; • Stall protection/warning system.

		P3.2.10 **Fuel Systems (ATA 28)** • System lay-out; • Fuel tanks; • Supply systems; • Dumping, venting and draining; • Cross-feed and transfer; • Indications and warnings; • Refuelling and defuelling; • Longitudinal balance fuel systems.
		P3.2.11 **Hydraulic Power (ATA 29)** • System lay-out; • Hydraulic fluids; • Hydraulic reservoirs and accumulators; • Pressure generation: electric, mechanical, pneumatic; • Emergency pressure generation; • Pressure Control; • Power distribution; • Indication and warning systems; • Interface with other systems.
		P3.2.12 **Ice and Rain Protection (ATA 30)** • Ice formation, classification and detection; • Anti-icing systems: electrical, hot air and chemical; • De-icing systems: electrical, hot air, pneumatic and chemical; • Rain repellant; • Probe and drain heating.
		P3.2.13 **Landing Gear (ATA 32)** 2 3 — • Construction, shock absorbing; • Extension and retraction systems: normal and emergency; • Indications and warning; • Wheels, brakes, antiskid and autobraking; • Tyres; • Steering.

		P3.2.14 **Lights (ATA 33)** • External: navigation, anti-collision, landing, taxiing, ice; • Internal: cabin, cockpit, cargo; • Emergency.
		P3.2.15 **Oxygen (ATA 35)** • System lay-out: cockpit, cabin; • Sources, storage, charging and distribution; • Supply regulation; • Indications and warnings;
		P3.2.16 **Pneumatic/Vacuum (ATA 36)** • System lay-out; • Sources: engine/APU, compressors, reservoirs, ground supply; • Pressure control; • Distribution; • Indications and warnings; • Interfaces with other systems.
		P3.2.17 **Water/Waste (ATA 38)** • Water system lay-out, supply, distribution, servicing and draining; • Toilet system lay-out, flushing and servicing; • Corrosion aspects.
		P3.2.18 **On Board Maintenance Systems (ATA 45)** • Central maintenance computers; • Data loading system; • Electronic library system; • Printing; • Structure monitoring (damage tolerance monitoring).

		P3.2.1 **Theory of Flight** P3.2.1.1 *Aeroplane Aerodynamics and Flight Controls* • Operation and effect of: — roll control: ailerons and spoilers; — pitch control: elevators, stabilators, variable incidence • stabilisers and canards; — yaw control, rudder limiters; • Control using elevons, ruddervators; • High lift devices, slots, slats, flaps, flaperons; • Drag inducing devices, spoilers, lift dumpers, speed brakes; • Effects of wing fences, saw tooth leading edges; • Boundary layer control using, vortex generators, stall wedges or leading edge devices; • Operation and effect of trim tabs, balance and antibalance (leading) tabs, servo tabs, spring tabs, mass balance,

		P3.2.1.2 *High Speed Flight* P3.2.2 **Airframe Structures — General Concepts** (a) • Airworthiness requirements for structural strength; • Structural classification, primary, secondary and tertiary; • Fail safe, safe life, damage tolerance • Zonal and station identification systems; • Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; • Drains and ventilation provisions; • System installation provisions; • Lightning strike protection provision. • Aircraft bonding (b) • Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning, anti-corrosive protection, wing, empennage and engine attachments; • Structure assembly techniques: riveting, bolting, bonding; • Methods of surface protection, such as chromating, anodising, painting; • Surface cleaning; • Airframe symmetry: methods of alignment and symmetry checks.
		P3.2.3 **Airframe Structures — Aeroplanes** P3.2.3.1 *Fuselage* • Construction and pressurisation sealing; • Wing, tail-plane pylon and undercarriage attachments; • Seat installation; • Doors and emergency exits: construction and operation; • Window and windscreen attachment.

		P3.2.3.2 *Wings* • Construction; • Fuel storage; • Landing gear, pylon, control surface and high lift/drag attachments.
		P3.2.3.3 *Stabilisers* • Construction; • Control surface attachment.
		P3.2.3.4 *Flight Control Surfaces* • Construction and attachment; • Balancing — mass and aerodynamic.
		P3.2.3.5 **Nacelles/Pylons (ATA 54)** (a) • Nacelles/Pylons: • Construction; • Firewalls; • Engine mounts.
		P3.2.4 **Air Conditioning and Cabin Pressurisation** • Pressurisation and air conditioning systems; • Cabin pressure controllers, protection and warning devices.
		P3.2.5 **Instruments/Avionic Systems** P3.2.5.1 *Instrument Systems* • Pitot static: altimeter, air speed indicator, vertical speed indicator; • Gyroscopic: artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; • Compasses: direct reading, remote reading; • Angle of attack indication, stall warning systems. • Other aircraft system indication.

		P3.2.5.2 *Avionic Systems* • Fundamentals of system lay-outs and operation of: — Auto Flight (ATA 22); — Communications (ATA 23); — Navigation Systems (ATA 34).
		P3.2.6 **Electrical Power (ATA 24)** • Batteries Installation and Operation; • DC power generation; • Voltage regulation; • Power distribution; • Circuit protection; • Inverters, transformers.
		P3.2.7 **Equipment and Furnishings (ATA 25)** (a) • Emergency equipment requirements; • Seats, harnesses and belts. (b) • Cabin lay-out; • Equipment lay-out; • Cabin Furnishing Installation (level 2); • Cabin entertainment equipment; • Galley installation; • Cargo handling and retention equipment; Airstairs.
		P3.2.8 **Fire Protection (ATA 26)** (a) • Fire extinguishing systems; • Fire and smoke detection and warning systems; • System tests. (b) • Portable fire extinguisher.
		P3.2.9 **Flight Controls (ATA 27)** • Primary controls: aileron, elevator, rudder; • Trim tabs; • High lift devices; • System operation: manual; • Gust locks; • Balancing and rigging; • Stall warning system.

