Tanta University

Total Marks: *100 Marks*

Faculty of Engineering

Course Title: *Theory of Metal Cutting*	Course Code: *MPD3116*	Year: *3rd Mech. Students*
Date: *12-01-2023 (Final Exam)*	Allowed time: *3 Hrs*	No. of Pages: *(2)*

Answer All The Following Questions By Illustrating Your Answers With Neat Sketches (Solve As You Can)
(6 Questions....Every Question Carries The Same Marks)

Question (1):-[4+4+9]

(a) What do you understand by the term "machinability"? What are the parameters that affect the machinability of material? State the criteria for determining the machining of a material.
(b) How machining parameters like cutting speed, feed and depth of cut affect tool life and why this nature of behavior.
(c) In a production turning operation, the workpart is 125mm in diameter and 300mm long. A feed of 0.225 mm/rev is used in the operation. If cutting speed = 3.0 m/s, the tool must be changed every 5 workparts; but if cutting speed = 2.0 m/s, the tool can be used to produce 25 pieces between tool changes. Determine the Taylor's tool life equation for this job.

Question (2):-[4+4+9]

(a) What is Merchant's circle diagram of forces in the analysis of machining process? With the help of this diagram relate the various quantities of interest to a person who wants a better insight into the process.
(b) Define the machinability and manufacturability of metal? and write the factors affecting them and what are the influential factors on machinability?
(c) A HSS tool required returning after (2 hours and 45 minutes) when machining steel at a cutting speed of (35 m/min). Calculate the tool life if the speed is increased to (70 m/min). (if n = 2).

Question (3):-[4+4+9]

(a) What are the requirements in cutting tools?, Define, in details, the wear of cutting tool?, What are causes tools?.
(b) What are the sources and causes of heat generation and development of temperature in machining. and what are the effects of the high cutting temperature on tool and job?.
(c) Given: max diameter (D_1 =80 mm), and min diameter (D_2 =74 mm), and for steel (K_s =1800 MPa), speed (n =560 rpm), and feed (f = S= 0.25 mm/rev), mechanical efficiency (η= 90%).
Calculate the power of motor for machine?.

Question (4):-[4+4+9]

(a) What are the basic categories of cutting tools in machining?, Give examples of machining operations that use each of the tooling types?.
(b) Dlfferentiate between orthogonal cutting and oblique cutting? and Describe the characteristics of tool materials.
(c) Calculate the various speeds for G.B.(Gear Box) has (12 speeds) if the minimum speed (300 rpm) and the maximum speed (1600 rpm).(By use any progression).
Construct the speed diagram and the construction diagram.

Question (5):-[7+8]

(a) The following data from the orthogonal cutting test is available:-
Rake angle = 10°, chip thickness ratio= 0.35, uncut chip thickness = 0.51, width of cut = 3 mm, yield shear stress of work material = 285 N/mm^2, Mean friction coefficient on tool face = 0.65.
Determine the: (i) Cutting force, (ii) Radial force, (iii) Normal force on tool, and (iv) Shear force on tool.

P.T.O.⟶ (2)

(b) The following equation for the tool life was obtained for H.S.S. tool $V T^{0.13} f^{0.6} d^{0.3} = C$. *A 60 min tool life was obtained using the following cutting conditions:-*
$V = 40$ *m/min,* $f = 0.25$ *mm/rev,* $d = 2.0$ *mm.* Calculate *the effect on tool life if speed, feed and depth of cut are together increased by 25% and also if they are increased individually by 25% ; where* f = *feed,* d = *depth of cut;* V = *speed.*

Question (6):-[7+10]

(a) An HSS tool is used for turning operation. The tool life is 1 hr. when turning is carried at 30 m/min. The tool life will be reduced to 2.0 min if the cutting speed is doubled. Find *the suitable speed in RPM for turning 300 mm diameter so that life 30 mm.*

(b) During turning a carbon steel rod of 160 mm diameter by a carbide tool of geometry; 0^o, 0^o, 10^o, 8^o, 15^o, 75^o, *0 (mm) at speed of 400 rpm, feed of 0.32 mm/rev, and 4.0 mm depth of cut, the following observations were made Tangential component of the cutting force,* $P_z = 1200$ *N. Axial component of the cutting force,* $P_x = 800$ *N. Chip thickness (after cut) = 0.8 mm. For the above machining condition,* Determine *the values of :-*
(i) Friction force, F and normal force, N acting at the chip-t00l interface.
(ii) Yield shear strength of the work material under this machining condition.
(iii) Cutting power consumption in KW.

