DEPARTMENT OF MECHANICAL ENGINEERING

FIRST SEMESTER EXAMINATIONS
2019/2020 ACADEMIC SESSION

COURSE: MEE 507 – Engineering Design Process (2 Units)
CLASS: 500 Level Mechanical & Automotive Engineering
TIME ALLOWED: 2 Hours
INSTRUCTIONS: Answer any **FOUR** questions

Date: February, 2020

Question 1

(a) Briefly describe "Engineering design" and differentiate between the three design levels **(4 Marks)**

(b) State a reason why we need to design a product for minimum cost. Who are the customers of a product, and also state the possible customers of any identified product of your choice **(4 Marks)**

(c) Identify three major sources of generating customer needs and briefly differentiate between mock-up, model and prototype. **(4 Marks)**

(d) Draw and label a typical project life cycle to include the four different phases **(3 Marks)**

Question 2

(a) Describe Herrmann model and state four behaviours needed for effective team performance **(4 Marks)**

(b) Define the following terms used in CPM/PERT networks: **(4 Marks)**
i. Critical Path ii. Earliest Event Time
iii. Latest Event Time iv. Float

(b) Consider the following list of activities with its duration and predecessors. Find the critical path, and the draw the network, as shown in Table 1 **(7 Marks)**

Table 1: Activity Chart

Activity	Predecessor	Duration (Days)
a	-	5
b	-	4
c	a	3
d	a	4
e	a	6
f	b, c	4
g	d	5
h	d, e	6
i	f	6
j	g, h	4

Question 3

(a) Identify four different skills to conduct market analysis and briefly differentiate between "needs" and "requirements" **(4 Marks)**

(b) Briefly describe the "Quality Function Deployment Method" with the aid of a well labelled house of quality chart and identify the steps involved in generating a morphological chart **(5 Marks)**

(c) The results obtained from a design team indicates the different values obtained for four different concepts in Table 2

Table 2: Results from Design Team

Design Criteria	Weighted Factor	Rating factor for Concept A	Rating factor for Concept B	Rating factor for Concept C	Rating factor for Concept D
Use of standard parts	8%	3	9	5	8
Safety	12%	5	10	6	10
Simplicity and maintenance	10%	2	10	7	9
Durability	10%	4	8	7	8
Public acceptance	18%	9	6	8	9
Reliability	20%	6	7	6	7
Performance	15%	1	10	3	2
Cost to develop	3%	1	10	4	8
Cost to buyer	4%	3	8	5	8

Generate a decision matrix table to identify the concept with the highest rating and which closely satisfies the set decision criteria **(6 Marks)**

Question 4

(a) For the events defined in Table 3, complete the table and also draw the PERT network. Find the probability of finishing the task on time if the design due date is after 95 days. **(6 Marks)**

Table 3: Events Time

Predecessor	Optimistic	Most Likely	Pessimistic	Expected	Variance
1	3	5	8		
1	4	6	9		
3	3	4	5		
2	2	3	4		
5	3	4	5		
1	8	12	14		
4	14	18	21		
7	5	10	14		
7	5	10	14		
7	5	10	14		
7	5	10	14		
7	5	10	14		
12	4	6	10		
11	4	6	10		
10	4	6	10		
9	4	6	10		
8	4	6	10		
13	10	12	18		
6	16	18	24		
14	7	10	15		

14	10	15	22		
17	5	9	9		
18	4	6	8		
16	6	8	12		
15	3	8	12		
19	3	4	5		

(b) Identify the three main sections of NSPE code of ethics and state the six basic canons in Engineering **(4 Marks)**

(c) Briefly describe five different types of customer needs with the aid of a suitable sketch **(5 Marks)**

Question 5

(a) Using the results obtained in Table 4 from a design team, name the specific method used to evaluate the different concepts, complete the tabulation and identify the concept with the best possible design. **(6 Marks)**

(b) Briefly describe concurrent engineering to include design for different attributes such as DFM, DFA and DFE **(5 Marks)**

(c) State and explain briefly the two basic techniques for conducting safety analysis on engineering designs **(4 Marks)**

Question 6

(a) Identify the four components of a functional structure and six steps involved in analysing an engineering design **(5 Marks)**

(b) Discuss "Reverse Engineering" and draw a well labelled break even chart **(4 Marks)**

(c) State any four points of increasing creativity skills and identify any four questions that can be asked during the ideation process of generating ideas and briefly define anthropometry ergonomics? **(6 Marks)**

Table 4: Evaluation Chart

Evaluation Chart								
	Objective Weight/10	Sketch 1	Sketch 2	Sketch 3	Sketch 4	Sketch	Sketch 6	D
Easy to Assemble	7	0	0	0	+	0	+	A
Easy to Disassemble	7	0	0	0	+	+	+	I
Safe for Operator	10	0	0	0	0	0	0	U
Low Vibration	5	+	-	+	0	0	0	M
Portable	4	-	0	0	0	0	+	
No Sharp Edges	6	+	0	+	-	-	0	
Retails for less than competition	9	+	+	+	+	+	+	
Convert Energy Efficiently	10	-	0	0	0	0	0	
No flying Debris	8	0	0	0	0	0	0	
Low Pollution	3	0	0	0	0	0	0	
Low Replacement Part Cost	7	+	0	0	+	+	+	
Low Noise	4	0	+	+	0	0	+	
Strong Material	6	0	0	0	0	0	-	
Low Energy Dissipation	8	+	0	0	-	0	-	
Aesthetically Appealing	6	-	0	-	0	0	+	
Total +								
Total -								
Overall Total								
Weighted Total								