		P3.2.10 **Fuel Systems (ATA 28)** • System lay-out; • Fuel tanks; • Supply systems; • Cross-feed and transfer; • Indications and warnings; • Refuelling and defuelling.
		P3.2.11 **Hydraulic Power (ATA 29)** • System lay-out; • Hydraulic fluids; • Hydraulic reservoirs and accumulators; • Pressure generation: electric, mechanical; • Pressure Control; • Power distribution; • Indication and warning systems.
		P3.2.12 **Ice and Rain Protection (ATA 30)** • Ice formation, classification and detection; • De-icing systems: electrical, hot air, pneumatic and • chemical; • Probe and drain heating;
		P3.2.13 **Landing Gear (ATA 32)** • Construction, shock absorbing; • Extension and retraction systems: normal and emergency; • Indications and warning; • Wheels, brakes, antiskid and autobraking; • Tyres; • Steering.
		P3.2.14 **Lights (ATA 33)** • External: navigation, anti collision, landing, taxiing, ice; • Internal: cabin, cockpit, cargo; • Emergency.
		P3.2.15 **Oxygen (ATA 35)** • System lay-out: cockpit, cabin; • Sources, storage, charging and distribution; • Supply regulation; • Indications and warnings

		P3.2.16 **Pneumatic/Vacuum (ATA 36)** • System lay-out; • Sources: engine/APU, compressors, reservoirs, ground • supply; • Pressure control; • Distribution; • Indications and warnings; • Interfaces with other systems.
		P3.2.17 **Water/Waste (ATA 38)** • Water system lay-out, supply, distribution, servicing and • draining; • Toilet system lay-out, flushing and servicing; • Corrosion aspects.
		P3.3 GAS TURBINE ENGINE
		P3.3.1 **Fundamentals** • Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; • The relationship between force, work, power, energy, velocity, acceleration; • Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop.
		P3.3.2 **Engine Performance** • Gross thrust, net thrust, choked nozzle thrust, thrust distribution, • resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; • Engine efficiencies; • By-pass ratio and engine pressure ratio; • Pressure, temperature and velocity of the gas flow; • Engine ratings, static thrust

		P3.3.3 **Inlet** • Compressor inlet ducts • Effects of various inlet configurations; • Ice protection.
		P3.3.4 **Compressors** • Axial and centrifugal types; • Constructional features and operating principles and applications; • Fan balancing; • Operation: • Causes and effects of compressor stall and surge; • Methods of air flow control: bleed valves, variable inlet guide vanes, variable stator vanes, rotating stator blades; • Compressor ratio.
		P3.3.5 **Combustion Section** Constructional features and principles of operation.
		P3.3.6 **Turbine Section** • Operation and characteristics of different turbine blade types; • Blade to disk attachment; • Nozzle guide vanes; • Causes and effects of turbine blade stress and creep.
		P3.3.7 **Exhaust** • Constructional features and principles of operation; • Convergent, divergent and variable area nozzles; • Engine noise reduction;
		P3.3.8 **Bearings and Seals** • Constructional features and principles of operation.
		P3.3.9 **Lubricants and Fuels** • Properties and specifications; • Fuel additives; • Safety precautions.

		P3.3.10 **Lubrication Systems** • System operation/lay-out and components.
		P3.3.11 **Fuel Systems** • Operation of engine control and fuel metering systems • including electronic engine control (FADEC); • Systems lay-out and components.
		P3.3.12 **Air Systems** • Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.
		P3.3.13 **Starting and Ignition Systems** • Operation of engine start systems and components; • Ignition systems and components; • Maintenance safety requirements.
		P3.3.14 **Engine Indication Systems** • Exhaust Gas Temperature/Interstage Turbine Temperature; • Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; • Oil pressure and temperature; • Fuel pressure and flow; • Engine speed; • Vibration measurement and indication; • Torque; • Power.
		P3.3.15 **Power Augmentation Systems** • Operation and applications; • Water injection, water methanol; • Afterburner systems.

		P3.3.16 **Turbo-prop Engines** • Gas coupled/free turbine and gear coupled turbines; • Reduction gears; • Integrated engine and propeller controls; • Overspeed safety devices.
		P3.3.17 **Turbo-shaft engines** • Arrangements, drive systems, reduction gearing, couplings, control systems.
		P3.3.18 **Auxiliary Power Units (APUs)** • Purpose, operation, protective systems
		P3.3.19 **Powerplant Installation** • Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.
		P3.3.20 **Fire Protection Systems** • Operation of detection and extinguishing systems.
		P3.3.21 **Engine Monitoring and Ground Operation** • Procedures for starting and ground run-up; • Interpretation of engine power output and parameters; • Trend monitoring (including oil analysis, vibration and boroscope) • Inspection of engine and components to criteria, tolerances and data specified by engine manufacturer; • Compressor washing/cleaning; • Foreign Object Damage.
		P3.3.22 **Engine Storage and Preservation** — 2 — • Preservation and depreservation for the engine and accessories/systems.
		P3.4 PISTON ENGINE