The End of Examination Paper

…[[[With My Best Wishes and Good Luck]]]…

{{Examiner: Dr Eng.: Alaa-Eldin El-Hammady}}

Tanta University

Production Engineering and Mechanical Design Department

Final Exam – First Term – Academic Year 2022/2023

Faculty of Engineering

Course Title: Theory of Metal Forming	**Course Code:** MPD3117	**Year:** 3rd Year Production Students
Date: 15 January 2023	**Allowed Time:** 3 Hrs.	**Total Marks:** 100 Marks

تعليمات: (١) الامتحان مكون من ثلاثة أسئلة في صفحتين – (٢) أجب عن جميع الأسئلة مع افتراض أي بيانات ناقصة – (٣) دعم إجابتك بالرسم كلما أمكن ذلك.

Question 1: [30 Marks]

a) What is meant by metal forming? How its processes can be classified?

b) A circle 1 cm diameter was printed on a sheet of metal prior to a complex stamping operation. After the stamping, it was found that the circle had become an ellipse with major and minor diameters of 1.300 and 1.100 cm.
- Determine the effective strain.
- If a condition of plane stress ($\sigma_3 = 0$) existed during the stamping, and the ratio $\alpha = (\sigma_2 / \sigma_1)$ remained constant, what ratio $(\sigma_1 / \bar{\sigma})$ must have existed?

c) What is meant by strain hardening? Why does it occur?

d) If the plastic behavior of a metal can be expressed as $\bar{\sigma} = 500\bar{\varphi}^{0.5}$ MPa:
- Estimate the yield strength if a bar of this material is uniformly cold worked to a reduction of Q = 0.3.
- Estimate the yield strength after the bar is cold worked 50%.

Question 2: [30 Marks]

a) Estimate the total elongation in a tensile bar if f=0.98, m=0.5, and n=0.

b) The thickness of a sheet varies from 8.00 mm to 8.01 mm depending on location so tensile specimens cut from a sheet have different thicknesses. For a material with n = 0.15 and m = 0, what will be the strain in the thicker region when the thinner region necks?

c) Calculate the temperature rise in a high-strength steel that is adiabatically deformed to a strain of 1.0. Pertinent data are $\rho = 7.87 \times 10^3$ kg/m^3, $\sigma_a = 800$ MPa, $C = 0.46 \times 10^3$ J/kg °C.

d) A typical aluminum beverage can is 5.25 in. high and 2.437 in. in diameter. The starting material is aluminum alloy 3004-H19 that has already been cold rolled over 80%.
- What diameter blank is required?
- Is a redrawing step necessary? (Assume that a safe drawing ratio is 1.8)

Question 3: [40 Marks]

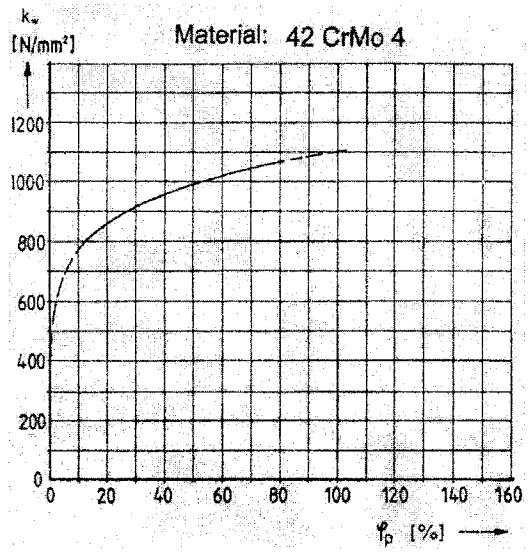
a) A coil of steel, 252 mm wide and 3 mm thick, is drawn though a pair of dies of semi-angle 8° to a final thickness of 2.4 mm in a single pass. The outlet speed is 3.5 m/s. The average yield strength is 700 MPa and the friction coefficient is 0.06. Calculate the power in kW consumed.

