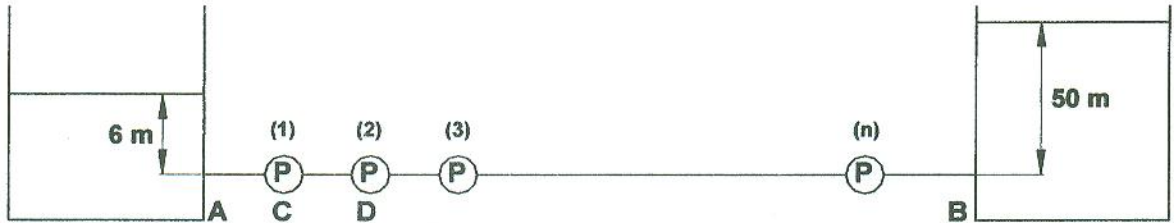


4-It is required to transmit $1 \text{ m}^3/\text{s}$ of water from A to B in the system shown below. The available pump type has the following performance:

Q (m^3/s)	0	0.5	0.75	1.0	1.25
H (m)	130	130	120	100	70
η %	0	50	70	85	75

Estimate the minimum number of pumps required and the power consumption.

If this pump has a cavitation factor as 0.1, what would be the maximum value of the distance AC and CD (Neglect the K.E. in your calculations). Take $h_{\text{atm}} - h_{\text{vap}} = 10 \text{ m}$ water, $L_{\text{AB}} = 100 \text{ km}$, the pipe's diameter = 750 mm and its coefficient of friction $f = 0.022$.



(15 points)

5-

- A lift centrifugal pump was started, but nothing was coming out. What is the reason in your opinion? And how can you solve such a problem?
- Operating a centrifugal pump away of the design discharge produces unpleasant effects. At least, describe two of such effects. Support your answer with figures.
- Axial flow pumps and fans should be maintained to operate at maximum flow rate and not at reduced flow rate, why? Explain your answer with figures. And, how can you maintain this operating condition?
- What is the reason of creating the axial thrust in radial pumps? How can we balance it?
- Although the theoretical head is in linear relationship with the discharge for kinetic machines, the actual relationship is not. Derive the theoretical one from the Euler's pump equation and then continue to conclude the reduced actual one.

(15 points)

د. أيمن بكري

انتهت الأسئلة،، مع أطيب الأمنيات بالتوفيق،،،

Please, answer the following questions (assume any missing data):-

- 1- The inlet and outlet diameters of a centrifugal fan rotating at 1450 rpm are 475 mm and 700 mm respectively. The corresponding impeller widths are 190 mm and 145 mm. The performance of the fan is controlled by a series of inlet vanes which are set to produce a whirl component in the direction of rotation such that the relative velocity of air at inlet is 31 m/s making an angle of 15° with the tangent to the blade inlet circle and causing a shock loss of $0.6 V_1^2/2g$ where V_1 is the absolute velocity of air at inlet. The impeller blades are backward inclined and the inlet and outlet angles are 12° and 38° respectively measured from the tangent.

Assuming that due to slip the actual whirl component at outlet is 0.8 of the theoretical and that the impeller loss is 0.4 of the velocity head at impeller outlet, calculate the total head developed by the impeller and the air flow rate through the fan. Also, estimate the required power to drive the fan.

(15 points)

- 2- Specifications for an axial flow coolant pump for one loop of a pressurized water nuclear reactor are: (head =85 m, flow rate= 20000 m³/h, speed =1490 rpm, diameter =1200 mm, water density = 714 kg/m³, and shaft power = 4 MW (electrical)). The manufacturer plans to build a model. Test conditions limit the available electric power to 500 kW and flow rate to 0.5 m³/s of cold water (density =1000 kg/m³). If the model and prototype efficiencies are assumed equal, find the head, speed and scale ratio of the model. Calculate the dimensionless specific speed of the prototype and confirm that it is identical with the model.

(10 points)

- 3- The following data is related to a centrifugal pump running at 1000 rpm:

Q (lit/s)	50	100	150	200	250	300
H (m)	21	20	19	17.5	15	12.5
η %	38	62.5	76	83	80	70

When this pump is used in a pipe line it gives 200 lit/s where the static lift is 7.5 m. In order to increase the flow rate by 25% two methods were proposed:

- Increasing the pump speed, calculate the new speed and shaft power.
- Using additional pumps running at the same speed. How many units must be connected, are they connected in series or parallel?, calculate shaft power.