		P3.4.1 **Fundamentals** 1 2 — • Mechanical, thermal and volumetric efficiencies; • Operating principles — 2 stroke, 4 stroke, Otto and Diesel; • Piston displacement and compression ratio; • Engine configuration and firing order
		P3.4.2 **Engine Performance** 1 2 — • Power calculation and measurement; • Factors affecting engine power; • Mixtures/leaning, pre-ignition.
		P3.4.3 **Engine Construction** 1 2 — • Crank case, crank shaft, cam shafts, sumps; • Accessory gearbox; • Cylinder and piston assemblies; • Connecting rods, inlet and exhaust manifolds; • Valve mechanisms; • Propeller reduction gearboxes
		P3.4.4 **Engine Fuel Systems** P3.4.4.1 *Carburettors* 1 2 — Types, construction and principles of operation; Icing and heating.
		P3.4.4.2 *Fuel injection systems* 1 2 — Types, construction and principles of operation.
		P3.4.4.3 *Electronic engine control* 1 2 — Operation of engine control and fuel metering systems including electronic engine control (FADEC); Systems lay-out and components.
		P3.4.5 **Starting and Ignition Systems** 1 2 — Starting systems, pre-heat systems; Magneto types, construction and principles of operation; Ignition harnesses, spark plugs; Low and high tension systems.
		P3.4.6 **Induction, Exhaust and Cooling Systems** 1 2 — Construction and operation of: induction systems including alternate air systems; Exhaust systems, engine cooling systems — air and liquid.

		P3.4.7 **Supercharging/Turbocharging** 1 2 — Principles and purpose of supercharging and its effects on engine parameters; Construction and operation of supercharging/turbocharging systems; System terminology; Control systems; System protection.
		P3.4.8 **Lubricants and Fuels** 1 2 — Properties and specifications; Fuel additives; Safety precautions.
		P3.4.9 **Lubrication Systems** 1 2 — System operation/lay-out and components.
		P3.4.10 **Engine Indication Systems** • Engine speed; • Cylinder head temperature; • Coolant temperature; • Oil pressure and temperature; • Exhaust Gas Temperature; • Fuel pressure and flow; • Manifold pressure.
		P3.4.11 **Powerplant Installation** • Configuration of firewalls, cowlings, acoustic panels, • engine mounts, anti-vibration mounts, hoses, pipes, • feeders, connectors, wiring looms, control cables and rods,
		P3.4.12 **Engine Monitoring and Ground Operation** • Procedures for starting and ground run-up; • Interpretation of engine power output and parameters; • Inspection of engine and components: criteria, tolerances, • and data specified by engine manufacturer.
		P3.4.13 **Engine Storage and Preservation** • Preservation and depreservation for the engine and accessories/ systems.
		P3.5. PROPELLER

ISSUE IV

		P3.5.1 **Fundamentals** • Blade element theory; • High/low blade angle, reverse angle, angle of attack, rotational speed; • Propeller slip; • Aerodynamic, centrifugal, and thrust forces; • Torque; • Relative airflow on blade angle of attack; • Vibration and resonance.
		P3.5.2 **Propeller Construction** 1 2 — • Construction methods and materials used in wooden, composite and metal propellers; • Blade station, blade face, blade shank, blade back and hub assembly; • Fixed pitch, controllable pitch, constant speeding propeller; • Propeller/spinner installation.
		P3.5.3 **Propeller Pitch Control** • Speed control and pitch change methods, mechanical and electrical/electronic; • Feathering and reverse pitch; • Overspeed protection.
		P3.5.4 **Propeller Synchronising** • Synchronising and synchrophasing equipment.
		P3.5.5 **Propeller Ice Protection** • Fluid and electrical de-icing equipment.
		P3.5.6 **Propeller Maintenance** • Static and dynamic balancing; • Blade tracking; • Assessment of blade damage, erosion, corrosion, impact damage, delamination; • Propeller treatment/repair schemes; • Propeller engine running.

ISSUE IV

		P3.5.7 **Propeller Storage and Preservation** Propeller preservation and depreservation
	PART III HELICOPTER AIRFRAME	**P3RA.1 BASIC AERODYNAMICS**
		P3RA.1 .1 **Physics of the Atmosphere** • International Standard Atmosphere (ISA), application to aerodynamics.
		P3RA.1 .2 **Aerodynamics** • Airflow around a body; • Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; • The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio; • Thrust, Weight, Aerodynamic Resultant; • Generation of Lift and Drag: Angle of Attack, Lift
		P3RA.1 .3 **Theory of Flight** • Relationship between lift, weight, thrust and drag; • Glide ratio; • Steady state flights, performance; • Theory of the turn; • Influence of load factor: stall, flight envelope and structural limitations; • Lift augmentation.
		P3RA.1 .4 **Flight Stability and Dynamics** • Longitudinal, lateral and directional stability (active and passive).
		P3RA.2. HELICOPTER AERODYNAMICS, STRUCTURES AND SYSTEMS

		P3RA.2.1 **Theory of Flight — Rotary Wing Aerodynamics** • Terminology; • Effects of gyroscopic precession; • Torque reaction and directional control; • Dissymmetry of lift, Blade tip stall; • Translating tendency and its correction; • Coriolis effect and compensation; • Vortex ring state, power settling, overpitching; • Auto-rotation; • Ground effect.
		P3RA.2.2 **Flight Control Systems** • Cyclic control; • Collective control; • Swashplate; • Yaw control: Anti-Torque Control, Tail rotor, bleed air; • Main Rotor Head: Design and Operation features; • Blade Dampers: Function and construction; • Rotor Blades: Main and tail rotor blade construction and attachment; • Trim control, fixed and adjustable stabilisers; • System operation: manual, hydraulic, electrical and fly-bywire; Artificial feel;
		P3RA.2.3 **Blade Tracking and Vibration Analysis** • Rotor alignment; • Main and tail rotor tracking; • Static and dynamic balancing; • Vibration types, vibration reduction methods; • Ground resonance
		P3RA.2.4 **Transmissions** • Gear boxes, main and tail rotors; • Clutches, free wheel units and rotor brake.

