國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：工程英文【機電系碩士班丁組】　　題號：438001

※本科目依簡章規定「不可以」使用計算機　　

I. Select proper technical terms for each description: (48% in total, 3% each, 單選)

1. (1. allowance, 2. fillet, 3. taper, 4. tolerance): Minimum clearance between mating parts.
2. (1. allowance, 2. fillet, 3. taper, 4. tolerance): Conical form given to a shaft or a hole.
3. (1. allowance, 2. fillet, 3. taper, 4. tolerance): An interior rounded intersection between two surfaces.
4. (1. allowance, 2. fillet, 3. taper, 4. tolerance): Total amount of variation permitted in limit dimension of a part.
5. (1. addendum, 2. cam, 3. pinion, 4. rack): A rotating member for changing circular motion to reciprocating motion.
6. (1. addendum, 2. cam, 3. pinion, 4. rack): A flat bar with gear teeth in a straight line to engage with teeth in a gear.
7. (1. addendum, 2. cam, 3. pinion, 4. rack): The smaller of two mating gears.
8. (1. addendum, 2. cam, 3. pinion, 4. rack): Radial distance from pitch circle to top of gear tooth.
9. (1. anneal, 2. casting, 3. forge, 4. lathe): To force metal while it is hot to take on a desired shape by hammering or pressing.
10. (1. anneal, 2. casting, 3. forge, 4. lathe): To heat and cool gradually, to reduce brittleness and increase ductility.
11. (1. anneal, 2. casting, 3. forge, 4. lathe): A machine used to shape metal or other materials by rotating against a tool.
12. (1. anneal, 2. casting, 3. forge, 4. lathe): A metal object produced by pouring molten metal into a mold.
13. (1. alloy, 2. development, 3. key, 4. temper): To reheat hardened steel to bring it to a desired degree of hardness.
14. (1. alloy, 2. development, 3. key, 4. temper): Drawing of the surface of an object unfolded or rolled out on a plane.
15. (1. alloy, 2. development, 3. key, 4. temper): Two or more metals in combination, usually a fine metal with a baser metal.
16. (1. alloy, 2. development, 3. key, 4. temper): A small piece of metal sunk partly into both shaft and hub to prevent rotation.

II. 英翻中(共19分)

17. Rolling is a process of reducing the thickness or changing the cross section of long workpiece by compressive forces applied through a set of rolls. This process is similar to rolling dough with a rolling pin to reduce its thickness. Rolling, which accounts for about 90% of all metals produced by metalworking processes, was first developed in the late 1500s. Modern steelmaking practices and the

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production of various ferrous and nonferrous metals and alloys now generally involve combining continuous casting with rolling processes. This greatly improves productivity and lower production costs. Nonmetallic materials also are rolled to reduce their thickness and enhance their properties. Typical applications are in the rolling of plastics, powder metals, ceramic slurry, and hot glass.

III. 閱讀測驗 (第 18 至 28 題，每題 3 分，共 33 分)

說明: 請閱讀下列文章，然後根據文章之文意回答下列問題，並寫在答案紙上，可以中文或英文回答。

Directions: Read a journal abstract below, and then answer the following questions by writing your answers onto the answer sheets.

Friction stir forming for dissimilar material joining application
S. Lazarevic et al.
Mechanical Engineering, University of Hawaii, HI 96822, United States
Journal of Manufacturing Processes, (2013)
Mass reduction of automotive body structures is a critical part of achieving reduced CO_2 emissions in the automotive industry. There has been significant work on the application of ultra-high strength steels and aluminum alloys. However, the next paradigm is the integrated use of both materials, which poses a challenge of how to join the dissimilar materials. Friction stir forming is a new manufacturing process for joining dissimilar materials. The concept of this process is stir heating one material and forming it into a mechanical interlocking joint with the second material. In this research the process was experimentally analyzed in a position controlled robotic friction stir welding machine between aluminum and steel workpieces. New tool geometries were evaluated toward the goal of optimizing joint strength. The significant process parameters were identified and their optimized settings for the current experimental conditions defined using a design of experiments methodology. A scanning electron microscope was used to characterize the bonding and joint structure for single and multi-pin configurations. Two failure modes, aluminum sheet peeling and bonding delamination, i.e. braze fracture, were identified. It was found that the presence of zinc coating on the steel and overall joint geometry greatly affected the joint strength. The aluminum-zinc braze joint

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appears to be the largest contributor to joint strength for the single-pin joint configuration. The multi-pin geometry enabled a distribution of load to the four pins for increased joint toughness and ductility. Thus, the friction stir forming has been shown to exhibit potential for joining of aluminum to steel.

