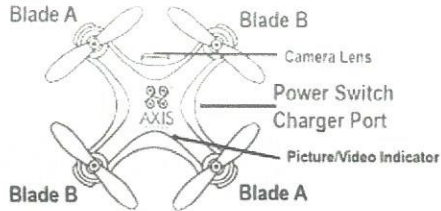


Question ** (25 marks: 25%): (CLO c: 70%)

Drone is an Unmanned Aerial Vehicle (UAV) i.e. an aircraft without a human pilot aboard. Drones have a variety of uses. It is worth to mention here, in our College of Engineering at King Saud University, Prince Sultan Center took an honorable job to design and fly drones.











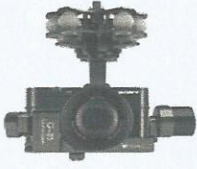





(a)



Schematic figure of a four bladed drone; (b) Picture of a four bladed drone

A sample design of a **four** bladed drone is shown in figure (a) and picture (b), respectively. **Each blade** is driven by **an electric motor**. The main features and options matrix is shown in **Table 1**.

Table 1: Main features and options matrix

Feature	Option 1	Option 2	Option 3	Option 4
Blade				
	A1: \$9.0	A2: \$6.0	A3: \$10.0	A4: \$12.0
Electric motor				
	B1: \$350.0	B2: \$ 250.0	B3: \$300.0	B4: \$400.0
Camera (Price: \$10.0 per MP)				
	C1: 40 Megapixel(MP)	C2: 80 Megapixel(MP)	C3: 60 Megapixel (MP)	C4: 50 Megapixel (MP)
Battery				
	D1: \$ 200.0	D2: \$ 250.0	D3: \$350.0	D4: \$300.0
Operating range	E1: 4500 m	E2: 5000 m	E3: 6000 m	E4: 5400 m
Maximum flight time	F1=30 min	F2=40 min	F3=30 min	F4=60 min

(a) Using the letters (A,B,C,D,E,F) shown in Table 1 for options, select the features of three designs to complete Table 2:

Table 2: Concepts generation

Design Feature	Design 1	Design 2	Design 3
Blade	A1	A2	A4
Electric motor	B1	B2	B4
Camera	C1	C3	C2
Battery	D2	D1	D3
Operating range	E2	E1	E3
Maximum flight time	F2	F1	F3

(b) Fill in Table 3 with the total cost for each design.

Table 3: Concept total cost

Feature	Design 1		Design 2		Design 3	
	No. of components	Cost	No. of components	Cost	No. of components	Cost
Blade	4	$9 \times 4 = 36$	4	$6 \times 4 = 24$	4	$12 \times 4 = 48$
Electric motor	4	$350 \times 4 = 1400$	4	$250 \times 4 = 1000$	4	$400 \times 4 = 1600$
Camera	1	$40 \times 10 = 400$	1	$60 \times 10 = 600$	1	$80 \times 10 = 800$
Battery	1	250	1	200	1	350
Total cost	2086		1824		2798	

Speed:

Design1: $5000/40 = 125 \text{ m/min}$

Design2: $4500/30 = 150 \text{ m/min}$

Design3: $6000/30 = 200 \text{ m/min}$

(c) Fill in Table 4 with the weight and rate using Table 2 and Table 3 in order to obtain the best design.

Table 4: Weight and rate

		Weight and rates matrix				Score
		Rate: 10 best1 worse				
		Criteria				
	Low cost	High resolution	High speed	High distance range		
Design 1	Weight (W)	30	20	30	20	350
	Rate (R)	5	2	2	5	
	W×R	150	40	60	100	
Design 2	Rate (R)	10	7	5	2	630
	W×R	300	140	150	40	
Design 3	Rate (R)	2	10	10	10	760
	W×R	60	200	300	200	

(d) Circle the best design

Design	1	2	3
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