MECH.5760 EPM Midterm Exam Even 7th Digit. Name: **Kunal Nandanwar (02049382)**

**Please answer only one question depending on your student ID last (end) digit**

**Submit only the questions and your answers for your quiz version to lessen the amount of paper**

**Please show background formulas and calculations for math problems. No credit if no backup data is provided.**

**1.1 (Please answer only one question depending on your last digit on your UML ID)**

**2**. A part is specified with a tensile strength 2 sided specifications.

It has a Cp = 0.7. Please determine the reject rate. RR = **35720 ppm**

Therefore,

Using Standard Distribution Chart (which is symmetric, hence Z= - Z) to find the expected reject rate:

|  |  |  |  |
| --- | --- | --- | --- |
| **Z** | **f(Z)** | **One sided** | **Two-sided** |
| -2.1 (or 2.1) | 0.01786 | 17860 ppm | 35720 ppm |

**1.2. (Please answer only one question depending on your last digit on your UML ID)**

**2.** A pull test for aluminum is conducted with strength minimum only (no maximum specification). The reject rate is 0.6%. Please determine the Cp and Cpk of the pull test. (Assume average is centered = N)

Cp = ; Cpk =

Since average is centered =>

Reject rate: 0.6 /100 = **0.006** (for 1-sided)

From Standard Distribution Chart: f(Z) = 0.006 => **Z = -2.51(approx.)**

Therefore,

**1.3** **(Please answer only one question depending on your last digit on your UML ID).**

**If there is no applicable answer, please indicate by placing N/A.**

**2.** A design of experiment is to be performed on 4 factors and two levels. How many experiments do you need to do? Please specify the orthogonal experiment, using the nomenclature Lx.

Full factorial **16** , 1/2 factorial (half Fraction) **8 ,** Saturated (Screening Design) **8**

1. Full factorial: No of experiments = 24 **= 16**

Ly

1. Half factorial: No of experiments = 24-1 **= 8**
2. Saturated: No of experiments = **8 (using slides)**
3. Total number of experiments: =1+4\*(2-1) = **5**

Orthogonality means that all estimates can be obtained   
independently of one another, and it is critical for experiment   
design.

Lx, Ly, and Lz are 3 mutually perpendicular axes   
which represent orthogonal design.

Lz

Lx

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**2.1 (Please answer only one question depending on your last digit on your UML ID)**

Give 3 differences (Maximum) between the following: Limit yourself to one paragraph, max 6 lines:

**Please list the reasons separately as items 1, 2 and 3.**

**2. Maturity versus Commodity products**

|  |  |
| --- | --- |
| **Maturity** | **Commodity** |
| 1. A product is called maturity product when it is in the maturity stage of the cycle (i.e., Growth -> Maturity ->Decline) | 1. A product is called commodity when it is an input or a basic product in the production line (i.e., products are in fact made using commodities) |
| 1. Value to the product can be added in the maturity stage | 1. Value can not be added to a commodity |
| 1. A maturity product is available in a polished state | 1. A commodity is always available in a natural state |

**2.2** **(Please answer only one question depending on your last digit on your UML ID)**

Briefly Discuss the attribute of Product lifecycle Stages in Design and Manufacturing. Please limit yourself to one paragraph, max 6 lines. **Please list attributes separately as items 1, 2 and 3**

**2. Maturity Stage**

1. During this stage, companies face several different challenges and try to retain or establish their market share
2. It is a stage in which the sales growth slows down after reaching a peak
3. In this stage, decreasing market share and declining profits are often observed in this stage
4. This stage lasts longer than the growth stage/startup stage
5. This is also a stage in which the product competes against other similar products
6. Leading the company to increase advertisements and marketing of products

**3.1** **(Please answer only one question depending on your last digit on your UML ID)**

Briefly give three (Max) differences between the methods of the following. Limit yourself to one paragraph, max 6 lines. **Please list the differences separately as items 1 and 2 (except for questions 8/9).**

**2. World Class versus Best-in-Class Company performance**

|  |  |
| --- | --- |
| **World Class Company Performance** | **Best-in-Class Company Performance** |
| 1. There are the companies which provide the best possible product at the best possible price when the customer needs it | 1. They thoroughly study the market of a product & design their own version of a product which beats the existing competitors in the market |
| 1. Driven to a single vision and a shared goal among employees which is to deliver the optimal product | 1. Pushing the employees to be highly competitive in their area of interest and building team with such mentality |
| 1. Most world class companies have a predefined operational framework to tackle a new product launch | 1. The best-in-class companies always try to enhance the existing framework & keep on modifying their structure to survive the competition |

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**3.2** (**Please answer only one question depending on your last digit on your UML ID)**

For Patents, please provide an answer. Limit yourself to one paragraph, max 6 lines

**2. How should you label any document during new project negotiations?**

1. Always have a sales contract
2. Negotiate credit letter application
3. Should issue a letter of credit
4. Should have an advising letter of credit
5. control documents and release payment at maturity
6. Finally, a document release

**5.1 (Please answer only one question depending on your last digit on your UML ID)**

**2.** Compare the two scenarios for acquiring a machine for a project for 22 years expected operations, at a company with an internal rate of return of i = 15%. Which scenario is better? Please round to the nearest $.

