Tanta University
Department of Electrical Power and Machines Engineering
Elective Course (1) Mechanical power stations

يصرح باستخدام جداول وخرائط البخار

Third Year (old curriculum) **3 hours exam**
January 2008

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

PROBLEM 1

In a 4500 kW power plant, the steam pressure and temperature at the turbine inlet are 90 bar and 500 °C respectively. The steam expands isentropically in the first stage turbine to the dry and saturated condition. Then it is reheated at a constant pressure to a temperature of410 °C, and enters the turbine second stage. The expansion is also isentropic in this stage and a part of the steam is bled, when it becomes dry and saturated, to a closed feed water heater. The remaining steam continues expanding to the condenser pressure of 0.1 bar. If the heating is ideal, and the bled steam is condensed to saturated water in the feed heater, where the condensate is returned to the feed line after the heater:

a)- Draw the plant flow diagram and the cycle on T-S chart
b)- Calculate the net work, heat addition and the cycle thermal efficiency.
c)- Determine the steam flow rate in the cycle
d)- Find the specific steam consumption, S.S.C.
Neglect the pump work.

PROBLEM 2

- (A)- Prove that the thermal efficiency of the Diesel cycle is as follow: $$\eta_D = 1 - \frac{1}{r^{\gamma-1}}\frac{r_c^{\gamma}-1}{\gamma(r_c-1)}$$
  Where: r = compression ratio
  r_c = cut-off ratio

- (B)- An air standard Diesel cycle with a compression ratio of15. The pressure and temperature at the beginning of compression are 1 bar and 27 °C respectively. Heat supplied at constant pressure is 2850 kJ/kg of air. Determine the following

P.T.O

a)- The thermal efficiency of the cycle
b)- The cut-off ratio of the cycle

PROBLEM 3

An open cycle gas turbine plant consists of a compressor, a combustion chamber, a heat exchanger and a turbine. Air is compressed from 1.01 bar and 20 °C to 6.5 bar. Heat is added to increase the temperature to 770 °C. Expansion takes place in the turbine after which the gases pass through the heat exchanger. Pressure drop in the air side of the heat exchanger together with the pressure drop in the combustion chamber is 0.07 bar and in gas side of the heat exchanger is 0.05 bar. If the effectiveness of the regenerator is 0.6 and the gases leave it at a pressure of 1.05 bar. Calculate the specific output and the plant efficiency. The process in the compressor and the turbine may be assumed with an isentropic efficiency of 0.85 each.

PROBLEM 4

- (A)- Steam is compressed reversibly and adiabatically from a pressure of 1.4 bar and dryness fraction of 0.9 to a pressure of 14 bar. Determine the final temperature of the steam.

- (B)- An engine receives heat at a rate of 1570 kJ/min at a temperature of 265 °C, and rejects heat at a rate of 1170 kJ/min at a temperature of 42 °C :
  - (i)- Calculate the power output of the engine.
  - (ii)- Determine the thermal efficiency of the engine?
  - (iii)- What would be the maximum attainable efficiency?

PROBLEM 5

- (A)- A household refrigerator is loaded with fresh food and closed. Consider the whole refrigerator and contents as a system. The machine consumes 1.2 KWH of electrical energy in cooling the food. The internal energy of the system is decreased by 5300 KJ as the temperature drops. Find the magnitude and the sign of heat transfer for the process.

- (B)- On a warm summer day, a housewife decided to beat the heat by closing the windows and doors of a room and opening the refrigerator door. Evaluate the final situation of the room temperature

Good luck

توليد الطاقة ٤ المحتوى كهرباء لائحة قديمة

Tanta University
Faculty of Engineering
Electrical Power and Machines Department — 3rd Year

Electrical Machine
Final Exam 2007/2008
3:00 hr

Attempt all questions

Question 1:

a) State true or false providing reasonable explanations:

1- The stator copper loss is considered negligible in the blocked rotor test of three-phase induction motor.
2- Three-phase induction motor cannot operate when one phase is disconnected.
3- Frequency control can be applied to three-phase synchronous motor as well as three-phase induction motor.
4- The delta-star switch is a staring method of three-phase induction motor.
5- The three-phase induction motor can stably operate at very low speed at normal supply frequency.
6- Hydraulic power plants utilize turbo generators with two rotor poles
7- The maximum torque of three-phase induction motor depends only on the supply voltage.
8- The copper loss of induction motor varies linearly with supply voltage
9- The damper winding of synchronous motor increases the input power factor.
10- The increase of rotor resistance of three-phase wound rotor induction motor increases the slip of maximum torque.