		P3RA.2.5 **Airframe Structures** (a) • Airworthiness requirements for structural strength; • Structural classification, primary, secondary and tertiary; • Fail safe, safe life, damage tolerance concepts; • Zonal and station identification systems; • Stress, strain, bending, compression, shear, torsion, tension, hoop stress, fatigue; • Drains and ventilation provisions; • System installation provisions; • Lightning strike protection provision. (b) • Construction methods of: stressed skin fuselage, formers, stringers, longerons, bulkheads, frames, doublers, struts, ties, beams, floor structures, reinforcement, methods of skinning and anti-corrosive protection. • Pylon, stabiliser and undercarriage attachments; • Seat installation; • Doors: construction, mechanisms, operation and safety devices; • Windows and windscreen construction; • Fuel storage; • Firewalls; • Engine mounts; • Structure assembly techniques: riveting, bolting, bonding; Methods of surface protection, such as chromating, anodising, painting; • Surface cleaning. • Airframe symmetry: methods of alignment and symmetry

		P3RA.2.6 **Air Conditioning** P3RA.2.6.1 *Air supply* • Sources of air supply including engine bleed and ground cart
		P3RA.2.6.2 *Air Conditioning* • Air conditioning systems; • Distribution systems; • Flow and temperature control systems; • Protection and warning devices.
		P3RA.2.7 Instruments/Avionic Systems P3RA.2.7.1 *Instrument Systems (ATA 31)* • Pitot static:altimeter, air speed indicator, vertical speed indicator; • Gyroscopic:artificial horizon, attitude director, direction indicator, horizontal situation indicator, turn and slip indicator, turn coordinator; • Compasses: direct reading, remote reading; • Vibration indication system and HUMS
		P3RA.2.7.2 *Avionic Systems* • Fundamentals of system layouts and operation of: • Auto Flight (ATA 22); • Communications (ATA 23); • Navigation Systems (ATA 34)
		P3RA.2.8 **Electrical Power (ATA 24)** 1 3 — • Batteries Installation and Operation; • DC power generation, AC power generation; • Emergency power generation; • Voltage regulation, Circuit protection. • Power distribution; • Inverters, transformers, rectifiers; • External/Ground power

		P3RA.2.9 **Equipment and Furnishings (ATA 25)** • Emergency equipment requirements; • Seats, harnesses and belts; • Lifting systems. • Emergency flotation systems; • Cabin lay-out, cargo retention; • Equipment lay-out; • Cabin Furnishing Installation.
		P3RA.2.10 **Fire Protection (ATA 26)** 1 3 — • Fire and smoke detection and warning systems; • Fire extinguishing systems;
		P3RA.2.1 1 **Fuel Systems (ATA 28)** 1 3 — • System lay-out; • Fuel tanks; • Supply systems; • Dumping, venting and draining; • Cross-feed and transfer; • Indications and warnings; • Refuelling and defuelling.
		P3RA.2.12 **Hydraulic Power (ATA 29)** 1 3 — • System lay-out; • Hydraulic fluids; • Hydraulic reservoirs and accumulators; • Pressure generation: electric, mechanical, pneumatic; • Emergency pressure generation; • Pressure Control; • Power distribution; • Indication and warning systems; • Interface with other systems.
		P3RA.2.13 **Ice and Rain Protection (ATA 30)** 1 3 — • Ice formation, classification and detection; • Anti-icing and de-icing systems: electrical, hot air and • chemical; • Rain repellant and removal; • Probe and drain heating.

		P3RA.2.14 **Landing Gear (ATA 32)** 2 3 — • Construction, shock absorbing; • Extension and retraction systems: normal and emergency; • Indications and warning; • Wheels, tyres, brakes; • Steering; • Skids, floats.
		P3RA.2. 15 **Lights (ATA 33)** 2 3 — • External: navigation, landing, taxiing, ice; • Internal: cabin, cockpit, cargo; • Emergency.
		P3RA.2.16 **Pneumatic/Vacuum (ATA 36)** 1 3 — • System lay-out; • Sources: engine, compressors, reservoirs, ground supply.; • Pressure control; • Distribution; • Indications and warnings; • Interfaces with other systems.
		P3RA.3. GAS TURBINE ENGINE
		P3RA.3.1 **Fundamentals** 1 2 — • Potential energy, kinetic energy, Newton's laws of motion, Brayton cycle; • The relationship between force, work, power, energy, velocity, acceleration; • Constructional arrangement and operation of turbojet, turbofan, turboshaft, turboprop.