18. In which journal was this paper published?
19. When was this paper published?
20. Lazarevic et al. wrote this article, what is the meaning of the word "et al."?
21. What is the friction stir forming?
22. What is the purpose of this paper?
23. What is the meaning of the term "dissimilar materials"?
24. What is the meaning of the term "braze joint"?
25. What is the meaning of the term "aluminum sheet peeling"?
26. What is the meaning of the word "ductility"?
27. What is the meaning of the term "toughness"?
28. What is the meaning of the term "joint strength"?

國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：工程數學【機電系碩士班乙組、丙組】　　題號：438002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

I. (35%)

1. (35%) Solve the following ordinary differential equations (ODEs).

(a) (15%) $y''-2y'-3y=6xe^{2x}-5,\ y(0)=4/3,\ y'(0)=1/3$

(b) (20%) $y''+2y'+y=\delta(t-\pi),\ y(0)=1,\ y'(0)=0$ (δ : Dirac delta function)

II. (35%)

1. (15%) Find an eigenbasis (a basis of eigenvectors) of matrix **A** and use similarity transformation to diagonalize it.

$$\mathbf{A}=\begin{bmatrix}3 & 2\\ 2 & 6\end{bmatrix}$$

2. (20%)

(a) (15%) Evaluate the flux integral $\int_S \mathbf{F}\bullet\mathbf{n}\,dA$ for the following data.

$$\mathbf{F}=[x,\ y,\ z],\ S:\mathbf{r}=\left\lfloor u\cos v,\ u\sin v,\ u^2\right\rfloor,\ 0\le u\le 2,\ -\pi\le v\le\pi$$

(b) (5%) Indicate the kind of surface.

III. (30%)

1. (5%) Which of the following is an "even" function of t?

(A) t^2

(B) t^2-4t

(C) $sin(t)+cos(t)+3t$

(D) t^3+16

2. (5%) A "periodic function" is defined as a function

(A) has a period $T=2\pi$

(B) satisfies $f(t+T)=f(t)$

(C) satisfies $f(t+T)=-f(t)$

(D) has a period $T=\pi$

3. (20%) Let $f(x)=\begin{cases}1 & if\ -\pi/2\le x\le\pi/2\\ -1 & if\ -\pi\le x<-\pi/2\ or\ \pi/2<x\le\pi\end{cases}$,

Please find the Fourier series for f(x)

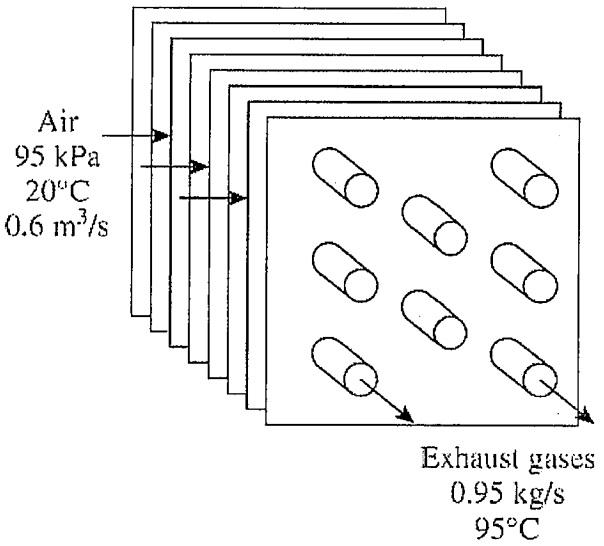
國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：基礎熱傳學【機電系碩士班甲組】　　題號：438004

