edcetera engineering

Final Exam

Continuing Education Course #445

Spacecraft Electrical Power

1. A typical electric power subsystem is approximately _____ percent of a spacecraft's total mass.
- a. 10%
- b. 33%
- c. 50%
- d. 65%

2. Which of the following is NOT a part of the typical Electric Power Subsystem?
- a. communication systems
- b. energy storage
- c. power generation
- d. power management

3. What are the primary drivers of the EPS from a power perspective?
- a. load, lifetime, energy requirements
- b. total load, lifetime, eclipse time
- c. voltage drop, weight, energy storage
- d. weight, total load, energy storage

4. Which of the following is the darkest eclipse most commonly encountered by spacecraft?
- a. lunar
- b. penumbra
- c. solar
- d. umbra

5. Which orbit is generally ideal for communications satellites that require continuous coverage over a given stable footprint on the Earth?
- a. GEO
- b. GSO
- c. HEO
- d. LEO

6. Approximately how many times does a LEO satellite circle the Earth for each time a GSO satellite circles the Earth?
- a. 2
- b. 4
- c. 6
- d. 12

7. What is the range of eclipse times, in minutes, for a LEO satellite?
- a. 25 to 100
- b. 35 to 120

○ c. 60 to 120
○ d. 120 to 240

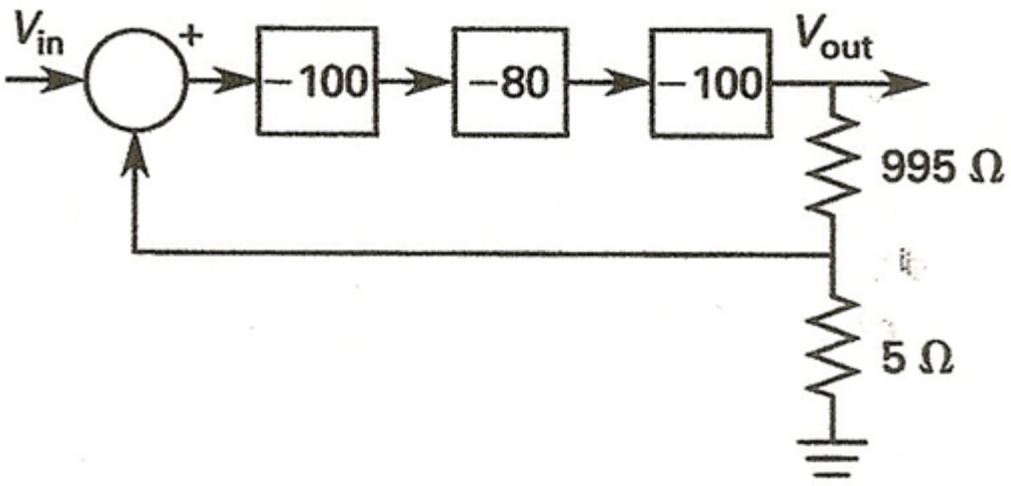
8. What is the orbital altitude of a GSO satellite?
○ a. 220 miles
○ b. 1243 miles
○ c. 22,236 miles
○ d. 35,786 miles

9. A total of __ satellite configurations in 6 orbits with an inclination of 55° ensures a minimum of __ satellites are always visible from the surface of the Earth.
○ a. 3, 24
○ b. 4, 24
○ c. 6, 24
○ d. 24, 4

10. A solar array is a _____ source while a battery is a _____.
○ a. current, voltage
○ b. current, power
○ c. power, voltage
○ d. voltage, current

11. A typical lithium-ion battery reaches 90% of maximum voltage at __% depth of discharge.
○ a. 40 %
○ b. 60%
○ c. 80%
○ d. 90%

12. An amplifier with multiple stages has gains as shown. What is the feedback value, H?

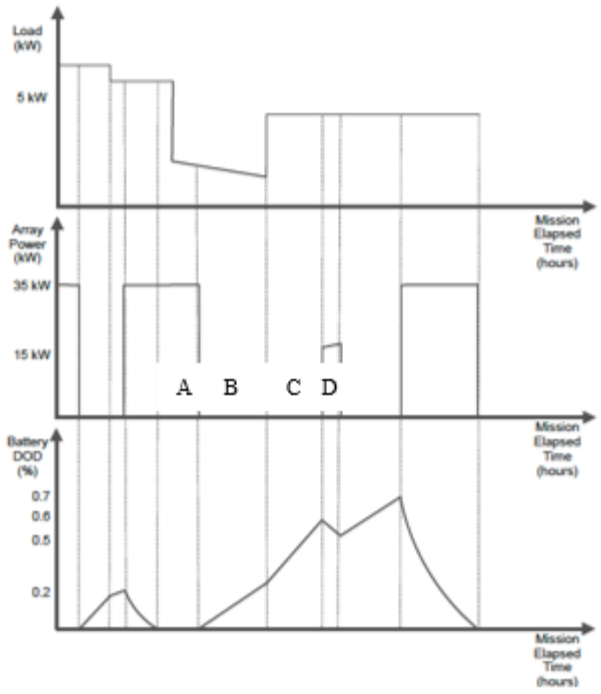


○ a. 0.005
○ b. 0.05
○ c. 1.0
○ d. 5.0

13. A given positive feedback circuit has a loop gain of -100, a gain of -2000, and an open loop transfer function of -19. What is the value of the feedback, H?