b) A solid disc of 10 cm diameter, 2.5 cm high is compressed. The tensile and shear yield strengths are 300 and 150 MPa. Estimate the force needed to deform the disc assuming sticking friction.

c) The plane-strain flow stress, σ_0, of a metal is 200 MPa. A sheet 0.60 m wide and 3 mm thick is to be cold rolled to 2.4 mm in a single pass using 30 cm diameter rolls. Assuming a coefficient of friction is 0.075:
   - Compute the roll pressure.
   - If front tension of 75 MPa were applied, what would be the average roll pressure?

d) A steel sheet, 1 mm thick and 1 m long, is bent to a radius of curvature of 12 cm. The flow stress in plane strain is 210 MPa and E = 224 GPa.
   - What fraction of the cross section doesn't yield?
   - What is the required bending moment to accomplish the process?
   - Calculate the final radius of curvature after removing the load.

e) The aim is to produce spheres 30 mm in diameter out of 42 CrMo 4. The initial diameter is to be set in such a way that the upsetting ratio is s = 2.6. The forming efficiency is 80% and the coefficient of friction is 0.15.
   - <u>The following is requested:</u> Volume of the sphere - Blank diameter d_0 for s = 2.6 - Blank dimensions - Actual upsetting ratio - Upset forging force- Upset forging work.



---------- انتهت الأسئلة ----------

مع أطيب التمنيات بالتوفيق والنجاح .... د.م/ أحمد حوام واللجنة

Tanta University

Department: Production and Mechanical Design
Total Marks: 60 Marks

Faculty of Engineering

Course Title: Machine Tool	Course Code: MPD3118	Year: 3rd
Date: Jan. 17 th 2023 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

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

Problem number (1) Fill out in the space about Machine Tools parts: (20 Marks)

1. **Driving elements includes (.....)**
2. **Frame includes (.....)**
3. **Form of machine tools includes (.....)**
4. **Design function of machine tools includes (.....)**
5. **Material of machine tools include (.....)**
6. **Weight of machine parts (.....)**
7. **Cost (.....)**
8. **Gear box includes (.....)**
9. **Types of speed change: (.....)**
10. **Main Types of ribbing systems (.....)**

Problem number (2) Choose the correct Answer (20 Marks)

1. **Requirements made to machine tool.**
   a) It should be powerful and durable
   b) It is the ability of the machine to not re-visit a location
   c) Drilling, tapping and reaming machine
2. **Productivity**
   a) Depends on the dynamic stiffness of the machine tool.
   b) The accuracy with which a job can be manufactured on machine tool.
   c) It is the ability of a machine to move to a commanded position
3. **Accuracy**
   a) The volume of material removed per minute from the workpiece
   b) In instrumentation, (how many decimal places are shown).
   c) Depends on the dynamic stiffness of the machine tool
4. **Materials of frame of machine made of**
   a) Cast iron
   b) Alloy steel
   c) Diamond
5. **In continuous force of machine?**
   a) Due to Main cutting force, PZ along the velocity vector, VC.
   b) Due to Shaping, planning, slotting and gear shaping operation.
   c) Due to Fluctuating forces due to intermittent cutting in milling, and hobbing.
6. **In impact-initiated force of machine?**
   a) Due to Feed or axial force, PX along the feed direction
   b) Due to Shaping, planning, slotting, and gear shaping operation.
   c) Due to Transverse force (thrust), PY normal to PZ – PX plane in turning.
7. **Intermittent force of machine?**
   a) Due to Fluctuating forces due to intermittent cutting in milling, hobbing etc.
   b) Due to Torque and thrust force in drilling, counterboring, counter sinking etc.
   c) Due to acceleration and deceleration at the end points of sliding.
8. **Gravitational forces of machine tools?**
   a) Due to Dead weight of the major and heavy components of the Machine
   b) Due to reciprocating tables, rams, jobs etc.

