



Second Semester Examination
Academic Session 2018/2019

June 2019

ESA490 – Aerospace Manufacturing Technology
[Teknologi Pembuatan Aeroangkasa]

Duration : 2 hours
(Masa : 2 jam)

Please check that this examination paper consists of **TEN (10)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

Instructions : Answer **FOUR (4)** questions. **All questions are COMPULSORY.**

[Arahan : Jawab **EMPAT (4)** soalan. **Semua soalan WAJIB dijawab.]**

In the event of any discrepancies, the English version shall be used.

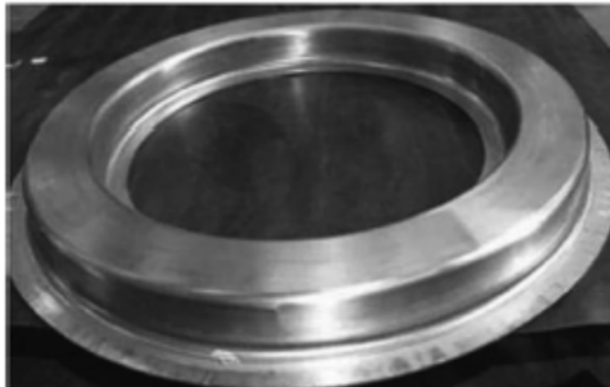
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunakan].

1. (a). Referring to the Malaysian Aerospace Industry Blueprint 2030, what are the **FOUR(4)** key areas to support the growth of aviation and space industry in Malaysia?
(20 marks)

- (b). Explain, what is the difference between dependent and independent demand for products.
(20 marks)

- (c). List **THREE (3)** manufacturing processes to produce the part as shown in **Figure Q1(c)**.
(15 marks)

- (d). Compare, with short comments, on the above choice of manufacturing processes in terms of costs, strength of the product and the time of manufacture.
(45 marks)

**Figure Q1(c)**

2. (a). List **FOUR (4)** major Rapid Prototyping Processes in the market today. **(20 marks)**

(b). Illustrate with simple sketches, the basic principles common to all Rapid Prototyping Processes. **(30 marks)**

(c). As a Process engineer in aerospace manufacturing industry, you have been assigned with the task in aircraft manufacturing planning, starting from market requirements to the final delivery of an aircraft to the customer. Discuss in details the various phases of aircraft manufacturing with the aid of **Figure Q2(c)**. **(50 marks)**

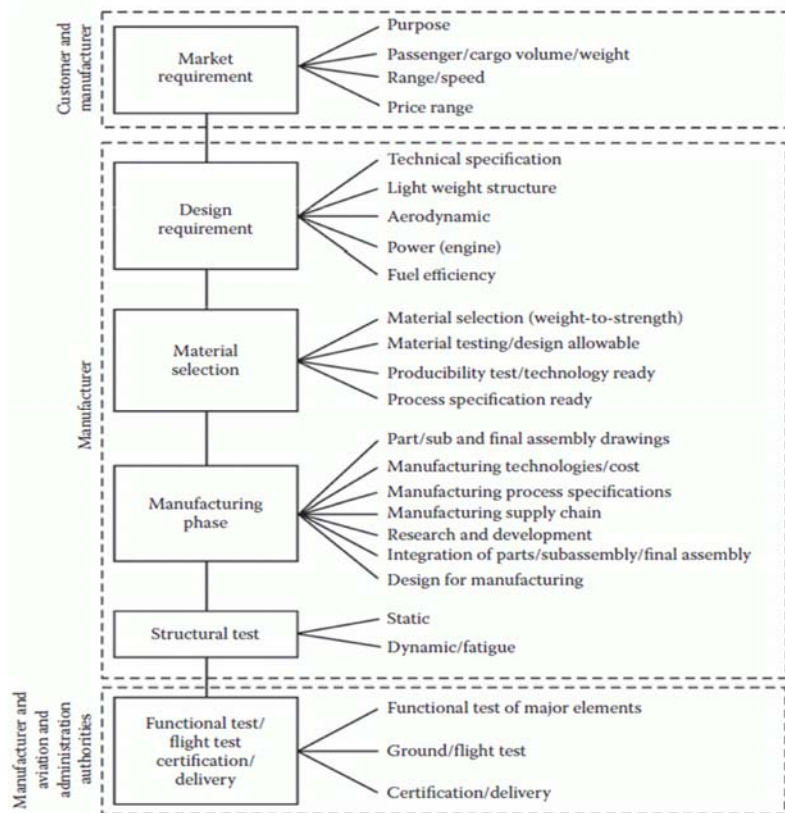


Figure Q2(c)

3. (a). In the aerospace manufacturing process, imperfect manufacturing conditions can lead to flaws and defective conditions of fabricated composite parts. In order to solve these problems, the Non-Destructive Testing (NDT) methods were developed to detect and characterize the flaws as well as to determine the material properties of composite materials. List and describe **FIVE (5)** examples of flaws that are found in composite materials.