Question 2:

a) Demonstrate the following phenomena:

(a) cogging (b)Crawling

b) Explain the principle of operation of double cage motor.

c) 115V, 3-phase, 6-pole, 60Hz, Y-connected induction motor is rated 3.73KW. The equivalent circuit parameters are:

$R_1=0.45\Omega$ $R'_2=0.40\Omega$
$X_1=0.80\Omega$ $X'_2=0.80\Omega$
$X_m=30\Omega$

The stator core loss is 50W and rotational loss is 150W. For a slip of 0.04, find (a) input current (b) input power factor (c) airgap power (d) rotor cupper loss (e) output torque (f) efficiency.

Question 3:

a) Discuss with necessary diagrams the different methods of induction motor starting.

b) What are the different methods used to control the speed of three-phase induction motor? Clarify the principle of each method with equations and graphs.

c) A 400V, Y-Y connected wound-rotor induction motor has 0.06Ω rotor resistance and 0.3Ω stand still reactance per phase. Find the additional resistance required in the rotor circuit to make the starting torque equal to maximum torque of the motor.

Question 4:

a) Illustrate briefly the effect of varying excitation upon the armature current and power factor of a synchronous motor when input power is maintained constant.

b) A 400V, 50Hz, 3ϕ, 37.3KW, star-connected synchronous motor has a full-load efficiency of 88%. The synchronous impedance of the motor is (0.2+j1.6Ω) per phase. If the excitation of the motor is adjusted to give a leading power factor of 0.9, calculate for full load (a) the induced emf (b) the total mechanical power developed.

Question 5:

a) Explain the conditions required to synchronize a three phase synchronous generator with the power system.

b) Find the no-load phase and current voltages of a start-connected 3-phase, 6-pole alternator which runs at 1200 rpm, having flux per pole of 0.1Wb sinusoidally distributed. Its stator has 54 slots with double layer windings. Each coil has one turn and the coil is chorded by 1 slot.

c) Two three phase 6.6KV, Y connected synchronous generators, A and B, operating in parallel to supply a load of 300KW at 0.8 power factor lagging. The synchronous impedance per phase of the machine A is 0.5+j10 and of B is 0.4+j12Ω. The excitation of machine A is adjusted that it delivers 150A at a lagging mower factor, and the governors are set that the load is shared between the two machines equally. Determine for each machine (a) the armature current (b) power factor (c) induced voltage (d) power angle.

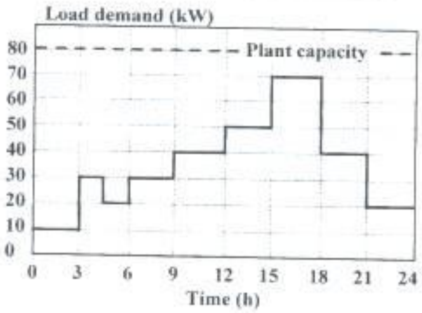
All best wishes

Tanta University
Faculty of Engineering
Electrical Power and Machines Engineering

لائحة جديدة

Third year
Final Examination 2007-2008
Generation and economy of electrical energy
Total time: Three hours

1-a) For the daily load curve shown in the figure, calculate: the total consumed energy, the average load demand, the load factor, the capacity factor and the utilization factor. Draw the load duration curve and the load energy curve. Verify the total consumed energy from the load energy curve.



1-b) Define the following terms: Installed capacity, Reserve factor, Diversity factor, Economic dispatch , Cold reserve, Depreciation, Base load, Ramp rate capability and Fixed cost.

1-c) The initial investment value of a certain equipment is evaluated by 1.2 million L.E. The life time of the equipments is estimated as 25 years. According to the diminishing-value method, the annual unit depreciation is found to be 0.054. Calculate the salvage value of the equipment and find the value of the equipment and the set aside money after the tenth year.

2-a) Prove that the optimal allocation of any load between the working power plants in a certain network is achieved when the incremental fuel costs multiplied by the corresponding penalty factors of all units are equal.

2-b) Explain the need for the power-factor tariffs methods for electrical energy.

2-c) Explain the meaning of the system constraints in electric power systems and give a suitable classification of these constraints. Choose <u>*only one*</u> constraint and explain its meaning and importance in power systems.

2-d) The input fuel in (Btu/h) for a power plant with min. and max. power of 10 and 100 MW respectively is given by: $F=(40+4*P + 0.012*P^2)*10^6$, where P is the generated power in (MW). Calculate the input fuel, the heat rate and he incremental fuel cost in $/MWh at an output power of 70 MW. Assume that the fuel cost is $0.12*10^{-6}$ $/Btu

---

3-a) Draw the flow chart summarizing the steps that can be followed to obtain the solution of the economic dispatch problem neglecting the system losses.