Tanta University

Department: Production and Mechanical Design
Total Marks: 60 Marks

Faculty of Engineering

Course Title: Machine Tool	Course Code: MPD3118	Year: 3rd
Date: Jan. 17 th 2023 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

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

Problem number (1) Fill out in the space about Machine Tools parts: (20 Marks)

1. **Driving elements includes (.....)**
2. **Frame includes (.....)**
3. **Form of machine tools includes (.....)**
4. **Design function of machine tools includes (.....)**
5. **Material of machine tools include (.....)**
6. **Weight of machine parts (.....)**
7. **Cost (.....)**
8. **Gear box includes (.....)**
9. **Types of speed change: (.....)**
10. **Main Types of ribbing systems (.....)**

Problem number (2) Choose the correct Answer (20 Marks)

1. **Requirements made to machine tool.**
   a) It should be powerful and durable
   b) It is the ability of the machine to not re-visit a location
   c) Drilling, tapping and reaming machine
2. **Productivity**
   a) Depends on the dynamic stiffness of the machine tool.
   b) The accuracy with which a job can be manufactured on machine tool.
   c) It is the ability of a machine to move to a commanded position
3. **Accuracy**
   a) The volume of material removed per minute from the workpiece
   b) In instrumentation, (how many decimal places are shown).
   c) Depends on the dynamic stiffness of the machine tool
4. **Materials of frame of machine made of**
   a) Cast iron
   b) Alloy steel
   c) Diamond
5. **In continuous force of machine?**
   a) Due to Main cutting force, PZ along the velocity vector, VC.
   b) Due to Shaping, planning, slotting and gear shaping operation.
   c) Due to Fluctuating forces due to intermittent cutting in milling, and hobbing.
6. **In impact-initiated force of machine?**
   a) Due to Feed or axial force, PX along the feed direction
   b) Due to Shaping, planning, slotting, and gear shaping operation.
   c) Due to Transverse force (thrust), PY normal to PZ – PX plane in turning.
7. **Intermittent force of machine?**
   a) Due to Fluctuating forces due to intermittent cutting in milling, hobbing etc.
   b) Due to Torque and thrust force in drilling, counterboring, counter sinking etc.
   c) Due to acceleration and deceleration at the end points of sliding.
8. **Gravitational forces of machine tools?**
   a) Due to Dead weight of the major and heavy components of the Machine
   b) Due to reciprocating tables, rams, jobs etc.

TANTA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF: **Production Engineering & Mech. Design Dep.**

EXAMINATION (3 YEAR) STUDENTS OF Production ENGINEERING

COURSE TITLE: **Mechanical Design (2)**			COURSE CODE: PMD3114
DATE: 23- 1-2023	TERM: First term	TOTAL ASSESSMENT MARKS: 75	TIME ALLOWED: 3 HOURS

Notes: 1/2

It is allowing for student to use bearing table and only one text book and any hand written is not accepted

Systematic arrangement of calculations and clear neat drawings are essential.

Any data not given is to be assumed – Answer as many questions as you can. Answer as brief. as possible.

Question One (15%):

a- You have a bearing exposed to very heavy radial load and 60% of the radial load was axial load and it is running at low speed what type of beading do you chose? Justify your answer.

b- Lest four types of bearings according to lubrication technique?

c- What types of rolling bearings it should be supported from four points (both inner and outer race should be supported from both sides)? And which one cannot be supported for more than two sides?

d- Why are needle bearings used? What magnitude of thrust load can they withstand? Give an example.

e- It is required from you to select type of bearings for the following applications and justify your answer: -

1. Fan works inside refrigerator at temperature lower than -70 C° and its weight is 5Kg and it works at speed 1450 RPM?
2. Grinding machine works at speed of 6000RPM and with radial load of 200 kg and axial load of 120kg?
3. Concrete vibrator rotates at 5000RPM with eccentric weight of 1kg and distance 1.5cm?
4. Hand car lifter which works with screw?
5. Fan works inside furnace its temperature less than 800 Co?
6. Train wheel
7. Surface grinding machines
8. Spindle of the poring machine (low speed and high torque)
9. Spindle of CNC lath machine (low torque and high speed)
10. Cement miller machine with a weight of 200 toms and it rotates at 1500 RPM?
11. Bearings support the spindle of drilling machine at both sides?
12. Bearings support the rear wheel of the truck?
13. The bearings in tailstock of lathe machine?
14. Bearings support the lath machine chuck?