(30 marks)

- (b). A final assembly plant inspects 23 important features of an aerospace grade shaft. During the previous month, 9056 aerospace grade shafts were produced. During inspection, 479 shafts were found defective with all 23 features, and 226 shaft had one or more defect. Determine Defects per million Opportunities (DPMO), Defects per million (DPM), and Defective units per million (DUPM) for these data and convert each to its corresponding sigma level.

(40 marks)

- (c). In aerospace manufacturing standard and requirement, define what is and what is not a First Article. State the list of documentation related to First Article.

(30 marks)

4. (a). The success of production depends on the manufacturing disciplines being involved throughout product design and supply chain. Discuss the **SIX (6)** Sourcing Strategies of Supply Chain.

(50 marks)

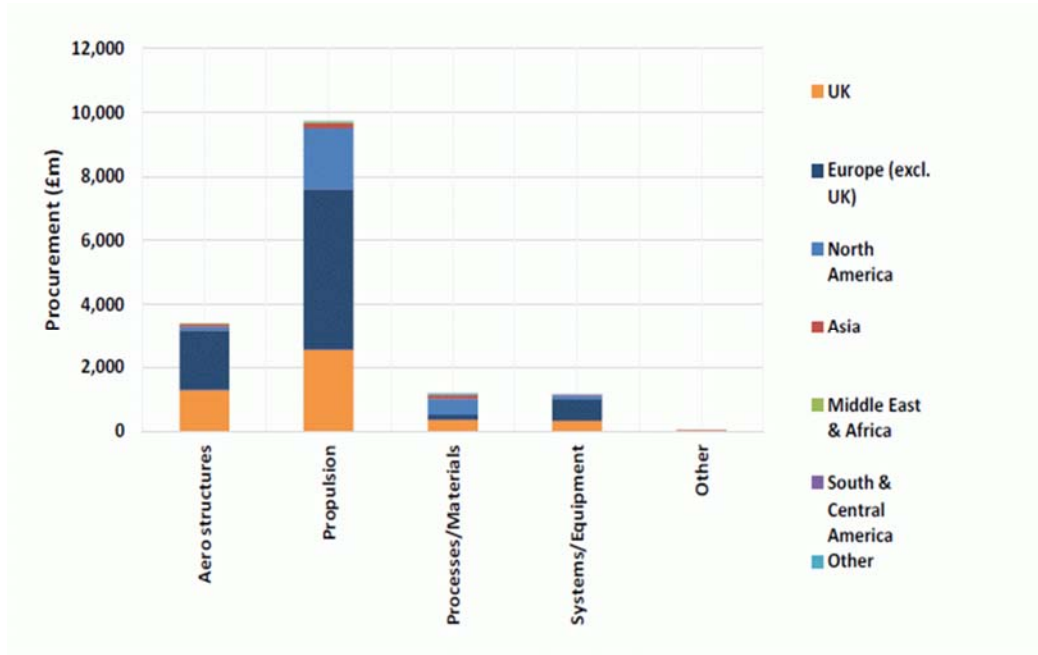


Figure Q4(b)

- (b). A supply chain focus is key to successfully executing production phase of aerospace manufacturing. Based on **Figure Q4(b)** the expenses of primes and major Tier 1 for each region, including only their top 10 suppliers, discuss the supply chain related to above figure data.

(50 marks)

1. (a). Merujuk kepada Pelan Industri Aeroangkasa Malaysia 2030, apakah **EMPAT (4)** bidang utama untuk menyokong pertumbuhan industri penerbangan dan industri angkasa di Malaysia?

(20 markah)

- (b). Terangkan, apakah perbezaan antara permintaan bergantung dan bebas untuk produk.

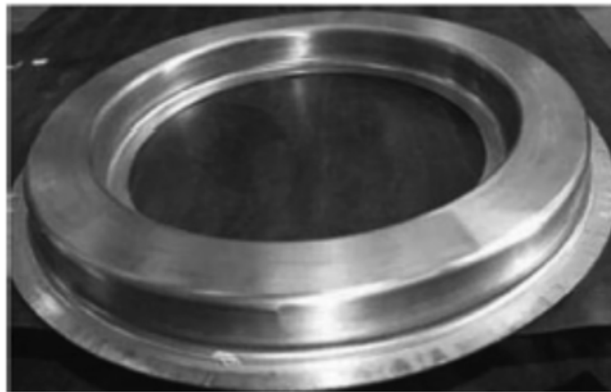
(20 markah)

- (c). **Berikan TIGA(3)** proses-proses pembuatan yang ditunjukkan dalam **Rajah S1(c)**.

