Question (4) **(16 marks)**

(a) Glycerin at 20°C and 0.3 kg/s is to be heated by ethylene glycol at 60°C and the same mass flow rate in a thin-walled double pipe parallel-flow heat exchanger. If the overall heat transfer coefficient is 380 W/m^2·°C and the heat transfer surface area is 5.3 m^2, determine (*a*) the rate of heat transfer and (*b*) the outlet temperatures of the glycerin and the glycol.

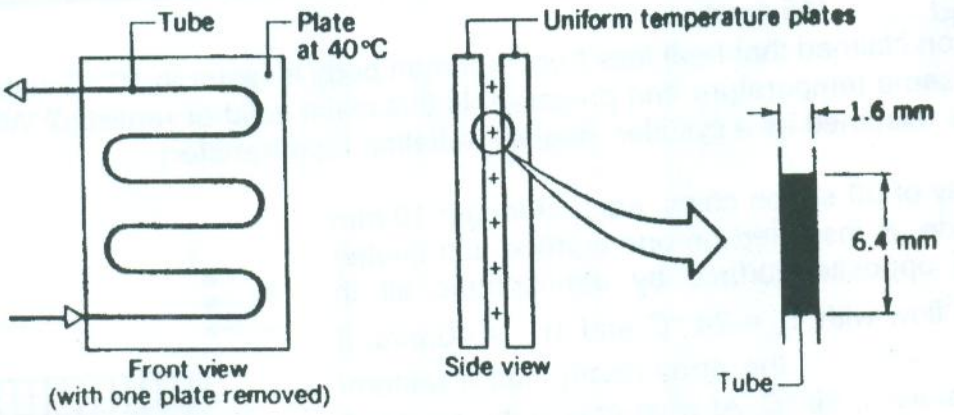
(b) A circular pipe of 25 mm outside diameter is placed in an air stream at 25 °C and 1 atm pressure. The air moves in cross flow over the pipe at 15 m/s, while the outer surface of the pipe is maintained at 100 °C. What is the rate of heat transfer from the pipe per unit length?

Question (5) **(15 marks)**

(a) Consider laminar flow over a flat plate. Will the heat transfer coefficient change with distance from the leading edge for the following cases?

i) - Blow a cold fluid over a hot flat plate,

ii)- Blow a hot fluid over a cold flat plate.



(b) You have been asked to perform a feasibility study on the design of a blood warmer to be used during the transfusion of blood to a patient. This exchanger is to heat blood taken from the bank at 10°C to 37°C at a flow rate of 200 ml/min. The blood passes through a rectangular cross-section tube, 6.4 mm by 1.6 mm, which is sandwiched between two plates held at a constant temperature of 40°C. Compute the length of the tubing required to achieve the desired outlet conditions at the specified flow rate. Assume the flow is fully developed and the blood has the **same properties as water**.

All the best

Course Examination Committee : Dr. Y. EL-Samadony
Course Coordinator : Prof. Abdel Naby Kabeel

Tanta University		Mechanical Power Engineering Department Course Title: **Heat transfer (2)** MEP3108		Faculty Of Engineering

Dept	Mechanical Power Engineering	Date	January 15th 2012
Year	3rd , (new curriculum) 2005	Allowed time	3 hrs
Final exam	January (First term)	Total Marks	75 Marks
		Academic Number	2011/2012

Close book exam. All questions must be answered. Draw schematic whenever applicable, and clearly state your assumptions. You can use heat transfer tables and charts

يسمح للطالب باستخدام جداول وخرائط انتقال الحراره

Question (1) **(15 marks)**

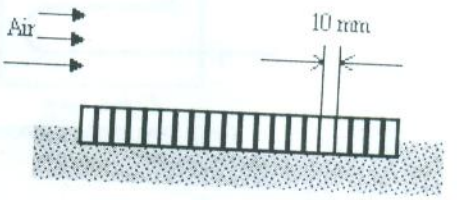
(a) Will a hot horizontal plate whose backside is insulated cool faster or slower when its hot surface is facing down instead of up? Explain