Question two (30%):

An axial groove journal bearing with a shaft diameter 75 mm and its tolerance +0.001&-0.008 mm while the journal diameter is 75.08 mm with tolerance of ±0.005. If the journal is running with oil type SAE 60 at temperature of 80 C° and the shaft rotates at speeds 1000, 2000, 4000, 6000 and 10000 RPM. Tabulate the maximum allowable load for the extreme dimension of the bearing assembly and the corresponding heat generation,

required flow and the minimum film thickness for all speeds. Assume the bearing length 40 mm and an eccentricity ratio of 0.4 should not be exceeded. Construct a graph for the speed versus heat generated.

Question Three **(15%)**

A hydrostatic step bearing; as shown in fig (1); has a thrust load of 445 KN applied to it. The bearing dimensions are as follows: journal radius 25 cm, recess radius 12.5 cm, minimum film thickness = 0.01 cm. The oil is SAE 30 at average oil temperature 63 C^{o} . What will be the value of supply pressure required and what is the required flow? The load carrying capacity is given by

$$W = \frac{p_o \pi}{2}\left[\frac{R_o^2 - R_i^2}{\ln(R_o / R_i)}\right]$$

and the required flow is given by

$$Q = \frac{P_o \pi h^3}{6\mu \ln(R_o / R_i)}$$

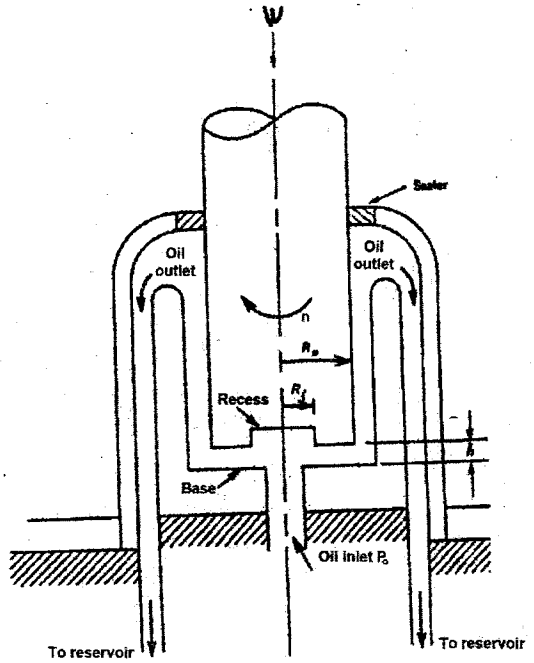


Fig.(1)

Question four (50%)

It is required from you to select the appropriate bearing type and draw free hand sketch for the assembly of this bearing and calculate the number of km to replace these bearing for the following cases:

1- High speed racing care (عربة سباق) its weight one ton and it can move with average speed 400 Km/hr. The car tires diameter 50 cm and the bearing axis diameter 4 cm. Assume reliability factor of 98%.

2- A small truck (عربة نقل صغيرة) its weight one ton and can carry two tons. it can move with average speed 60 Km/hr. The car tires diameter 50 cm and the bearing axis diameter 4 cm. Assume it exposed to moderate shock load

Good luck

Mechanical Power Engineering Department

Tanta University — **Faculty of Engineering**

Course Title	Elective Course (1) Refrigeration & Air-Conditioning	Academic Year 2022/2023 First Semester Exam	**Course Code**	MEP3153
Year/ Level	Third Year Production	No. of Pages (4)	**Allowed time**	3 hrs
Date	22-Jan- 2023	**نموذج C**	**Total Assessment Marks: 50**	

مسموح باستخدام خرائط الفريونات وجداول حساب الاحمال

لن يلتفت إلى الاجابات الغير مقرونة بخطوات حل وذلك للأسئلة التي تحتاج الى عمليات حسابية

اكتب رقم النموذج بأول صفحة بكراسة الاجابة

Question No. (1)

[10 marks]

Identify the choice that best completes the statement or answers the question.