(30 markah)

- (d). **Bandingkan** dengan secara ringkas pilihan-pilihan proses pembuatan di atas, dari segi kos, kekuatan produk dan jangkamasa pembuatan.

(30 markah)



Rajah S1(c)

2. (a). Senaraikan **EMPAT (4)** Proses Pencontohsulungan Pantas utama yang ada di pasaran sekarang.

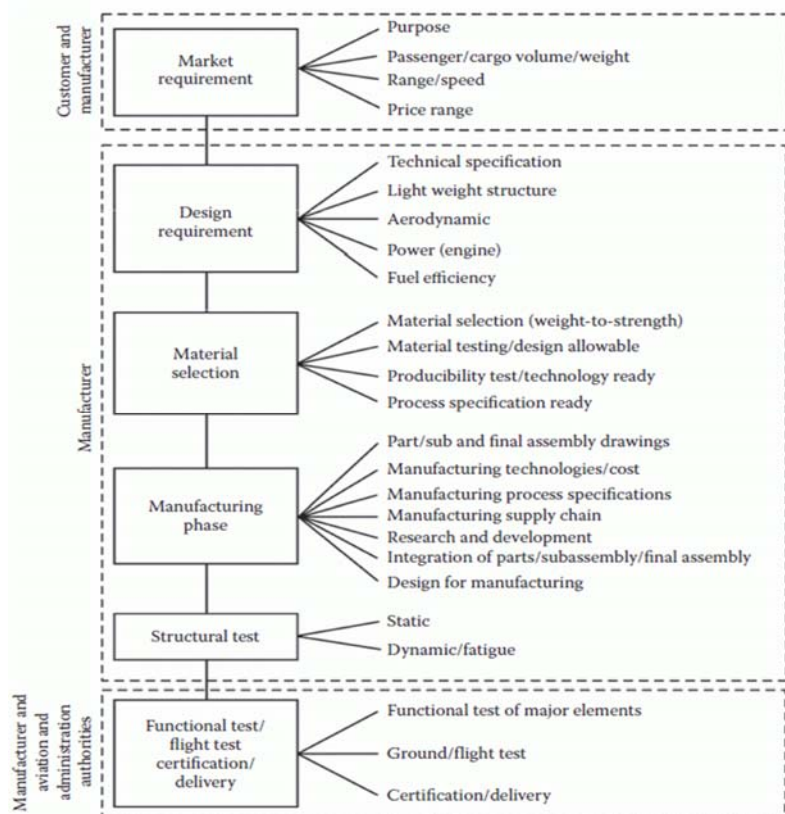
(20 markah)

(b). Jelaskan dengan bantuan lakaran mudah, prinsip asas yang sama bagi semua Proses Pencontohsulungan Pantas.

(30 markah)

(c). Sebagai seorang jurutera proses dalam industri pembuatan aeroangkasa, anda telah ditugaskan untuk merancang pembuatan pesawat bermula dari keperluan pasaran sehingga penghantaran akhir pesawat kepada pelanggan. **Bincangkan secara terperinci** fasa-fasa yang terlibat dalam pembuatan pesawat dengan bantuan **Rajah S2(c)**.

(50 markah)



Rajah S2(c)

3. (a). *Dalam proses pengilangan industri aeroangkasa, keadaan pembuatan yang tidak sempurna boleh membawa kepada kelemahan dan keadaan yang rosak dari bahagian komposit yang direka. Untuk menyelesaikan masalah di atas, kaedah Ujian-Tanpa Musnah (NDT) dibangunkan untuk mengesan dan mencirikan kekurangan serta menentukan sifat bahan bahan komposit. Senaraikan **LIMA (5)** contoh kelemahan yang terdapat dalam bahan komposit.*

(30 markah)

- (b). *Bahagian Pemasangan Akhir dimana 23 sifat pemeriksaan dijalankan bagi pembuatan aci. Pada bulan sebelumnya, 9056 aci bagi kegunaan aeroangkasa dihasilkan. Semasa pemeriksaan, 479 kecacatan di antara 23 ciri telah ditemui, dan 226 aci mempunyai satu atau lebih kecacatan. Tentukan Kecacatan setiap juta Peluang (DPMO), Kecacatan per juta (DPM), dan unit Kecacatan per juta (DUPM) untuk data ini dan tukar masing-masing kepada tahap sigma yang sepadan.*