(b) A horizontal plate has the shape of an equilateral triangle 45 cm on each side and exposed to atmospheric quiescent air at 40 °C. Calculate the heat lost by/to the top surface of the plate if the plate has a uniform temperature of 290 K

Question (2) **(15 marks)**

(a) A person claimed that heat loss from a human body is faster in 10 °C water than in air at the same temperature and pressure. Is this claim valid or realistic? Why? (Person may be assumed as a cylinder, neglect radiation heat transfer)

(b) An array of 30 silicon chips, each of length 10 mm on a side, is insulated on one surface and cooled on the opposite surface by atmospheric air in parallel flow with t_∞ = 24 °C and u_∞ = 40 m/s. If the top surface of the array nearly has a uniform temperature of 80 °C. At what chip is the electrical input a minimum? What is the value of this input?



Question (3) **(14 marks)**

(a) Discuss all factors that may have an influence on the pool boiling process and explain how this/these factor(s) may change the pool boiling modes (types).

(b) Saturated water at 100 °C is boiled with a brass heating element having a heating surface A= 0.04 m^2, which is maintained at a uniform temperature of 115 °C. Calculate the surface heat flux and the rate of evaporation?

University of Tanta College of Engineering Mech. Power Eng. Dept.	Final Exam January 2012	Subject: Students: Time allowed:	**Refrigeration** **4th year Power Mech.** **3 hours**

- *ONLY tables of refrigeration and air conditioning are allowed (available with students).*
- *Assume any missing data and assumptions.*

1. An air-cooling machine for a jet plane operates on a simple air cycle. The cockpit is to be maintained at 295 K. The ambient air pressure and temperature are 0.05 MPa and 230 K. Calculate the stagnation pressure of air entering the main compressor if the plane speed is 1000 km/h assuming 100% ram efficiency. If the compressor pressure ratio is 5 and the stagnation temperature of air entering the cooling turbine is 350 K and for a cockpit pressure of 0.1 MPa, calculate:

i) The stagnation temperature of air entering and leaving the compressor, assuming isentropic compression.
ii) The temperature of air leaving the cooling turbine, assuming isentropic expansion.
iii) The airflow rate for a cooling load of 5 TR.
iv) The COP of the system.

2. An absorption system uses Lithium-Bromide water solution and heat exchanger that heats the cool solution from the absorber on its way to the generator and cools the strong solution returning from the generator to the absorber. Use the following data:

Temperature:	in evaporator	283 K	in condenser	313 K
	In generator	373 K	in absorber	303 K
	entering generator	323 K	pump flow rate	0.6 kg/s

Determine the properties of all state points of the cycle and then find the cooling capcity of the cycle and its COP. Neglect all pressure drops in lines and components.

3. Compare the COP of the vapor compression cycle that uses wet compression (so that gas leaving compressor is dry saturated), dry saturated compression and superheated compression with gas entering compressor having 15 K superheat. In all cases R-134a is the refrigerant, condensing temp. is 313 K and evaporating temperature is 253 K. Assume simple ideal vapor compression cycle.

4. a) A three stores vapor compression plant uses R-22 as refrigerant and having evaporation temperatures of 273 K, 263 K and 248 K with cooling loads 20, 10 and 5 TR, respectively. Condensing temperature is 313 K. The system utilizes multiple expansion with flash tanks and multiple compression. The system utilizes a liquid-to-suction heat exchanger after the intermediate store at 263 K and affects the liquid line with 10 K subcooling. Compressions begin with superheated vapor with 7 K superheat due to line losses. Assume 60 kPa pressure drop in each discharge valve and 30 kPa pressure drop in each suction valve. Assume 30 kPa pressure drop in the condenser and 50 kPa in each evaporator. Determine the work done required for each compressor and the COP of the cycle.

b) Compare with the COP of a simple cycle with all cooling loads at 248 K evaporator.