1. The bank of tubes at the back of domestic refrigerator are
   a. capillary tubes
   b. refrigerant cooling tubes
   c. condenser tubes
   d. evaporator tubes
2. What does the curved lines on a psychrometric chart indicates?
   a. Specific humidity.
   b. Relative humidity.
   c. Dew point temperature.
   d. Dry bulb temperature.
3. In a psychrometric chart what does the vertical lines parallel to the ordinate indicates
   a. Dew point temperature.
   b. Wet bulb temperature.
   c. Dry bulb temperature.
   d. Specific humidity.
4. Efficiency of a Carnot engine is given as 80%. If the cycle direction be reversed, what will be the value of C.O.P. of reversed Cycle?
   a. 0.8
   b. 0.25
   c. 1.25
   d. 0.5
5. 3 TR is equal to
   a. 33 kW
   b. 3000 Btu/hr
   c. 36000 Btu/hr
   d. 3.517 kW
6. Which of the following statement is correct?
   a. Dew point temperature can be measured with the help of thermometer.
   b. For saturated air, dew point temperature is less than the web bulb temperature.
   c. Dew point temperature is the same as the thermodynamic wet bulb temperature.
   d. Dew point temperature is the saturation temperature corresponding to the partial pressure of the water vapour in moist air.
7. A heat pump working on a reversed Carnot cycle has a C.O.P. of 5. It works as a refrigerator taking 1 kW of work input. The refrigerating effect will be
   a. 4 kW
   b. 2 kW
   c. 1 kW
   d. 3 kW
8. The efficiencies of all _____ heat engines operating between the _____ two constant temperature heat reservoirs have the _____ value.
   a. reversible, same, different
   b. reversible, same, same
   c. irreversible, same, different
   d. irreversible, same, same
9. For a domestic refrigerator the COP is
   a. Equal to 1
   b. Less than 1
   c. More than 1
   d. None of these

Mechanical Power Engineering Department

Tanta University — **Faculty of Engineering**

نموذج C

10. The refrigerant specific enthalpy after the expansion valve compared to after condenser in the Ideal vapor compression refrigeration cycle is
    a. Lower
    b. Higher
    c. Same
    d. None of the above
11. Refrigeration in aeroplanes usually employs the following refrigerant
    a. Freon-11
    b. Freon-22
    c. Co_2
    d. Air
12. If DBT =25°C and WBT=20 °C, what is the RH?
    a. 37%
    b. 50%
    c. 63%
    d. 45%
13. Flash chamber in the refrigeration circuit is installed
    a. To reduce the size of compressor.
    b. To reduce the size of evaporator by avoiding vapour going to evaporator.
    c. To reduce the size of condenser.
    d. All of these.
14. Find the Carnot coefficient of performance for a refrigeration system operating between 320K and 285K.
    a. 0.12
    b. 6.5
    c. 8.14
    d. 3
15. Dew point temperature is constant as long as there is no change in
    a. Relative and specific humidity of air.
    b. Volume of air.
    c. WBT and DBT.
    d. Moisture content of air.
16. Which of the following decreases during sensible cooling of air?
    a. Dry bulb temperature
    b. Wet bulb temperature
    c. None of these.
    d. Specific humidity.
17. Among the following which statement is incorrect regarding "dehumidification process"?
    a. Specific humidity and relative humidity decreases.
    b. Enthalpy of saturation increases.
    c. Dry bulb temperature remains unchanged.
    d. Moisture is removed.
18. Find the Carnot coefficient of performance for a refrigeration system operating between 320 K and 285 K.
    a. 8.14
    b. 3.0
    c. 0.16
    d. 6.5
19. A boot-strap air cooling system has_____to reject the heat from the cycle.
    a. one heat exchanger
    b. two heat exchangers
    c. four heat exchangers
    d. three heat exchangers
20. The refrigerant supplied to a compressor must be
    a. mixture of liquid and vapour refrigerant
    b. dry saturated liquid refrigerant
    c. none of these
    d. superheated vapour refrigerant

