2001 博士班資格考筆試

航機製造題目 10% each total 50%

1. Residual stresses from manufacturing processes
   (i) What are the causes?
   (ii) Advantages and disadvantages of having them?
   (iii) How can they be reduced?
2. How do you compare the mechanical properties of forged parts, machined parts and casted parts? and why?
3. Given the following components, what are the preferred manufacturing process and its material? and why?
   (i) window frame (ii) motorcycle engine block (iii) car bumper.
4. Please name five non-traditional machining processes, their working principle and related applications.
5. Spellout the following manufacturing terminology and a short decsr.
   (i) RP (ii) MEMS (iii) CAM (iv) CIM

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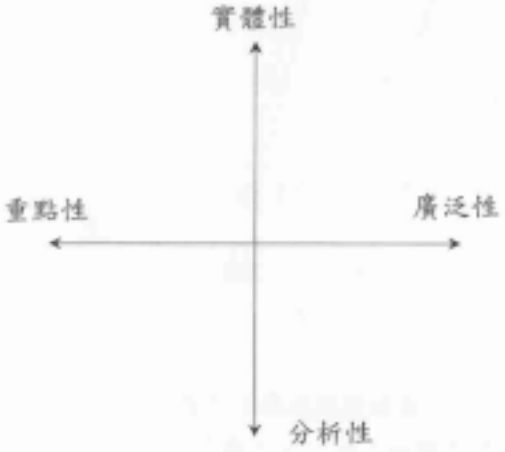
機械設計部分

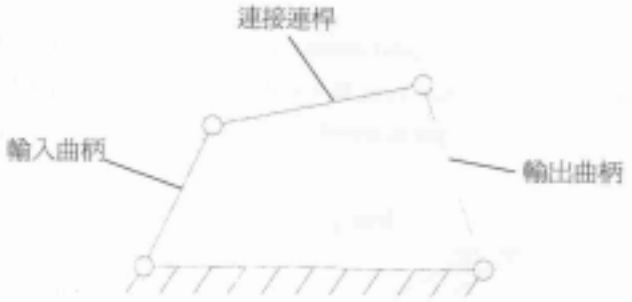
1. 在產品設計過程中，「設計原型(prototype)」是設計成員間傳達、評估設計概念與發掘設計問題的有效工具。美國麻省理工學院機械系教授 Ulrich 與 Eppinger 將原型定義為"近似於產品一個或多個重要性質的表現方式"，在此定義下，任何表現方式能夠對設計者展現出該產品的某些性質時，都可稱之為原型，原型所涵蓋的範圍可以從概念的圖示到具有完全功能性的產品。Ulrich 與 Eppinger 兩人並且依原型的性質與表現方式將原型可分為兩個象度(dimension)，如下圖所示。第一個象度是指原型所具有的「實體性(physical)」和與其相對之「分析性(analytical)」的等級；第二個象度則是指原型所具有之「廣泛性(comprehensive)」與其相對之「重點性(focused)」的等級。所謂"實體性"原型是近似產品的有形成品，產品設計者以製作實體的原型藉以了解、測試產品各種重要的特性；"分析性"原型則是以不具備有外形實體的方式來表現產品，對於產品重要特性的表達是以分析的方式取代實體模型的製作；"廣泛性"原型是指設計原型能夠滿足產品大部分的性質，例如一般設計者所認知之最終設計產品之雛型，即是屬於廣泛性原型；"重點性"原型通常只滿足產品的一個或少數性質，或針對某特定子系統製作原型。



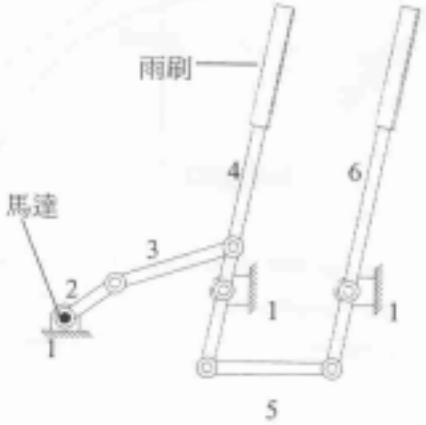
在以上定義下，試舉出 10 種不同的製作設計原型的方法，並繪製如上圖之二維座標，將 10 種不同的設計原型位置依照此類原型的性質定義在此座標中。(10%)