Which method would you prefer and why?

(20 points)

- 3) the undamped natural frequency, (ω_n)
- 4) the system transfer function
- 5) the time to settle down to within $\pm 2\%$ of the final value, (t_s)

Question 3. (15 degrees):

For the block diagram (expressing a linear system) shown in Fig. Q3, find:

- 1) an expression for the output when the input R_1 is acting alone
- 2) an expression for the output when the input R_2 is acting alone
- 3) an expression for the complete output when all inputs act simultaneously

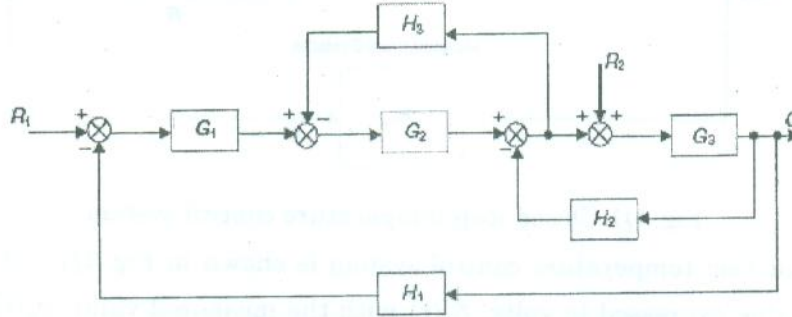


Fig. Q3 Block diagram for a closed loop system

Question 4. (15 degrees):

A block diagram of a welding head positioning system, (in a welding robot), is shown in Fig. Q4. Determine the range of K and a for which the system is stable. Find the range of a for a value of $K=40$.

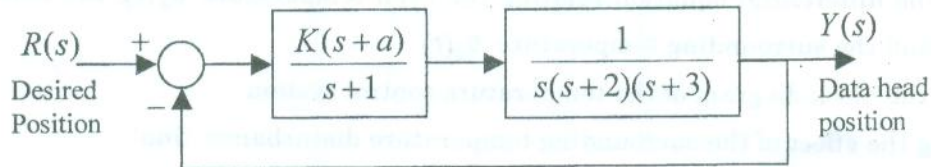


Fig. Q4 Welding head position control

Question 5. (20 degrees):

A feedback control system has the following open-loop transfer function

$$G(s)H(s) = \frac{K}{s(s+1)(s+5)}$$

- 1) Obtain asymptotes, breakaway point and imaginary axis cross-over point. Sketch the root locus.
- 2) A compensating element having a transfer function $G_1(s) = (s+2)$ is included in the open-loop transfer function. If the breakaway point is 0.56, sketch the new root locus. Comment on stability of the system with, and without the compensator.
- 3) Demonstrate (applying the angle condition) that, for the compensated system, the coordinates $-1.8 \pm j4.0$ lie on the root loci. What is the value of K for these points? Applying the magnitude condition, find the coordinates of the third root.

Best wishes, Dr. Zakarya ZYADA

Organization, clearness and neatness of answers are essential. Use graphic aids as much as you can.

Question 1, (20 degrees):

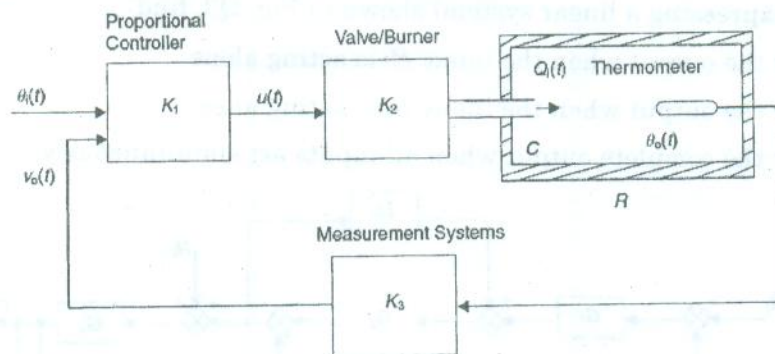


Fig. Q1 Closed loop temperature control system

The elements of a closed loop temperature control system is shown in Fig. Q1. A proportional controller compares the desired value expressed in volts, $\theta_i(t)$ with the measured value $v_o(t)$ and provides a control signal $u(t)$ of K_1 times their difference to actuate the valve and burner unit. The heat input to the oven, $Q_i(t)$, is K_2 times the control signal. The walls of the oven have a thermal resistance R_T and a thermal capacitance C_T and an operating temperature $\theta_o(t)$. The surrounding temperature to the oven is $\theta_s(t)$. The thermometer and measurement system feed a measured value of K_3 times $\theta_o(t)$ to the controller. The system parameters are: $K_1 = 5$; $K_2 = 1.5 \text{ J/V}$; $K_3 = 1 \text{ V/K}$; $R_T = 2 \text{ K/J}$; $C_T = 25 \text{ Js/K}$.