		P3RA.3.2 **Engine Performance** — 2 — • Gross thrust, net thrust, choked nozzle thrust, thrust distribution ,resultant thrust, thrust horsepower, equivalent shaft horsepower, specific fuel consumption; • Engine efficiencies; • By-pass ratio and engine pressure ratio; • Pressure, temperature and velocity of the gas flow; • Engine ratings, static thrust, influence of speed, altitude and hot climate, flat rating, limitations
		P3RA.3.3 **Inlet** 2 2 — • Compressor inlet ducts • Effects of various inlet configurations; • Ice protection.
		P3RA.3.4 **Compressors** 1 2 — • Axial and centrifugal types; • Constructional features and operating principles and • applications; • Fan balancing; • Operation: • Causes and effects of compressor stall and surge; • Methods of air flow control: bleed valves, variable inlet • guide vanes, variable stator vanes, rotating stator blades; • Compressor ratio
		P3RA.3.5 **Combustion Section** 1 2 — Constructional features and principles of operation.
		P3RA.3.6 **Turbine Section** 2 2 — • Operation and characteristics of different turbine blade types; • Blade to disk attachment; • Nozzle guide vanes; • Causes and effects of turbine blade stress and creep.

		P3RA.3.7 **Exhaust** 1 2 — • Constructional features and principles of operation; • Convergent, divergent and variable area nozzles; • Engine noise reduction;
		P3RA.3.8 **Bearings and Seals** — 2 — • Constructional features and principles of operation.
		P3RA.3.9 **Lubricants and Fuels** 1 2 — • Properties and specifications; • Fuel additives; • Safety precautions.
		P3RA.3.10 **Lubrication Systems** 1 2 — • System operation/lay-out and components.
		P3RA.3.1 1 **Fuel Systems** 1 2 — • Operation of engine control and fuel metering systems • including electronic engine control (FADEC); • Systems lay-out and components.
		P3RA.3.12 **Air Systems** 1 2 — • Operation of engine air distribution and anti-ice control systems, including internal cooling, sealing and external air services.
		P3RA.3. 13 **Starting and Ignition Systems** 1 2 — • Operation of engine start systems and components; • Ignition systems and components; • Maintenance safety requirements.

		P3RA.3.14 **Engine Indication Systems** • Exhaust Gas Temperature/Interstage Turbine Temperature; • Engine Thrust Indication: Engine Pressure Ratio, engine • turbine discharge pressure or jet pipe pressure systems; • Oil pressure and temperature; • Fuel pressure and flow; • Engine speed; • Vibration measurement and indication; • Torque; • Power.
		P3RA.3.1 5 **Power Augmentation Systems** • Operation and applications; • Water injection, water methanol; • Afterburner systems.
		P3RA.3.16 **Turbo-prop Engines** • Gas coupled/free turbine and gear coupled turbines; • Reduction gears; • Integrated engine and propeller controls; • Overspeed safety devices.
		P3RA.3.17 **Turbo-shaft engines** • Arrangements, drive systems, reduction gearing, couplings, control systems.
		P3RA.3.18 **Auxiliary Power Units (APUs)** • Purpose, operation, protective systems
		P3RA.3.19 **Powerplant Installation** • Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.

		P3RA.3.20 **Fire Protection Systems** • Operation of detection and extinguishing systems.
		P3RA.3.21 **Engine Monitoring and Ground Operation** • Procedures for starting and ground run-up; • Interpretation of engine power output and parameters; • Trend (including oil analysis, vibration and boroscope) monitoring; • Inspection of engine and components to criteria, tolerances and data specified by engine manufacturer; • Compressor washing/cleaning; • Foreign Object Damage.
		P3RA.3.22 **Engine Storage and Preservation** • Preservation and de-preservation for the engine and accessories/systems.
		P3RA.4. PISTON ENGINE
		P3RA.4. 1 **Fundamentals** • Mechanical, thermal and volumetric efficiencies; • Operating principles — 2 stroke, 4 stroke, Otto and Diesel; • Piston displacement and compression ratio; • Engine configuration and firing order.
		P3RA.4.2 **Engine Performance** • Power calculation and measurement; • Factors affecting engine power; • Mixtures/leaning, pre-ignition.
		P3RA.4.3 **Engine Construction** • Crank case, crank shaft, cam shafts, sumps; • Accessory gearbox; • Cylinder and piston assemblies; • Connecting rods, inlet and exhaust manifolds; • Valve mechanisms; • Propeller reduction gearboxes.

		P3RA.4.4 **Engine Fuel Systems** P3RA.4.4. 1 *Carburettors* • Types, construction and principles of operation;
		P3RA.4.4.2 *Fuel injection systems* • Types, construction and principles of operation.
		P3RA.4.4.3 *Electronic engine control* • Operation of engine control and fuel metering systems including electronic engine control (FADEC); • Systems lay-out and components.
		P3RA.4.5 **Starting and Ignition Systems** • Starting systems, pre-heat systems; • Magneto types, construction and principles of operation; • Ignition harnesses, spark plugs; • Low and high tension systems.
		P3RA.4.6 **Induction, Exhaust and Cooling Systems** • Construction and operation of: induction systems including alternate air systems; • Exhaust systems, engine cooling systems — air and liquid.
		P3RA.4.7 **Supercharging/Turbocharging** • Principles and purpose of supercharging and its effects on engine parameters; • Construction and operation of supercharging/turbocharging systems; • System terminology; • Control systems;
		P3RA.4.8 **Lubricants and Fuels** • Properties and specifications; • Fuel additives; • Safety precautions.