نموذج C

Question No. (2)

[10 marks]
*Identify **one or more** choices that best complete the statement or answer the question.*

A room 5m×4m×3m height (with the longer wall oriented facing north direction) in a gymnasium building is to be conditioned. The building site is 32°North latitude. East wall separate the room from conditioned space otherwise south wall separates the room from unconditioned space. Other walls (north and west) are side streets. All walls are constructed from 100-mm face brick, 50-mm insulation and 100-mm concrete. The room has single window facing north with 2m×1.5m and 6-mm single glass having light colour medium weave shading. The average number of occupants in space is 15 person's works from 8.00 Am till 4.00 Pm. Lighting is unvented and unsuspended fluorescent lamps, number of lamps are 8 and each lamp has 40 watt. Inside design condition is 25°C and outdoor air is assumed to be 40°C. Base your calculations on June, 2.00 Pm O'clock. Determine the following:
a) Wall loads,
b) Occupants loads
c) Lighting loads
d) Sensible heat factor (SHF)

a. $Q_{occupants}$ =7247 W(sensible+latent)
b. $Q_{lighting}$ =318 W
c. SHF =0.67
d. Q_{walls} =637 W
e. SHF =0.44
f. Q_{walls} =435 W
g. $Q_{lighting}$ =211 W
h. $Q_{occupants}$ =4684 W(sensible+latent)

Question No. (3)

[10 marks]
*Identify **one or more** choices that best complete the statement or answer the question.*

The vaporizing and condensing temperature of a Refrigerant-12 system are 4°C and 43°C, respectively. The suction vapor is superheated to 21°C in the suction line, whereas the liquid is subcooled to 32°C by giving off heat to the ambient air.
what is the COP of this cycle?
what is the adiabatic discharge temperature of the refrigerant in this cycle?

a. 70°C
b. 0.5
c. 16°C
d. 59°C
e. 44.6°C
f. 1
g. 4.5
h. 6

Tanta University | Mechanical Power Engineering Department | Faculty of Engineering

نموذج C

Question No. (4)

[10 marks]
*Identify **one or more** choices that best complete the statement or answer the question.*

A boot-strap cooling system is used for an aeroplane to take 10 tons load. The temperature and pressure conditions of atmosphere are 15°C and 0.9 bar. The pressure of air is increased from .9 to 1.1 bar due to ramming action of the plane. The pressure of air leaving the main compressor and auxiliary compressor are 3.2 and 4.2 respectively. Isentropic efficiency of both compressors is 90% and isentropic efficiency of the turbine is 85%. About 55% of the total heat of air leaving the main compressor is removed in the first heat exchanger and 30% of the total heat of air leaving the auxiliary compressor is removed in the second heat exchanger using rammed air. Assuming the ramming action is isentropic. Determine:
a) Net power required to take the cabin load;
b) COP of the system; (consider turbine work)
c)Draw the layout diagram and T-S chart of the cycle.
The required cabin pressure is 1.03 bar and the temperature of air leaving the cabinshould not exceed 27°C.

a. 0.45
b. 2
c. 1.41
d. 35.13 kW
e. 1.35
f. 78 kW
g. 26 kW
h. 17.49 kW

Question No. (5)

[10 marks]

1. Moist air enters a cooling coil at 28°C dry-bulb temperature and 50% RH at flow rate of 1.5 kg/s. The air leaves at 13°C dry-bulb temperature and 90% RH. Calculate the air conditioning load on the coil.
2. Explain What is meant by thermal comfort? Mention 3 different factors that affect the thermal comfort of occupants. Illustrate with detailed sketch the comfort zones on the psychrometric chart.
3. Show using sketches a summer air conditioning system that uses a cooling coil and reheat coil. Sketch the corresponding psychrometric chart. Explain why should a reheat coil be used in a summer air conditioning.