With best wishes ,,, *A.Prof. Dr. Alsaied Khalil*

ن- محرك إشتعال بالشرارة ذو غرفة احتراق مسطحة وشمعة الشرارة منها وضع جانبي وقطر الاسطوانة الداخلي 100 mm . احسب تقديم الشرارة المناسب عند دوران المحرك بسرعة 3000 r.p.m علما بأن فترة الاشتعال 0.002 sec وسرعة جبهة اللهب 36 m/sec

م- يدور محرك ديزل رباعي الأشواط بسرعة 450 r.p.m وكان الضغط المتوسط الفعال هو 15 bar فإذا كان عدد الاسطوانات 8 ، والقطر 400 mm والمشوار 460 mm ، وكان استهلاك النوعي الفرملي للوقود 223 gm/kw.hr فإذا كانت القيمة الحرارية للوقود المستخدم 42.4 MJ/kg والكفاءة الميكانيكية 82 % احسب :-

1 - القدرة الفرملية للمحرك . 2 - الجودة الحرارية الفرملية والجودة الحرارية البيانية للمحرك .

ك- محرك احتراق داخلي إشتعال بالضغط رباعي الأشواط قطر اسطوانته 110 مم وطول مشوار مكبسه 140 مم ، وعدد اسطواناته 6 اسطوانات ونسبة انضغاطه 18 اجريت له تجربة معملية عند سرعة 2300 لفة من الدقيقة واخذت له القراءات الآتية :-

- هبوط الضغط عبر الفوهة لصندوق الهواء 40 سم ماء
- معامل تصرف الهواء عبر الفوهة لصندوق الهواء 0.65
- الكفاءة الحجمية للمحرك 80 % منسوبة للظروف الجوية 1 بار و 30 °م
- الكفاءة الميكانيكية للمحرك 78 %
- الكفاءة الحرارية للمحرك 32 %
- القدرة الضائعة من الاحتكاك 17 كيلووات
- الارتفاع في درجة حرارة الهواء المبرد به المحرك 30 °م .
- درجة حرارة غازات العادم 450 °م .

المطلوب :-

احسب عند ظروف التجربة ما يلي :-

1 - قطر فوهة صندوق الهواء (سم)

2 - معدل تصرف هواء التبريد للمحرك (كجم / دقيقة)

3 - ارسم أيضا العلاقة بين قدرة المحرك الفعالة (كيلووات) وكل من الكفاءة الميكانيكية للمحرك والاستهلاك النوعي الفعال للوقود (جم / كيلووات ساعة)

جامعة طنطا - كلية الهندسة
الفرقة الثالثة ميكانيكا قوى
الفصل الدراسي الأول
٢٠١١/٢٠١٢
وقت الإجابة ساعة واحدة

اسم المقرر: محركات حرارية (٢)
النظرية النهائي: ٨٥ درجة
زمن الامتحان: ٣ ساعات
النظام: لائحة جديدة

أجب عن الأسئلة الآتية:- استخدم الرسم كلما أمكن ذلك

السؤال الأول (١٢ درجة)

١- استرجع بالرسم تتابع فتح وغلق صمامات محرك رباعي الأشواط؟ ثم اذكر وظيفة كل جزء؟

ب- علل تاليس:-

1- عدم انتشار محركات الاحتراق الداخلي التي تعمل بالوقود الصلب؟
2- نسبة الانضغاط في محرك الديزل أكبر منها في محرك البنزين؟
3- تستخدم القدرة النوعية للمقارنة بين المحركات المختلفة؟
4- ارتفاع درجة حرارة الهواء الذي يدخل إلى محرك الديزل غير مرغوب فيها؟

ج- يفتح صمام العادم قبل النقطة الميتة السفلى خلال شوط التمدد؟
د- يقفل صمام السحب بعد النقطة الميتة السفلى خلال شوط الانضغاط؟

السؤال الثاني (١٨ درجة)

١- اذكر وظائف نظام التبريد في المحرك؟ ثم اذكر اجزاء نظام التبريد بالتفاصيل؟ ثم اذكر وظيفة محلل الترموستات؟

ب- اذكر خواص زيوت التزييت؟ ثم اذكر الإضافات المساعدة لزيوت التزييت؟

ج- اذكر ميزات المحركات ذات الأربعة أشواط على شكل حرف V وكذلك الأشواط الأنفية لتفاديها