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		P3RA.4.9 **Lubrication Systems** • System operation/lay-out and components.
		P3RA.4.10 **Engine Indication Systems** • Engine speed; • Cylinder head temperature; • Coolant temperature; • Oil pressure and temperature; • Exhaust Gas Temperature; • Fuel pressure and flow; • Manifold pressure.
		P3RA.4. 11 **Powerplant Installation** • Configuration of firewalls, cowlings, acoustic panels, engine mounts, anti-vibration mounts, hoses, pipes, feeders, connectors, wiring looms, control cables and rods, lifting points and drains.
		P3RA.4.12 **Engine Monitoring and Ground Operation** • Procedures for starting and ground run-up; • Interpretation of engine power output and parameters; • Inspection of engine and components: criteria, tolerances, and data specified by engine manufacturer.
		P3RA.4.13 **Engine Storage and Preservation** • Preservation and depreservation for the engine and accessories/systems.
	P **A** **P**	P3**Av.1 BASIC AERODYNAMICS**
		P3Av1 .1 Physics of the Atmosphere • International Standard Atmosphere (ISA), • application to aerodynamics.

	R **III** **A** **V** **I** **O** **N** **I** **C** **S**	P3Av1 .2 Aerodynamics • Airflow around a body; • Boundary layer, laminar and turbulent flow, free stream flow, relative airflow, upwash and downwash, vortices, stagnation; • The terms: camber, chord, mean aerodynamic chord, profile (parasite) drag, induced drag, centre of pressure, angle of attack, wash in and wash out, fineness ratio, wing shape and aspect ratio; • Thrust, Weight, Aerodynamic Resultant; • Generation of Lift and Drag: Angle of Attack, Lift coefficient, Drag coefficient, polar curve, stall;
		P3Av1 .3 Theory of Flight • Relationship between lift, weight, thrust and drag; • Glide ratio; • Steady state flights, performance; • Theory of the turn; • Influence of load factor: stall, flight envelope and structural limitations; • Lift augmentation
		P3Av1 .4 Flight Stability and Dynamics • Longitudinal, lateral and directional stability (active and passive).
		Av 2.0 AIRCRAFT AERODYNAMICS, STRUCTURES AND SYSTEMS

ISSUE IV

		P3Av2.1 Theory of Flight (a) *Aeroplane Aerodynamics and Flight Controls* • Operation and effect of: — roll control: ailerons and spoilers; — pitch control: elevators, stabilators, variable incidence stabilisers and canards; — yaw control, rudder limiters; • Control using elevons, ruddervators; • High lift devices: slots, slats, flaps; • Drag inducing devices: spoilers, lift dumpers, speed brakes; • Operation and effect of trim tabs, servo tabs, control surface bias.
		(b) High Speed Flight • Speed of sound, subsonic flight, transonic flight, • supersonic flight, Mach number, critical Mach number.
		(c) Rotary Wing Aerodynamics • Terminology; • Operation and effect of cyclic, collective and anti-torque controls.

P3Av2.2 **Structures — General Concepts**

(a)

- Fundamentals of structural systems.

(b)

- Zonal and station identification systems;
- Electrical bonding;
- Lightning strike protection provision.

P3Av2.3 **Autoflight (ATA 22)**

- Fundamentals of automatic flight control including working principles and current terminology;
- Command signal processing;
- Modes of operation: roll, pitch and yaw channels;
- Yaw dampers;
- Stability Augmentation System in helicopters;
- Automatic trim control;
- Autopilot navigation aids interface;
- Autothrottle systems.
- Automatic Landing Systems: principles and categories,
- modes of operation, approach, glideslope, land, go- around,
- system monitors and failure conditions.

P3Av2.4 **Communication/Navigation (ATA 23/34)**

- Fundamentals of radio wave propagation, antennas, transmission
- lines, communication, receiver and transmitter;
- Working principles of following systems:
  - — Very High Frequency (VHF) communication;
  - — High Frequency (HF) communication;
  - — Audio;
  - — Emergency Locator Transmitters;
  - — Cockpit Voice Recorder;
  - — Very High Frequency omnidirectional range (VOR);
  - — Automatic Direction Finding (ADF);
  - — Instrument Landing System (ILS);
  - — Microwave Landing System (MLS);
  - — Flight Director systems;
  - — Distance Measuring Equipment (DME);

		— Doppler navigation; — Area navigation, RNAV systems; — Flight Management Systems; — Global Positioning System (GPS), — Global Navigation • Satellite Systems (GNSS); — Inertial — Air Traffic Control transponder, secondary surveillance radar; — Traffic Alert and Collision Avoidance System (TCAS); — Weather avoidance radar; — Radio altimeter; — ARINC communication and reporting;
		P3Av2.5 **Electrical Power (ATA 24)** • Batteries Installation and Operation; • DC power generation; • AC power generation; • Emergency power generation; • Voltage regulation; • Power distribution; • Inverters, transformers, rectifiers; • Circuit protection; • External/Ground power.

P3Av2.6 **Equipment and Furnishings (ATA 25)**

- Electronic emergency equipment requirements;
- Cabin entertainment equipment.

P3Av2.7 **Flight Controls (ATA 27)**

(a)

- Primary controls: aileron, elevator, rudder, spoiler;
- Trim control;
- Active load control;
- High lift devices;
- Lift dump, speed brakes;
- System operation: manual, hydraulic, pneumatic;
- Artificial feel, Yaw damper, Mach trim, rudder limiter, gust locks.
- Stall protection systems.