2. 四連桿機構中必定有一個固定連桿，和固定連桿連接的一個連桿為驅動連桿或輸入連桿，機構學上的專有名詞也叫做「輸入曲柄(input crank)」。另外一個和固定連桿相連的連桿為被驅動連桿，或者叫做「輸出曲柄(output crank)」，輸入和輸出曲柄之間的連桿叫做「連接連桿(coupler link)」，各個連桿的相對關係如下圖所

示。四連桿機構又可分為「曲柄搖桿(crank and rocker)」機構，輸入曲柄可以作360度完全旋轉，其他連桿則只作往復震盪動作；「雙曲柄(double crank)」機構，除固定連桿外其他三個連桿都可以相對於固定連桿作360度完全旋轉；「雙搖桿(double rocker)」機構，輸入和輸出曲柄都只能作往復震盪動作。



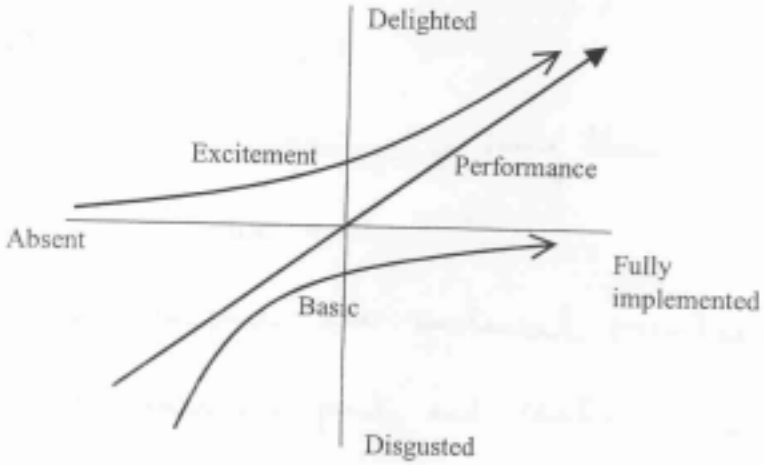
下圖是一個汽車雨刷機構，試以前述機構名詞，很“專業”地描述此雨刷機構的組成與動作。(10%)



3. 工廠中佩戴的安全眼鏡常常會因為工作環境溼度過高，或經歷冷熱不同環境而起霧，影響勞工工作，因此必須針對此點加以改善。試構思幾種可能的安全眼鏡改良設計，能夠改善安全眼鏡起霧的現象。為了評估這些改善方案是否有效，必須要有一客觀的實驗，能夠模擬工廠環境，產生霧氣，並量測在工廠環境下安全眼鏡是否容易起霧。請設計一個這樣的實驗，並說明在你的實驗中評估安全眼鏡是否容易起霧的指標為何。(10%)

4. 試繪圖或列出計算公式表達下列齒輪之專有名詞：gear, pinion, base circle, pitch circle, pressure line, pressure angle, pitch, module, addendum, dedendum, idle gear。(10%)

5. Kano presented a model of customer satisfaction. According to this model, there are three different types of product quality that give customer satisfaction: basic quality, performance, and excitement quality, as shown in the figure below.



Basic quality is the customers' requirements that are not verbalized as they specify assumed functions of the device. Performance quality refers to customer's requirements that are verbalized in the form that the better the performance, the better the product. The products that include excitement quality will be popular and delighted. However, these customers' requirements are often unspoken because customers do not expect them to be met in the products. Therefore, an engineering designer has a responsibility to find the excitement qualities of the products that customers may not even realize.

Use a product that you are familiar with as an example, to describe what are the basic quality, performance quality, and excitement quality of this product. (10%)