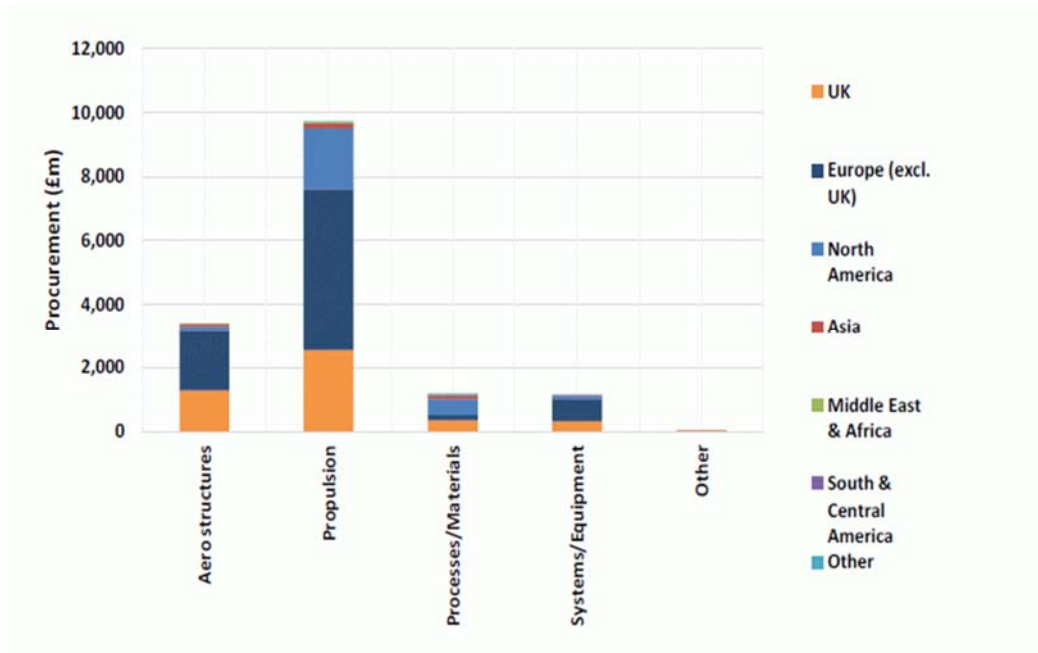
(40 markah)

- (c). *Dalam piawaian dan keperluan pengeluaran aeroangkasa, apakah Artikel Pertama dan apa yang bukan Artikel Pertama. **Nyatakan** senarai dokumentasi yang berkaitan dengan Artikel Pertama.*

(30 markah)

4. (a). Kejayaan pembuatan adalah bergantung kepada disiplin-disiplin pembuatan yang terlibat daripada rekabentuk produk dan rangkaian bekalan. Bincangkan **ENAM (6)** strategi sumber berhubung rangkaian bekalan tersebut.

(50 markah)



Rajah S4(b)

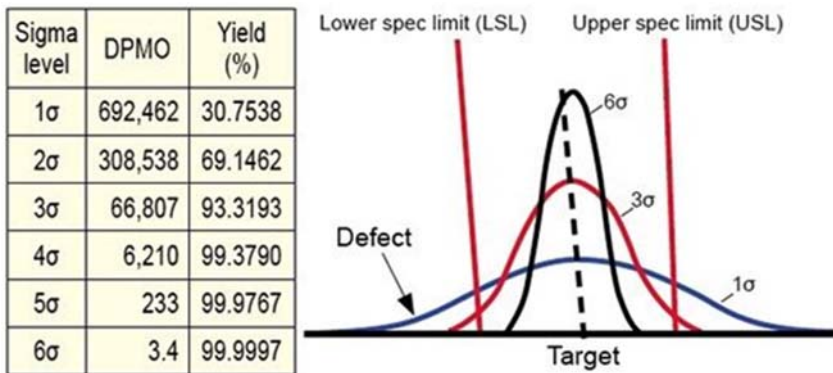
- (b). Fokus rangkaian bekalan adalah kunci kejayaan dalam melaksanakan fasa pengeluaran program pembuatan aeroangkasa. **Bincangkan** model rantaian proses yang berkaitan dengan data pada **Rajah S4(b)**.

(50 markah)

APPENDIX/LAMPIRAN

TABLE 42.3 Sigma Levels and Corresponding Defects Per Million in a Six Sigma Program.

Sigma level	Defects per million	Sigma level	Defects per million	Sigma level	Defects per million	Sigma level	Defects per million
6.0σ	3.4						
5.8σ	8.5	4.8σ	483	3.8σ	10,724	2.8σ	96,801
5.6σ	21	4.6σ	968	3.6σ	17,864	2.6σ	135,666
5.4σ	48	4.4σ	1,866	3.4σ	28,716	2.4σ	184,060
5.2σ	108	4.2σ	3,467	3.2σ	44,565	2.2σ	241,964
5.0σ	233	4.0σ	6,210	3.0σ	66,807	2.0σ	308,538



$$DPM = 1,000,000 \frac{N_d}{N_u}$$

$$DUPM = 1,000,000 \frac{N_{du}}{N_u}$$

$$DPMO = 1,000,000 \frac{N_d}{N_u N_o}$$

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