Question 1

(a) The three primary maintenance processes recognised by the CAA and FAA are; hard-time, on-condition, and condition-monitoring. Explain these three maintenance processes by giving an example of each. [8 marks]

(b) Explain the MSG-3 assigned task categories in terms of lubrication servicing, functional check, restoration, and discard. [4 marks]

(c) What are the classes of maintenance stations, and describe any two of them? [4 marks]

(d) In brief, discuss the en route service and terminating pre-flight checks. [4 marks]

Question 2

(a) Discuss the principles and the legislation of the following documentations:
   i. Authorised Release Certificate (Form JAA 1).
   ii. Renewal of the Certificate of Airworthiness.
   iii. Certification of modifications.
   iv. Category B1 licence. [8 marks]

(b) JAR-145 specifies the requirements for organisations that maintain commercially used aircraft and components of such aircraft. What is their responsibility with regard to equipment, tools and materials in order to ensure their continued JAR-145 approval from their national airworthiness authority? [4 marks]

(c) An approved maintenance training organisation JAR–147 is planning to change their location and expanding their aircraft type/task training. What are the first steps that the approved training organisation should consider before these changes take place? [4 marks]

(d) What are the types of modifications classified by the JAA? Describe the differences between them. [4 marks]
Question 3

(a) There are three major groups of spares recognised by the majority of airlines. These are: components (rotables and repairables), recoverables and expendables. Identify these aircraft parts in terms of economically recoverable, authorised repair, serial number, depreciated, and comparative unit cost. [5 marks]

(b) What is the main difference between a Master Minimum Equipment List (MMEL), and Minimum Equipment List (MEL)? Discuss the relevant legislation in terms of criticality and/or essentiality codes. [5 marks]

(c) The key ingredients of material requirements planning MRP are; Bill Of Material (BOM), Master Schedule (MS), and maintenance planning horizon PH. Briefly discuss their input into the MRP process. [6 marks]

(d) Based on the past records of a segmented rotor-disk brakes workshop, the estimation of demand during lead-time is normally distributed with $D_{LT}$ at 36 units and $\sigma_{d}$ is 15. What safety stock should be carried for a 90 percent cycle-service level where the value of $z$ is equal to 1.28 from the normal distribution table? What reorder point should be used at this stage? [4 marks]

Question 4

(a) Briefly discuss the principles and function of the following aircraft maintenance manuals:
   i. Operator/manufacturer scheduled maintenance development ATA MSG-3
   ii. E-Business specification for materials management ATA SPEC 2000
   iii. Aircraft operations manual
   iv. Component Maintenance Manual (CMM) [8 marks]

(b) What are the main parameters that influence direct and indirect maintenance cost? Describe any six of them. [6 marks]

(c) Describe the main data that is normally covered in the analysis of the actual maintenance job performance, which has been completed, so that bad conditions can be corrected in time. [6 marks]
Question 5

(a) The purpose of a De-Fuelling and Refuelling station in a maintenance complex is to ensure the self-efficiency of users for various operations. Describe these operations for both De-fuelling and Refuelling. [5 marks]

(b) The major decision facing an airline is whether to combine the painting operation with an intermediate layout or an overhaul of the aircraft. Briefly discuss these methods which consist of carrying out paint stripping and painting. [5 marks]

(c) The HFACS-ME framework is adapted to classify human errors and other factors. Under what error categories and levels (third order) could the following cases be investigated using this technique?

i. A poor component layout prohibits direct viewing during inspection.
ii. A maintainer who works for 20 hours straight and suffers from fatigue.
iii. A maintainer who is securing an aircraft in driving rain fails to properly secure it.
iv. A maintainer who is spotting an aircraft with his view is obscured by catapult steam.
v. A maintainer, due to perceived pressure, omits an inspection and signs it off. [5 marks]

(d) Commission versus Omission errors are among the CAA top list of maintenance errors. In brief what are the sub-categories of omission errors? [5 marks]

Question 6

(a) In general, metal aircraft are very free from deterioration by corrosion, but only because their designers and manufacturers are aware of the problems involved and have taken a great deal of care to avoid them. What are the main factors that cause aircraft corrosion? [5 marks]

(b) The FAA-proposed a corrosion control programme for ageing aircraft, and it adopted final recommendations on limiting structural fatigue. Briefly describe these levels of corrosion programme and their implications. [5 marks]

(c) Discuss the basic procedure used in visual NDT examination for surface flaws found on engine blades, and explain the work functionality of flexible fibre-optic Borescopes (Flexiscope). [5 marks]

(d) What are the main steps required for the detection of surface flaws by using Liquid Penetrant Testing LPT?
Question 7

(a) Identify the recommended NDT methods, or methods that could be used for detection of the following defects types:
   i. Cracks in bolts
   ii. Cracks in tubing
   iii. Lack of penetration
   iv. Stress corrosion
   v. Intergranular corrosion

(b) Failure was found to have initiated along a fuselage skin longitudinal lap joint. The eddy current method had been used to detect the flaws on the top rivet row, which was cracked at the critical lap joint. Determine the depth of penetration that will penetrate down into the fatigue flaw if the Aluminium resistivity is $2.65 \times 10^{-8}$ ohm-cm and frequency of 100 kHz was applied.

(c) Discuss the capability of Acoustic Emission Testing ATE, as a technique for monitoring and evaluating structural integrity.

(d) What are the main advantages and limitations of utilising Ultrasonic Testing (UT) for the detection of surface and subsurface flaws?

Question 8

(a) An aircraft was instructed by the Control Tower to abort its takeoff while it was accelerating at takeoff speed with a gross weight of 16,000 lb, and the indicated airspeed at the time the brakes were applied was 160 kn. The density altitude was 8,000 ft. When these values are applied to the brake limitation chart (Figure Q8), what is the kinetic energy? How long is the ground cooling time required? Identify its condition zone requirements.

(b) Numerous devices have been designed to control pressure in hydraulic systems. Describe the relief valve, its principle and purpose in terms of safety.

(c) An airspeed indicator is required on all certificated aircraft except free balloons. Identify some of the uses of the airspeed indicator.

(d) Certain general features and operational capabilities for fire warning and protection systems must be met or exceeded if such systems are to be used in certificated aircraft. Explain the requirements for overheat and fire protection systems.
Figure Q.8 - Brake limitation chart. (Goodyear Aerospace)

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