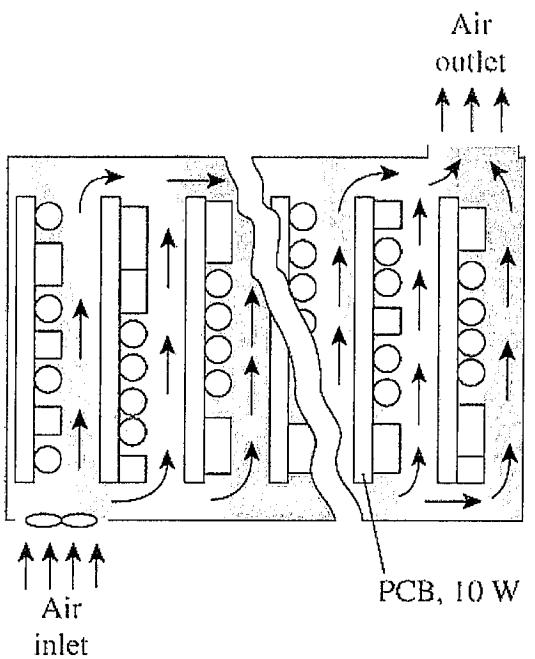
※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

1. 5%. Please explain the physical meaning of velocity boundary layer and thermal boundary layer. If the Prandtl number of a fluid is great than 1, do you think which one will have thicker boundary layer thickness?

2. 20%. Air (c_p = 1.005 kJ/kg • °C) is to be preheated by hot exhaust gases in a cross-flow heat exchanger before it enters the furnace. Air enters the heat exchanger at 95 kPa and 25°C at a rate of 0.6 m^3/s. The combustion gases (c_p = 1.10 kJ/kg • °C) enter at 160°C at a rate of 0.95 kg/s and leave at 95°C. Determine the rate of heat transfer to the air and its outlet temperature.



3. 20%. A computer cooled by a fan contains eight PCBs, each dissipating 10 W power. The height of the PCBs is 12 cm and the length is 18 cm. A 25-W fan mounted at the inlet supplies the cooling air (c_p = 1.005 kJ/kg • °C). If the temperature rise of air as it flows through the case of the computer is not to exceed 10°C, determine (a) the flow rate of the air that the fan needs to deliver and (b) the fraction of the temperature rise of air that is due to the heat generated by the fan and its motor.



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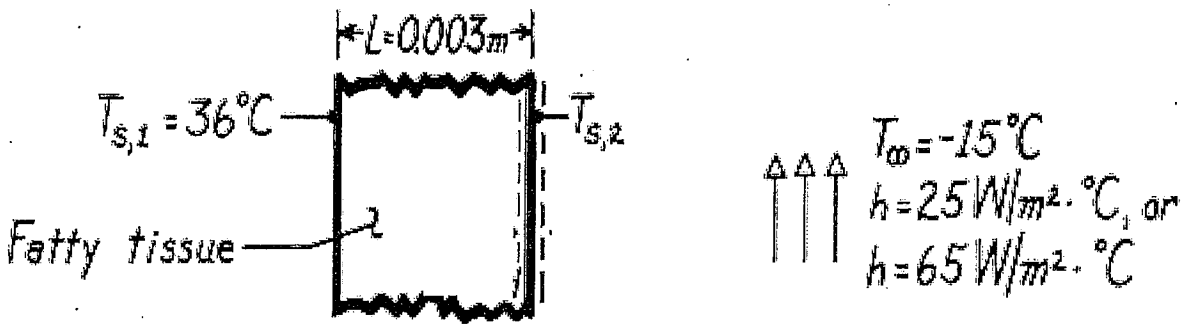
4. 25%. To investigate the wind chill effect, we can consider the following picture. The inner skin and air temperature are given as $T_{S,1}$and T_∞, the thickness of the fatty tissue of the human skin is L, the heat convection coefficient h=25 and 65 W/m^2· ℃ for calm and windy weather respectively, and conductivity$k$=0.2 W/(m· K) for the fatty tissue.

(a) (8%) What is the ratio of the heat loss per unit area from the skin for the calm day to that for the windy day?

(b) (7%) What are the temperatures of the outer skin $T_{S,2}$ under calm and windy day?

(c) (10%) What temperature would the air have to assume on the calm day to produce the same heat loss occurring with the current air temperature on the windy day?



5. 30%. A rectangular bar is with W as width,H as height, and L as length. It has a homogeneous initial temperature T_i and thermal properties such as thermal conductivity k, density ρ, and specific heat c. Then it is suddenly immersed into a hot liquid bath with T_∞ and heat convection coefficient h. The lumped capacitance method will be applied here to analyze the transient conduction problem.

(a)(5%) What is 'lumped capacitance method'?

(b)(5%) If you want to use lumped method to analyze this problem, is there any requirement?