- a. 0.0095
- b. 0.05
- c. 100
- d. 2000

14. Which region of indicates an array in a partial eclipse?



- a. A
- b. B
- c. C
- d. D

15. What battery topology naturally balances individual cells?

- a. p-s
- b. s-p
- c. parallel
- d. series

16. During time in Earth's shadow the spacecraft draws 40 A for 100 minutes. Assume the battery was fully charged with a stored energy of 90 A-h. What is the depth of discharge at the end of the eclipse?

- a. 40%
- b. 44%
- c. 74%
- d. 90%

17. What most nearly is the battery charge capacity given the following data?

Bus Voltage	28V
Peak Load	1200 W
Load Duration	110 min
Cell Voltage	4.0

Allowable DoD 65%

- a. 121 A-h
- b. 725 A-h
- c. 846 A-h
- d. 7250 A-h

18. What is the total energy in a battery with a capacity of 90 A-h and an average bus voltage of 50 V?
- a. 18 W-h
- b. 90 W-h
- c. 45 W-h
- d. 4500 W-h

19. A lithium-ion battery specification sheet lists the following manufacturer's data.

Average Bus Voltage	50 V
Average Cell Voltage	4.0 V
Energy Density	120 W-h/lb
Battery Energy	4000 W-h

How much does the battery weigh?

- a. 2.5 lb
- b. 12 lb
- c. 30 lb
- d. 33 lb

20. Lithium-ion batteries are charged at a constant _____ until the cell voltage is 3.9 V – 4.2 V and then charged at a constant _____.
- a. current, lower current
- b. current, voltage
- c. voltage, current
- d. voltage, lower voltage

21. Considering requirements, where do battery requirement derive from?
- a. cell requirements
- b. chemistry requirements
- c. EPS requirements
- d. space power standards

22. Which of the following determine source selection and sizing?
- a. average power, cell chemistry
- b. average power, eclipse time
- c. orbital parameters, thermal requirements
- d. peak power, voltage control

23. What is battery telemetry's major purpose?
- a. monitor voltage
- b. monitor for faults
- c. monitor battery SOH
- d. monitor battery temperature

24. Which of the following is the top priority for requirements

- a. contract requirements
- b. industry standards
- c. regulations
- d. law

25. A requirement that specifies a "need" but not a "solution" is considered what type?

- a. goal oriented
- b. insufficient
- c. not comprehensive
- d. performance based

26. A category ___ requires shielding separate from other categories of harness.

- a. Ia
- b. Ib
- c. IIa
- d. IIIa

27. What is good thumb rule to use for the number of spare contact/pin connections to design into a project at the beginning of said process?

- a. 5%
- b. 10%
- c. 30%
- d. 50%

28. A wire is rated for 30 A and is bundled within a harness of 20 wires. What is the de-rated current of the wire?

- a. 9 A
- b. 10 A
- c. 15 A
- d. 20 A

29. The following data for a given copper wire circuit is available.

wire resistivity	$1.68 \times 10^{-8}\ \Omega \cdot m$
wire area	$0.04\ in^2$
circuit length	125 ft
current maximum	15 A
initial voltage	28 V

What most nearly is the final voltage at the load?

- a. 27.0 V
- b. 27.5 V
- c. 27.8 V
- d. 27.9 V

30. What TRL number is assigned to a flight proven part, subsystem, or system?

- a. 1
- b. 3

○ c. 6
○ d. 9

31. What grade of part has no predefined quality standards associated?
○ a. 1
○ b. 2
○ c. 3
○ d. 4

32. What is the condition for unconditional stability?
○ a. $Z_{\text{Load}} > 1$

○ b. $Z_{\text{Source}} > Z_{\text{Load}}$

○ c. $\frac{|Z_{\text{Load}}|}{|Z_{\text{Source}}|} < 1$

○ d. $\frac{|Z_{\text{Load}}|}{|Z_{\text{Source}}|} > 1$

33. A negative feedback system if the change in phase caused by the feedback loop exceeds ____ or greater.
○ a. 30°
○ b. 60°
○ c. 90°
○ d. 180°

34. The _____ margin is the number of decibels that the open-loop transfer function, G(s)H(s), is below 0 dB at the phase crossover frequency
○ a. gain
○ b. cross
○ c. phase
○ d. transfer

35. Which test is more severe?
○ a. acceptance
○ b. functional
○ c. short-circuit
○ d. qualification