(b)

System operation; electrical fly by wire

P3Av2.8 Instrument Systems (ATA 31)

- Classification;
- Atmosphere;
- Terminology;
- Pressure measuring devices and systems;
- Pitot static systems;
- Altimeters;
- Vertical speed indicators;
- Airspeed indicators;
- Machmeters;
- Altitude reporting/alerting systems;
- Air data computers;
- Instrument pneumatic systems;
- Direct reading pressure and temperature gauges;
- Temperature indicating systems;
- Fuel quantity indicating systems;
- Gyroscopic principles;
- Artificial horizons;
- Slip indicators;
- Directional gyros;
- Ground Proximity Warning Systems;
- Compass systems;
- Flight Data Recording systems;
- Electronic Flight Instrument Systems;
- Instrument warning systems including master warning systems and centralised warning panels;

		• Stall warning systems and angle of attack indicating systems; • Vibration measurement and indication. P3Av2.9 Lights (ATA 33) • External: navigation, landing, taxiing, ice; • Internal: cabin, cockpit, cargo; • Emergency. P3Av2.10 On board Maintenance Systems (ATA 45) • Central maintenance computers; • Data loading system; • Electronic library system; • Printing; • Structure monitoring (damage tolerance monitoring).
		P3**Av 3.0 PROPULSION**
		P3Av 3.**1 Turbine Engines** (a) • Constructional arrangement and operation of turbojet, turbofan, turboshaft and turbopropeller engines; (b) • Electronic Engine control and fuel metering systems (EADEC) P3Av 3.2 **Engine Indicating Systems** • Exhaust gas temperature/Interstage turbine temperature • systems; • Engine speed; • Engine Thrust Indication: Engine Pressure Ratio, engine turbine discharge pressure or jet pipe pressure systems; • Oil pressure and temperature; • Fuel pressure, temperature and flow; • Manifold pressure; • Engine torque; Propeller speed.

APPENDIX 'VII'

GUIDELINES FOR PREPARATION OF TRAINING MANUAL

The format of Training Manual shall have (i) Preface (ii) Contents (iii) LEP. It should be in loose leap binder form. Training Manual shall contain atleast the following:

1. Certificate by Accountable Manager.
2. Location and layout of the institute.
3. The Scope of approval of the institute and the list of approved courses along with duration of training period in terms of No. of hours/months of theory and practical classes.
4. The names, qualifications and experience of chief instructor and all regular instructors and their field of specialisation, if any.
5. Responsibilities of chief instructor and all other regular instructors
6. The qualification of the individuals who would be admitted to the course and criteria and method of selection for admission.
7. Attendance requirements of the individuals who would be admitted to the course
8. Syllabus for each course phase wise for which approval is required. The syllabus shall list the Headings under which the subject matter will be presented and the sequence in which training will be imparted along with details of the subject that will be covered. The syllabus should also include appropriate time allotted to each topic.
9. Details of training aids including aircraft, engine, systems, mock-ups and equipment available.
10. Details of technical literature, periodicals and books available and the manner of making them available to the students.
11. Details of practical training that will be imparted to the candidates along with approximate period to be spent for each portion of the practical training.
12. The manner of conducting semester examination to assess the performance of trainees continuously and qualifying pass marks.
13. The manner in which the OJT will be conducted.
14. The manner in which the trainees failing in a few subjects would be coached additionally and examined subsequently.
15. Records to be maintained --- Type of records and duration, Records of foreign students along with their security clearance and visa validity.
16. Samples copies of Mark sheets/ Certificates to be issued to candidates after successful completion of semester/ full course, respectively.

APPENDIX 'VIII'

MINIMUM RECOMMENDED TEXT BOOKS
AIRCRAFT MAINTENANCE ENGINEERING TRAINING INSTITUTE

The following books prescribed by Central Examination Organisation of DGCA should be available with the institute library:

Paper I :

- Aircraft Manual
- Civil Aviation Requirements (Section 2- Airworthiness)
- Aeronautical Information Circulars
  (relating to Airworthiness)
  Airworthiness Advisory Circulars
- Aircraft Maintenance Engineers' Notices

Paper II :

- Civil Aircraft Inspection Procedures
  (CAP 459-Part I, Basic)
- Airframe & Powerplant Mechanics
  (General Handbook EA-AC 65-9A)
- Shop Theory by James Anderson Earl E. Tatro
- Training Manual General Section Book 1 thru 7 by Dale Crane.
- Aircraft Materials & Processes by Titterton
- Machine Drawing by AC Parkinsons
- Advanced Composites (EA-358) by Cindy Foreman
- Digital Fundamentals by Malvino and Leech
- Standard Aviation Maintenance Hand book EA-282-0
- Standard Aircraft Handbook (5th Edition) -Larry Reithmaier

PAPER III
AIRFRAME : (LIGHT AEROPLANES)

- Airframe and Powerplant Mechanics (AC 65-1 5A)-Airframe Hand Book
- Aircraft Materials and Processes- by George F.Titterton.
- Mechanics of Flight By -A.C.Kermode
- Civil Aircraft Inspection Procedure (CAP 459) Part II Aircraft
- Aircraft Maintenance and Repair (6th Edi) -By Kroes, Watkin and Delp
- Acceptable Methods, Techniques and practices
  (FAA)-EA-AC 43.13-1 A&2A
- Aircraft Construction Repair and Inspection
  -by Joe Christy

Light Aircraft Mai ntenance-byJ . E. Heywood
Light Aircraft Inspection-by J.E.Heywood
Aircraft Electrical Systems-by E. H.J.Pallet
Aircraft Instruments-by E.H.J.Pallet
Automatic Flight Controls-by E.H.J. Pallet
Advanced Composites (EA-358) -by Cindy Foreman
Airframe and Powerplant Mechanics-(EA-AC 65-9A)-General Hand Book