(c)(10%) Please derive a governing equation to determine the temperature $T(t)$ of the bar after it is immersed into the hot bath as t is the transient time.

(d)(10%) Please solve $T(t)$ from equation you list in (c).

國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【機電系碩士班戊組】　　題號：438005

※本科目依簡章規定「不可以」使用計算機　　

I. English to Chinese Translation (75%)

1. We live in a world with an ever-increasing and energy-hungry population. Man-made energy, in the form of electricity or locomotion, has become an essential part of survival and progress, but is also the single major cause for many modern environmental problems such as greenhouse gas emissions and sea acidification. (20%)

2. Nanocomposites materials have drawn much attention because of their interesting optical properties which are different from the individual polymers. Combining inorganic nanoparticles and organic polymer together exhibit unexpected properties and enhances the optical properties of nanocomposites. (20%)

3. Traditionally, etching silicon technology is widely adopted in the microfabrication of conductive patterns in flexible electronics. This method involves not only a complicated process but also much pollution. (10%)

4. Multilevel Cu interconnects have been widely used for the most advanced VLSI circuits due to their high electrical conductivity and high electro-migration resistance. (5%)

5. With the increasing usage of mixed-signal integration, reliability requirements for analog MOS circuit application have become more critical. (5%)

6. The study we present in the present paper is an attempt to supplement the findings of these earlier studies. It is similar to the previous studies discussed above, in that the focus is on command of the grammar of the second language. It differs from previous studies, however, in the way subjects' proficiency in the language is assessed. (15%)

II. Single Choice Questions (5% for each)

1. Via broadband internet connection, online shop can take an unconventional approach _____ promoting goods.
   (A) with
   (B) to
   (C) at
   (D) by

2. The results of the test are consistent _____ the hypothesis that there is an increase in basic memory capacity with age.
   (A) with
   (B) to
   (C) at
   (D) for

3. When one takes risks, he or she is, by definition, not _____ control of the results.
   (A) for
   (B) to
   (C) in
   (D) as

4. In the ancient times, gold once functioned _____ the medium of exchange.
   (A) for
   (B) to

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(C) in
(D) as

5. When reading a novel, readers would sometimes identify _____ characters of their own gender.
(A) with
(B) to
(C) at
(D) by

國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：應用力學【機電系碩士班丙組】　　題號：438006

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

第[1]題與第[2]題為複選題。**(50%)**

請務必將複選題之答案寫在答案卷內之『選擇題作答區』，否則不予計分。

[1] At the instant shown, the length of the boom AB is being decreased at the constant rate of 0.2 m/s and the boom is being lowered at the constant rate of 0.08 rad/s, which of the following statements are correct?(25%)

(A) The vertical component of the velocity of point B is less than 68 mm/s.

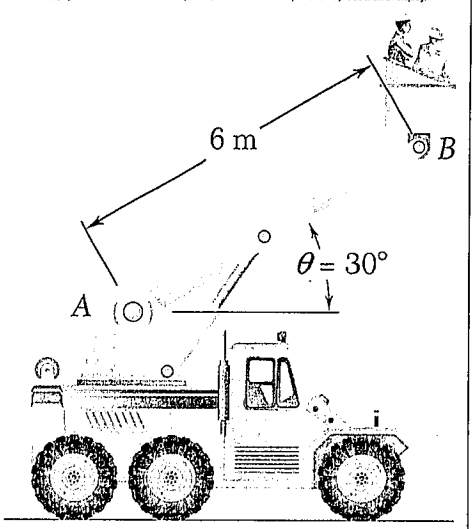
(B) The magnitude of the absolute velocity of point B is greater than 0.5 m/s.

(C) The relative acceleration of point B with respect to boom AB equals to (6 m)(0.08 rad/s)^2.

(D) The coriolis velocity of point B equals to (2) (0.08 rad/s)(0.2 m/s).

(E) The magnitude of the absolute acceleration of point B is greater than 48 mm/s^2.

(F) None of the above statements is correct.



[2] A cord is wrapped around the inner drum (radius = 60 mm) of a wheel (radius = 100 mm) and pulled horizontally with a force of 200 N. The wheel has a mass of 50 kg and a radius of gyration of 70 mm. Knowing that the coefficients of static friction and kinetic friction between the ground and the wheel are 0.20 and 0.15, respectively, which of the following statements are correct? (25%)

(A) The wheel is rotating without sliding on the ground.