- 1) Find the differential equation relating the oven temperature $\theta_o(t)$, the heat input to the oven $Q_i(t)$ and the surrounding temperature $\theta_s(t)$.
 - 2) Draw the block diagram of the temperature control system.
- Neglecting the effect of the surrounding temperature disturbance, find:
- 3) The open loop transfer function and the open loop time constant.
 - 4) The closed loop transfer function and the closed loop time constant.
 - 5) The steady state error of the closed loop system when the input is a unit step.
 - 6) If the proportional controller is replaced with an integral controller K_1/s , what will be steady state error in this case for a unit step input?

Question 2, (20 degrees):

A. Consider a system represented by the differential equation

$$\frac{d^2 y}{dt^2} + 4 \frac{dy}{dt} + 3y = 2r(t), \text{ where the initial conditions are } y(0) = 0, \frac{dy}{dt}(0) = 0 \text{ and } r(t) = 1, t \geq 0. \text{ Find}$$

the response, $y(t)$, and the steady-state response, y_{ss} .

B. When a unity gain second order system is subject to a unit step input, its transient response contains a first overshoot of 77%, occurring after 32.5 ms has elapsed. Find:

- 1) the damped natural frequency, (ω_d)
- 2) the damping ratio, (ξ)



أجب عن الأسئلة الآتية:

السؤال الأول: أ- ما مفهوم التلوث وما هي مستوياته وأنواعه ؟

ب- متى نطلق على الهواء أنه ملوثاً، وما هو دور أكاسيد النيتروجين وثنائي أكسيد الكبريت (NO/SO_2) وكذلك الأوزون الأرضي في عملية التلوث ؟

ج- اذكر العوامل المحددة لكثافة الملوثات الجوية، ثم اشرح بالتفصيل دور الحالة الجوية السائدة في تحديد كثافة الملوثات الجوية.

(١٥ درجة)

السؤال الثاني: أ- ما هي العوامل التي يجب الاعتماد عليها عند اختيار الجهاز الأمثل والأنسب للتحكم في ملوثات الهواء.

ب- أذكر مصادر تلوث المياه، وما هي الأسباب التي تؤدي إلى تلوث المياه بالنفط؟

ج- اشرح بالتفصيل الطمر الصحي في التخلص من النفايات الصلبة، ثم أذكر الطرق الملائمة في التخلص من نفايات المستشفيات.

(١٥ درجة)

السؤال الثالث: أ- تستقبل التربة كميات هائلة من المخلفات و الملوثات سنويا ، ويمكن تصنيف الملوثات حسب منشئها إلى ملوثات طبيعية و ملوثات بشرية أو صناعية، تكلم بالتفصيل عن الآثار المترتبة علي تدهور التربة وكذلك كيفية التحكم في تلوث التربة.

ب- التطبيقات الزراعية والصناعية للإشعاع من المصادر الصناعية للتلوث بالإشعاع ، تكلم عنها بالتفصيل؟

ج- للحد من مشكلة النفايات الصلبة وإدارتها إدارة سليمة لا بد من تحقيق مجموعة أهداف، حدد تلك الأهداف.

c- Basic dynamic load rating

d- Dynamic equivalent load

e- Reliability of bearing

- 2- In a gear box, there are four bearings of type single row deep groove ball bearing of internal diameters of 30, 40, 60, 80 mm each of type double shield one face sealed. It is recommended to increase their duty level from medium (degree 2) to up-medium level (degree 3) in order to improve its performance. Write down a recommendation table list (according to the following table) indicating the new bearing code number in front of the old code bearing number their serial number.

Bearing Serial No.	Old bearing code	New bearing code	Quantity	Remarks
?	?	?	1	
?	?	?	1	
?	?	?	1	
?	?	?	1	

Question number (4)

(20 Marks)

- 1- Discuss in details the following using diagrams (in clear points):

- a- Steps of preparing maintenance plan.
- b- Steps of preparing maintenance program.
- c- Logistics.
- d- Supply chain management 5 sections.
- e- Supply and demand chain networks.
- f- Supply chain logistics 4 stages integration.
- g- The 4 factors of supply chain analysis.
- h- Logistics partnership types.