TANTA UNIVERSITY — **3rd YEAR 2022-2023**
FACULTY OF ENGINEERING — **DATE: 10/1/2023** **TIME: 3 HOURS**
PRODUCTION ENG. & MECH. DESIGN DEPT. — **MPD 3115:THEORY OF VIBRATIONS**
MECHANICAL POWER ENG. DEPT. — **MPD 3153:THEORY OF VIBRATIONS**

FINAL TERM EXAM

Question 1 (20% Marks)

An electric motor of mass M, mounted on an elastic foundation, is found to vibrate with a deflection of 0.15 m ***at resonance***. It is known that the unbalanced mass of the motor is 8% of the mass of the rotor due to manufacturing tolerances used, and the damping ratio of the foundation is ζ=0.025. Determine the following:

a) The eccentricity or radial location of the unbalanced mass (e).
b) The peak deflection of the motor when the frequency ratio varies from resonance.
c) The additional mass to be added uniformly to the motor if the deflection of the motor at resonance is to be reduced to 0.1 m.

Question 2 (25% Marks)

A shaft, carrying a mid-way rotor of weight 100 N and eccentricity 0.1 cm, rotates at 1200 rpm. Assume the stiffness of the shaft as 0.2 MN/m and the external damping ratio as 0.1. Determine the following:

a) The steady-state whirl amplitude and the force transmitted to each bearing.
b) The maximum whirl amplitude.
c) The shaft diameter, if the shaft length is 200 mm and the allowable bending strength is 70 MPa.
d) What is the critical speed and what will be the change in this critical speed if elastic bearings are added instead of the rigid bearings.

Question 3 (20% Marks)

A rotating machine having a mass of 2000 kg rests on springs with a static deflection of 0.007 m. When the machine runs at 1000 rpm, the unbalance rotating force is 3300N. The ratio of two consecutive amplitudes in free vibration is 1 to 0.83, determine the following:

a) The dynamic amplitude, the transmitted force and the transmissibility at this speed.
b) What will happen to the amplitude and the transmitted force if the speed of the machine is reduced?

Question 4 (25% Marks)

The basic principle of vibration control in most practical cases is to keep the natural frequencies low. One of the approaches to achieve this principle is to study the effect of the coupling between coordinates on the natural frequencies. For the simple model of an automobile shown in **Fig. 1**, the *position* of the suspension has an effect on the *coupling* between coordinates and thus on the *natural frequencies*.

a) Derive the equations of motion using Lagrange's method, and then derive the condition for decoupling the coordinates.
b) Compare between the two cases (coupled and decoupled); which is better according to the principle mentioned above. Take $I_G=2Ma^2$ and for the coupled case a =0.25 L.

Question 5 (25% Marks)

A machine of mass 150 kg with a rotating unbalance of 0.5 kg.m is placed at the mid span of a 2 m long simply supported beam. The machine operates at a speed of 1200 rpm. The beam has an elastic modulus of 210×10^9 N/m^2 and a cross section moment of inertia of 2.1×10^{-6} m^4 with an assumed damping factor of 0.3.

a) Determine the steady state response.
b) In the *absence of damping*, design a dynamic vibration absorber such that when attached to the mid span of the beam, the vibration of the beam will be ceased and the absorber amplitude will be 20 mm.
c) The two natural frequencies of the new system.
d) The force transmitted to each of the support of the beam for the new system.

For simple supported beam $k=\frac{48EI}{L^3}$.

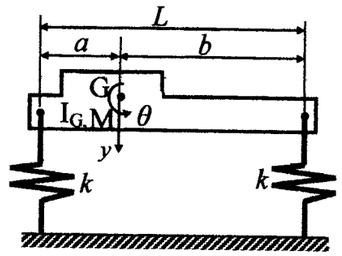


Fig. 1

Best Wishes for all,