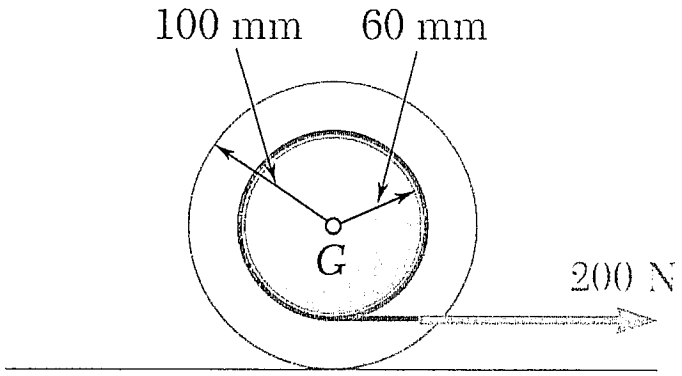
(B) The acceleration of mass center G is proportional to the angular acceleration of the wheel.

(C) The friction force between the ground and the wheel is greater than 80 N.

(D) The acceleration of mass center G is greater than 2.4 m/s^2.

(E) The angular acceleration of the wheel is less than 20 rad/s^2.

(F) None of the above statements is correct.



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國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：應用力學【機電系碩士班丙組】　　題號：438006

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）　　

Problems [3], [4] and [5] are calculations. (50%)

[3] The angle of twist for a circular shaft subjected to a twisting moment is given by the equation $\theta = TL/GJ$. In dimensional analysis what are the dimensions of J if θ is an angle in radians, T is the moment of a force, L is a length, and G is a force per unit area? (15%)

[4] A beam of length L with both ends simply supported and subjected to uniformly distributed load w please draw the shear and moment diagrams. (15%)

[5] A constant couple $C = 25i + 35j - 50k$ N·m acts on a rigid body. The unit vector associated with the fixed axis of rotation of the body for an infinitesimal angular displacement $d\theta$ is $e_\theta = 0.667i + 0.333j + 0.667k$. Determine the work done on the body by the couple during an angular displacement of 2.5 radians. (20%)

國立中山大學103學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【機電系碩士班乙組】　　題號：438007

※本科目依簡章規定「不可以」使用計算機　　

Part I: Please completely fill out the following questions. (20%)

1. _____ is defined as the rate of change of position in terms of distance. (2%)
2. _____ is defined as the rate of change of velocity. (2%)
3. _____ is a quantity with magnitude but no direction, e.g., distance, time, speed. (2%)
4. _____ is the ability or capacity to do work. (2%)
5. _____ are all measured in Joules (J). (2%)
6. _____ is defined as the intensity of the force acting normal to an area. (2%)
7. Equation $\sigma = E\varepsilon$, where σ is stress, ε is strain and E is Young's modulus, is known as ___ law. (2%)
8. _____, ν, is defined as $\nu = -\frac{\varepsilon_{lat}}{\varepsilon_{long}}$, where ε_{lat} is the lateral strain and ε_{long} is the longitudinal strain. (2%)
9. If a given function f(x) can be written as a power series $f(x) = \sum_{n=0}^{\infty} a_n x^n$, then the series $\sum_{n=0}^{\infty} a_n x^n$ is call the _____. (2%)
10. When the axial forces in particular members of a truss must be determined, the _____ can often provide the needed results more efficiently than the **method of points**. (2%)

Part II: Please translate the following sentences into English. (20%)

11. 國立中山大學機械與機電工程學系是台灣最好的系之一。(5%)
12. 靜力、動力及材力是大學部的基礎課程。(5%)
13. 據說台積電的員工有 50%以上具有機械背景。(5%)
14. 直角座標、圓柱座標及球座標都是正交座標系統。(5%)

Part III: Please completely answer the following questions. (60%)

15. A driver not wearing a seatbelt can be injured by the steering wheel during a head-on collision. Why does the driver hit the steering wheel when the car suddenly comes to rest? (10%)
16. What is Newton's 3rd law? How is Newton's 3rd law involved when you jump straight upward? (10%)
17. If a Mack truck and a Honda Civic have a head on collision, upon which vehicle is the impact force greater? Explain. (10%) (b)Which vehicle experiences the greater acceleration? Explain. (10%)
18. Please describe the field of **Solid Mechanics** in this department to the best of your knowledge. (20%)