- 2- Transportation is consider a main role in logistic operations, discuss by using schemes and give example (from India)

GOOD LUCK

Course Examination Committee

Prof. Dr. Khaled M. Saadeldin

Course Coordinator: Prof. Dr. Alsaied Khalil

Course Title: Logistic Support
Date: Jan 2012 (Final first term)Course Code: MEP 4124
Allowed time: 3 hrsYear: 4th
No. of Pages: 2

Remarks: (answer the following questions and assume any missing data- improve and organize your answer and writing)

Attempt all questions

Question number (1) (20 Marks)

- 1- Draw in details the following operation relations showing the operation limits of the old, new, and working after overhaul (plot real values):
 - a- Gas turbine starting exhaust temperature with speed of rotation.
 - b- Specific fuel consumption with load for diesel engine and efficiency.
 - c- Gas turbine compressor characteristics (pressure ratio-mass flow rate).
 - d- Gas turbines exhaust temperature with load.
 - e- Diesel engine coolant temperature with load.
 - f- Vibration noise level with speed of rotation for diesel and gas turbine engines.
- 2- A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10% of time, 2 kN for 20% of time, 1 kN for 30% of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 % reliability, calculate the dynamic load rating of the bearing.

Question number (2) (20 Marks)

- 1- Consider an overlapping operation between 3 power equipments having the life time cycles of 60, 80, and 100 weeks. Give the following actions in tables:
 - a- Calculate and draw the stages period diagram based on the overlapping operation sequence.
 - b- Draw the operational time sharing planning schedule, and find the total period of operation till the last equipment go to overhaul.
 - c- Find and show the suitable periods of overhaul and minor repair maintenance of all equipment on the operational planning schedule.
- 2- Define and discuss in details the following by using diagrams:
 - a- The maintenance and the different types of maintenance.
 - b- The historic stages of maintenance evolution which indicates that the modern instrumentations played a key role in equipments life cycle and operation running cost and new type of maintenance is developed, discuss in details in clear points.
 - c- The different types of rolling bearings.

Question number (3) (20 Marks)

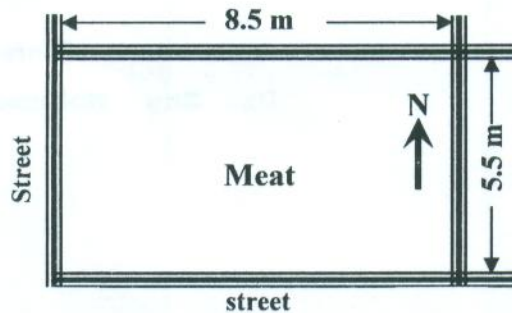
- 1- Define in details the following parameters of rolling bearing:
 - a- Life of bearing
 - b- Rating life of bearing

Course Title: Advanced Ref. and Air Conditioning
Date: Jan. 12th 2012(first term)Course Code: MEP4127
Allowed time: 3 hrsYear: 4th
No. of Pages: (2)

Remarks: (Answer the following questions, assume any missing data, answers may be supported by sketches), Tables of ref. and air conditioning and tables of ref. equipment and design data are ONLY allowed (available with students).

Problem number (1) (35 Marks)

- a) Define the cold store and mention their types and the main considerable points when starting to design a one. (5 Marks)
- b) The shown figure is a plan of a single floor of a house at Alex. It is required to design cold store room of 8.5 m×5.5 m×6 m to store **Meat**. Perform a complete detailed design for the room, provided with a layout of the unit using R-22 as a refrigerant. The following items should be taken into considerations:
- Type of storing is long.
 - Storing rate is 20 %
 - The room is used 10 months per year
 - Cork bard can be used as insulation material. The cubic meter of this insulation costs 300 L.E. for buying + 150 L.E. for fixing. Its supposed age can be considered as 20 years.
 - There are three workers.
- (30 Marks)

**Problem number (2) (17 Marks)**

- a) Describe in details each component of the most popular method in ice manufacture. (7 Marks)
- b) Mention the three types of air conditioning systems. (3 Marks)
- c) What is the hybrid desiccant air conditioning system? Comparing between it and a vapour compression system with terminal reheat (using psychrometric chart). (7 Marks)

Problem number (3) (15 Marks)

- a) What are the fundamental components of a closed hydronic system? Show with sketches two different types of hydronic system layout and sketch the pressure drop diagram of each type. (8 Marks)