د- اذكر العوامل التي تعتمد عليها القدرة المتصوفة في المحرك؟

السؤال الثالث (٢٠ درجة)

١- استرجع بالرسم مراحل الاحتراق في كل من محرك البنزين ومحرك الديزل؟

ب- اشرح كيف تؤثر كل من العوامل الآتية على أداء كل من محرك البنزين ومحرك الديزل؟

1- نسبة التخلخل 2- سرعة المحرك

ج- اذكر كيف يؤثر كل من (نقطة الاشتعال - نسبة الانضغاط) على الدقة في محرك البنزين ومحرك الديزل؟ ثم علل ذلك؟

د- اذكر أنواع غرف الاحتراق؟ ثم اذكر أصعب الأبحاث والدراسات التي تجرى لتصميم غرف الاحتراق؟

السؤال الرابع (٣٠ درجة)

١- اذكر ما تعرفه عن:-

1- انفجار مورس 2- غاز ديلاتر

انظر خلفه ←

Tanta University
Faculty of Engineering
Department of Mechanical Engineering
Year: Master Subject: advanced fluid mechanics
Name: Talal Abou elmaaty

Date: Jane 2012
Time allowed: 3 Hr
Full mark:
Final Exam: 1pages

1- Mention with sketch the basic parts of a power system and the different types used in power systems

2- Clarify with sketch the typical velocity and shear distributions in turbulent flow near a wall and state the velocity distribution law in each layer
Air at 20 °C flows through a 14 – cm diameter tube under fully developed conditions the centre line velocity is u_o = 5 m/s. Estimate the friction velocity u^* , the wall shear stress τ_w and the average velocity ($v = 1.51\times10^{-5}$)

3- For a laminar flow inside a circular pipe, deduce that, the Darcy friction coefficient (f) is four times the Skin friction coefficient (C_f)
Oil with a viscosity of 1.5 poise and density 843.3 kg/m^3 flows through 30 cm ID pipe if the head loses inside a 3000 m length of a pipe is 20 m, find
- The average velocity
- Darcy friction coefficient
- The skin friction coefficient

4- A slipper bearing has the following data: U = 0.76 m/s, μ = 0.144 Pa.s , l/h_1 = 400 , k = 2, and h_o (= $2h_1h_2/(h_1+h_2)$) = 2.54×10^{-5} m . Plot the pressure distribution in the gap as a function of x/l.
Calculate also the following;
- The location of the maximum pressure in the lubricating fluid
- The total load that the bearing guide will support
- The shearing force on the bearing guide

5- For a plane wall, two dimension, steady incompressible flow deduce the continuity equation as a function of the stream function (Ψ)
The velocity components in a steady, incompressible, two dimensional flow field are
U= 2y, v = 4x, Determine the corresponding stream function and show on s sketch several streamlines.

Problem number (4) **(15 Marks)**

a) Define the water hammer, mention the factors affecting on it. **(5 Marks)**

b) Water is flowing through a 2000 m long pipe of 20 cm diameter and 0.8 cm wall thickness with a velocity of 2 m/s. The bulk's modulus of elasticity of water is 2.1×10^9 Pa and the Young's modulus of elasticity of the pipe material is 2.1×10^{11} Pa. If the valve at the end of the pipe line is closed instantaneously calculate:

1- The rise in pressure due to water hammer.
2- The velocity of the pressure wave and the time taken by the pressure wave to return at the valve after the valve is closed. **(10 Marks)**

Problem number (5) **(10 Marks)**

a) Derive an expression for calculating the volume flow rate through a large diameter pipe. **(4 Marks)**

b) Derive an expression for calculating the pressure loss through a tapering pipe. **(6 Marks)**

With the best wishes

Course Examination Committee:

Dr. Eng. Mohamed Mahgoub Bassuni

Tanta University

Department: Mechanical Power Engineering
Total Marks: **75** Marks

Faculty of Engineering

Course Title: Fluid Mechanics (2)	**Course Code: MEP3110**	**Year: 3rd**
Date: Jan. 18 th 2012 (First term)	**Allowed time: 3 hrs**	**No. of Pages: (2)**