PAPER III
AIRFRAME : (HELICOPTERS)

The helicopter and How to Fly-by John Fay
basic helicopter maintenance-by Joseph Schafer
(Order No.EA-HF-2) IAP inc.
Basic Helicopter Hand Book-by FAA EA
AC 61-1 3B
Helicopter Aerodynamics-by R.W.Prouty
Aircraft Materials and Processes - -
by George F. Titterton
Advanced Composites(EA-358)-by Cindy Foreman
Civil Aircraft Inspection Procedure
(CAP 459) Part II Aircraft.
Rotary Wing Aerodynamics-by W.Z.Stepniewski
(Dover Publication Inc)
Basic Helicopter Aerodynamics-by J.Seddon (BSP Professional Books)
Aircraft Electrical System-by E. H.J. Pallett
Aircraft Instruments-by E.H.J.Pallett
Automatic Flight Control-by E. H.J.Pallett

PAPER III
AIRFRAME : (HEAVY AEROPLANE)

Airframe and Powerplant Mechanics(AC 65-1 5A) -Airframe Hand Book
Civil Aircraft Inspection Procedure (CAP 459) Part II Aircraft Advanced
Com posites(EA-358)-By Cindy Foreman
Any Books of Manuals covering all basic systems
of Modern Heavy Transport Airplane
Aircraft Repair Manual (FAA-AC-43.13)- By Larry Reithmaier
Aerodynamics-By Clancey
Aircraft Construction Repair and Inspection -By Joe Christy
Practical Aircraft Electronics System- by Albert Helfrick
Aircraft Materials and Processes-by George F.Titterton
Mechanics of Flight-by A.C.Kermode
M. GUILLON:Hydaulic Servo Systems', McGraw- Hill co., New York
Aircraft Instruments-by E.H.J.Pallett

POWER PLANT : (PISTON ENGINES)

Airframe and Powerplant Mechanics (EA-AC 65-1 2A)
-Power Plant Hand Book
Power Plant-By Bent and Mckinley
Civil Aircraft Inspection Procedure (CAP 459) Part II Aircraft
Aircraft Propeller and Controls-by Frank Delp
A&P Tecnicians Powerplant Text book- (EA-ITP-P)
Aircraft Piston Engines-By Herschel Smith
Airframe and Power Plant mechanics-General
Hand Book (EA-AC65-9A)

PAPER III
POWER PLANT : (TURBINE ENGINES)

IRWINE TREAGER: 'Aircraft Gas Turbine Tecnology
McGraw-Hill Book Company.
ROLLS ROYCE LIMITED:The Jet Engine' Product
Support (Graphics)Limited Derby, England.
UNITED TECHINOLOGIES P&W OPER/INSR 200(Latest
Edition): The Aircraft Gas Turbine Engine and
Its Operation 'United Aircraft Corporation.
Any Books or Manual covering all basic systems of Modern Jet Engine
JACK V. CASAMASSA and RALPH D.BENT:'Jet Aircraftpower Systems' -
McGrawhill Co..
TRANING NOTES: 'Gas Turbine Engines' Turbomeca,
Bordes, France.
DALE CRANE and NEAR CARLSON : 'Encyclopaedia
for Aviation Tecnologies' Distributor
-The English Book Store, Connaught Circus New Delhi
M.GUILLON: 'Hydaulic Servo Systems', McGraw-Hill co., New York
JOHN ANDERSON: 'Introduction to Flight',
McGraw-Hill Co., New York
Civil Aviation Authority: 'Civil Aircraft Inspection
Procedure (CAP459) Part-II
M .J.KROES, T.W.Wild, R.D. Bent and J.L.McKINLEY;
'Aircraft Power Plants' McGraw-Hill co., New York.
FRANK DELP : 'Aircraft Propellers and Controls'
Distributor-The English Book Store
Cannought Circus, New Delhi
E.MANGHAM, A.PEACE : 'Jet Engine Manual',
Distributor-The English Book Store,
Cannought Circus, New Delhi

ELECTRICAL SYSTEM

Electrical Technology-by B. L.Theraja
Aircraft Electrical System-by E . H .J . Pallett
Basic Electronics-Bemard Grob
Digital Computer Fundamentals-by Malvino
Micro Electronics Aircraft System- by E.H.J.Pallett
Basic Electricity-by Dale Crane
Aviation Electronics Vol.I(Every Pilot Guide to Aviation Electronics-by John M.Ferrara -Air and Space Company)
Principles of Servo mechanism-by A Typers & R.B.Miles
Aircraft Electricity and electronics-by Bent Mekinley and also by Eismin/ Bent Mekinley (M.C.Graw Hill Publication)
Civil Aircraft Inspection Procedure-Part II
Integrated Electronics-Millman and Halkias

PAPER III

lNSTRUMENT SYSTEM

Aircraft Instruments-by E.H.J.Pallett
Automatic Flight Control-by E.H.J.Pallett
Digital Principles and Applications-by Malvino and Leech
Basic Electronic -by Bemard Grob
Aircraft Instruments-by C.A.Williams
Integrated Electronic-Millman and Halkias
Aircraft Engineers hand Book No. 4 Instruments - by R.W.Sloley and W.H.Coulthard
Civil Aircraft Inspection Procedure-Part II Electrical Technology-by B. L.Theraja
The Mechanism of Inertial Position and Heading Indication by Winston Merkey John Hovorka
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