Scenario 1. Buy an initial small machine at $12,000, it cost $2,400/year to run for the first 12 years, buy a second larger machine at $30,000 and run it for 10 years at a cost of $4,000/year. There is no salvage value at the end of service for either machine.

Scenario 2. Buy a large machine for $34,000 and run it for 22 years at a cost of $1,000/year. At the end of the 22 years, the machine is assumed to have a salvage value of $12,000.

Assumption:

* Machines are purchased at the beginning of the year
* Operational costs are added at the end of the year

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario 1** | |  | **Scenario 2** | |
| ROI | 15% |  | ROI | 15% |
| Initial Cost (small) | $12000 |  | Initial Cost | $34000 |
| OC (small) | $2400/year |  | OC | $1000/year |
| Initial Cost (large) | $30000 |  | Salvage | $12000 |
| OC (large) | $4000/year |  |  |  |
| Salvage | None |  |  |  |

|  |  |  |
| --- | --- | --- |
| **(PV in dollars)** | **Scenario 1** | **Scenario 2** |
| PV = | - Initial cost of smaller machine – Running cost of smaller machine (year 1 to 12) – initial cost of larger machine (at end of year 12) – Running cost of larger machine (from 11th year till 22nd year) | - Initial cost of large machine– Running cost of machine (till 22 years) + Salvage value after 22 years |
| PV = | -12000 - 2400(P/A, 15%,12) - 30000(P/F, 15%, 12) – [4000(P/A, 15%, 22) - 4000(P/A, 15%, 12)] | -34000 - 1000(P/A, 15%, 22) + 12000(P/F, 15%, 22) |
| PV = | -12000 - 2400\*5.4206 – 30000\*0.1869 – [4000\*6.3587 – 4000\*5.4206] | -34000 - 1000\*6.3587 + 12000\*0.0462 |
| PV = | -$34368.84 | -$39804.3 |

We can see that scenario 1 has lower PV magnitude and hence it is preferred to initially get small machine and then the larger oneMECH.5760 EPM Midterm Exam Even 7th Digit. Name: **Kunal Nandanwar (02049382)**

**5.2** **(Answer only one question depending on your last digit UML ID), See note at Exam end**

2. There are two electric motors that can provide 100 hp. Alpha motor can be purchased at $1,000 and has an efficiency of 85%, an estimated life of 10 years, and estimated maintenance costs of $50/year. Beta Motor will cost $1,400 and has an efficiency of 95%, life of 12 years and maintenance cost of $25/year. Assume that the company internal rate of return is 15%. Perform a Breakeven analysis to find out at what hours of operations the two motor costs are the same. Assume an electricity rate of $0.06 per kilowatt hour. Please plot your results.

For DETERMINING ELECTRIC MOTOR LOAD AND EFFICIENCY,

please use 100 hp = 100 Nameplate Rated Horsepower

page 3 equation 2,

<https://www.energy.gov/sites/prod/files/2014/04/f15/10097517.pdf>

P = 10hp = 100\*(0.7457kWh) = 74.57 kWh

Electricity rate = $0.06/kWh

Internal rate of return = 15%

Let N be number of hours per year

|  |  |  |
| --- | --- | --- |
|  | Alpha Motor | Beta Motor |
| Purchase Amount | $1000 | $1400 |
| Efficiency | 85% | 95% |
| Estimated Life | 10 years | 12 years |
| Estimated maintenance | $50/year | $25/year |

|  |  |  |
| --- | --- | --- |
|  | Alpha Motor | Beta Motor |
| Total Electricity cost = | 1000(A/P, 15%, 10) + 50 + N\*(74.57\*0.06)/0.85 | 1400(A/P, 15%, 12) + 25\*N + N\*(74.57\*0.06)/0.95 |
| = | 1000\*(0.1993) + 50\*1 + 5.26N | 1400\*(0.1845) + 25\*1 + 4.71N |
| = | 249.3 + 5.26N | 283.3 + 4.71N |

For Breakeven Point: 249.3 + 5.26N = 283.3 + 4.71N => N = 34/0.55 = 61.8 hours = 62 hours

Chart, line chart

Description automatically generated