Remarks: (answer the following questions, assume any missing data, answers may be supported by sketches)

Problem number (1) (15 Marks)

a) Find an expression for calculating the Darcy-Weisbach formula for loss of head in pipes. **(6 Marks)**

b) Water is being discharged from a reservoir through a pipe 5000 m long and of 60 cm diameter to another reservoir having water level 13 m below the first reservoir. It is required to feed a third reservoir whose water level is 16 m below the first reservoir through a pipe line 2600 m long to be connected to the pipe at a distance of 2000 m from its entrance. Find the diameter of this new pipe, so that the discharge into both reservoirs is the same. Assume $f = 0.032$ for all pipes. **(9 Marks)**

Problem number (2) (20 Marks)

a) Prove that the discharge over a triangular notch (V-notch) is given by the following relation:

$$\dot{Q} = \frac{8}{15} C_d \sqrt{2g} \times \tan\frac{\theta}{2} H^{5/2}$$

where:

H : is the height of the liquid above the apex of the notch, θ is the angle of the notch, C_d is the coefficient of discharge of the notch. **(6 Marks)**

b) Water flows over a rectangular notch 60 cm wide over a depth of 12 cm. Then the same quantity of water passes through a right angle triangular notch. If the discharge coefficients of the rectangular and triangular notches are 0.6 and 0.62 respectively, find the height of the water above the apex of the V-notch. **(6 Marks)**

c) A 2500 m length trapezoidal channel lies in Tushki with side slopes of 1:1 has to be designed to convey 12 m^3/s at a velocity of 3 m/s, so that the amount of concrete lining (البطانة الخرسانية) for the bed and sides is **minimum**. Find out the total cost required for channel lining, if the cost of one square meter of the wetted area of lining is 140 L.E. **(8 Marks)**

Problem number (3) (15 Marks)

a) Find an expression for calculating the time of flow from one reservoir into another reservoir through a long pipe. **(5 Marks)**

b) Two tanks of 8 m and 6 m diameters are connected by a 300 m long and 25 cm diameter pipe. The level of water in the bigger tank is 5 m higher than that in the smaller tank. Assume $f = 0.015$, find:

1- The time in hours taken to have no flow between tanks.

3- The maximum quantity of water in liters that could be transmitted between tanks.

2- The time in hours taken to transmit 16000 liters of water between tanks. **(10 Marks)**

to the ventilator to reduce the vibration. Derive the dynamic equations for small oscillations using Lagrange equations and determine the natural frequencies and normal modes of the system. **(Marks 20%)**

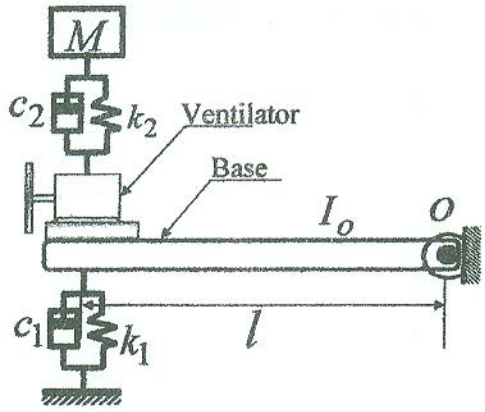


Fig. 1

5- A physical model of a winch is represented in Fig. 2, in which the stiffness of the torsional shafts are k_{t1} and k_{t2}. The two mass-less gears have a gear ratio of n. The inertia of the rotor of the motor is I_2 while the inertia of the drum is I_1. The rope is modeled as a mass-less spring of stiffness of k. A block of mass m is attached to the end of the rope. The damping properties of the system are modeled by a damper with a coefficient c. Derive the equations of motion using Lagrange's method. **(Marks 20%)**

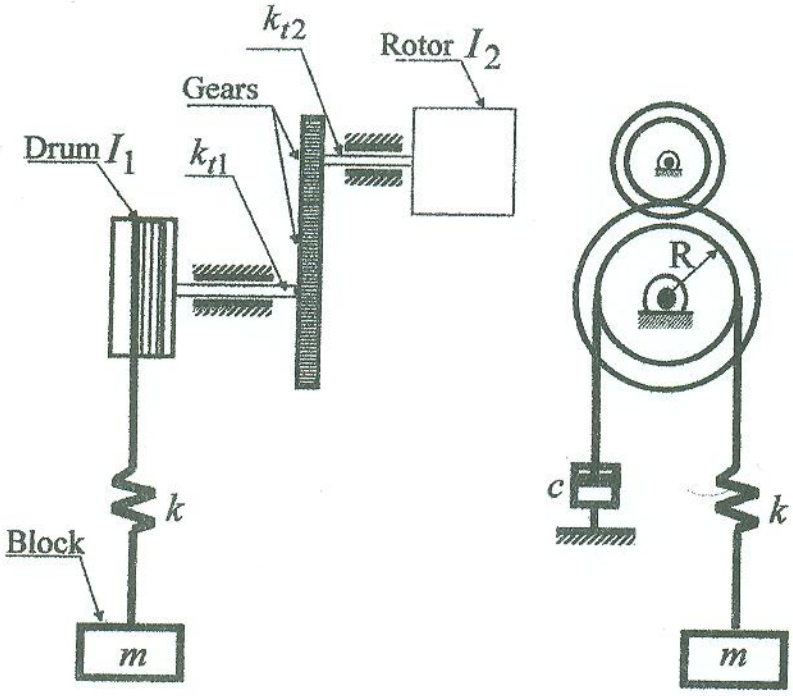


Fig. 2

FINAL TERM EXAM

1- A circular disc weighting 178 N is mounted midway on a 15 mm diameter steel shaft 915 mm long and its Young's modulus is 2×10^{11} N/m^2. The center of gravity of the disc is 3 mm from its geometric center. The unit rotates at 600 r.p.m and the damping factor is 0.05. Determine the critical speed of the shaft and the bending stress at the operating speed. Where the disc should be located in order to increase the critical speed by 20 %. (Note, the deflection of simply supported shaft subjected to a load p is $\delta_{st} = \frac{pa^2b^2}{3EIL}$). **(Marks 20%)**

2- A vibrometer having a spring stiffness of 4 KN/m and a viscous damping 50% of the critical is used to measure a vibration of 2000 cpm. If the error is not exceeding 2%, which one of the following masses (1.5, 2, 2.5, 3) kg is used in the instrument. If it is desired to use this instrument as an accelerometer by changing the spring, which one of the following stiffness (110, 114, 118, 122) KN/m can be used, comment on the result. **(Marks 20%)**

3- A washing machine is simplified by a rotating unbalance machine. A bundle of wet clothes forms an unbalance mass of 1 kg and the total mass of the washer including the clothes is 20 kg. The radius of the washing basket is 0.25 m. Assume that the spin cycle rotates at 300 r.p.m. The stiffness and the damping of the support of the machine are 1000 N/m and 0.01, respectively.

- **a-** Calculate the magnitude of the unbalance force causing the vibration.
- **b-** What percent of the above force is transmitted to the foundation?
- **c-** Calculate the amplitude of the machine and the force transmitted to the foundation.
- **d-** For the un-damped case, in order to reduce the force transmitted to the foundation, a dynamic vibration absorber is attached to the machine. Design the absorber to keep the resultant resonant frequencies at least ±20% of the operating speed and then calculate the amplitude of the absorber and the force transmitted to the foundation. Comment on the result.
- **e-** Suggest with explanation another way to reduce the force transmitted to the foundation without altering the speed of the spin cycle. **(Marks 20%)**

4- An assembly of a ventilator with its base, as shown in Fig. 1, is free to oscillate about O. It is kept in the horizontal position by means of a spring and a damper (k_1, c_1). Its moment of inertia about O is (I_o). The rotor of the ventilator has unbalance of (me) and rotates with a constant angular velocity of (γ). A damped dynamic vibration absorber of mass (M) with a stiffness and a damper of (k_2, c_2) is attached