3-b) A load of 300 MW is supplied by two units with incremental fuel costs in $/MWh as follows: $\frac{dC_1}{dP_1} = 0.1\,P_1 + 20$ and $\frac{dC_2}{dP_2} = 0.12\,P_2 + 15$. Determine the most economic division of load between the two units and the extra cost if equal load sharing is used

3-c) Repeat problem (3-b) assuming that the minimum and maximum loads on each unit are respectively 100 and 280 MW and the loss formula is given as:

$P_{loss} = 0.0002\,P_1^2 + 0.00019\,P_1 \cdot P_2 + 0.00025\,P_2^2$, where P is in MW. Find the optimal load allocation among the generators starting with a lagrange multiplier value of 30 and penalty factors of 1.0 and 1.1 for the first and second generating units respectively. The allowed tolerance is 3%.

4-a) What is the function of:

- The pressure tunnel, the surge tank, the valve house and the penstock in hydroelectric power plant
- Moderator, Shielding, Control Rods and Coolant in nuclear power plants

4-b) Mention the main components of the nuclear reactor and explain the main purpose of each components.

4-c) What are the advantage and disadvantages of Diesel power plants.

4-d) Discuss the meaning of the efficiency of each part of steam power plants.

4-e) Explain the methods of orientation of the blades to keep them in the face of air in wind turbines.

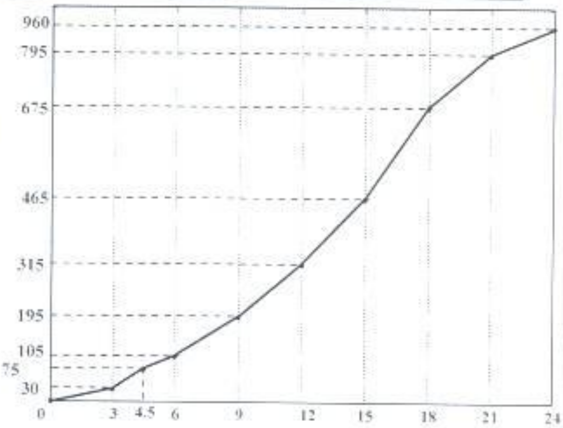
4-f) Discuss the advantages and disadvantages of solar cells.

4-g) Explain the principles of operation of the fuel cells and discuss their electrical characteristics

Good luck

Tanta University Faculty of Engineering Electrical Power and Machines Engineering	لائحة قديمة
Third year Final Examination 2007-2008 Generation and economy of electrical energy Total time: Three hours	

1-a) **For the load energy curve shown in the figure, draw the daily load curve and find: the total consumed energy, the average load demand and the load factor. Draw the load duration curve.**



1-b) **Define the following terms, which are all related to the wind turbines: Blade pitch angle, cut in speed, upwind turbines and power coefficient "C_p".**

1-c) A small distribution station has an initial investment value of 2 million L.E. and a salvage value of 0.5 million L.E. and is designed to operate for 20 years. Find the annual unit depreciation using the diminishing-value method. Also, find the value of the station and the set aside money after the fifth year.

2-a) Discuss the importance of the ramp rate, start-up time and shut-down time on the choice of the operating and standby unit and the distribution of reserve power on different power plants.

2-b) **Draw the variation of the total cost with energy according to Hopkinson rate and Doherty rate methods and compare between the two methods.**

3-c) **Prove that the optimal allocation of any load between the working power plants in a certain network is achieved when the incremental fuel costs of all units are equal.**

2-d) **What is the difference between soft and hard constraints? Give details about the importance of the constraints in determining the operating point in power systems.**

3-a) Explain in details the meaning of load dispatch and its importance in power system operation.

3-b) The incremental fuel costs in \$/MWh for a plant consisting of three units are given by: $\frac{dF_1}{dP_1} = 0.01P_1 + 3.2$, $\frac{dF_2}{dP_2} = 0.012P_2 + 2.8$ and $\frac{dF_3}{dP_3} = 0.008P_3 + 3.0$. Calculate the saving in \$ in the case of a load demand of 600 MW when the optimal dispatch is used compared to distributing the load equally between the three units. The minimum and maximum loads on each unit are respectively 100 and 300 MW.

3-c) What is the meaning of the Input-output curve of a generating units and its importance regarding the economic issue. Explain the curves that can be extracts from this curve.

3-d) Classify Steam power plants according to all possible methods and explain their advantages and disadvantages.

4-a) Draw the schematic configuration of hydroelectric power plant and explain the function of its components

4-b) Discuss in details the methods of extracting electric power from nuclear power stations.

4-c) What are the components of the gas power plants and how can the efficiency of such units be increased? Mention the advantage and disadvantages of gas power plants.

4-d) Why diesel power plants are not widely used.

4-e) Compare between horizontal-axis and vertical-axis wind turbine.

Good luck

Electrical Department
Faculty of Engineering
Tanta University

3[rd] Year, Power Section
Jan. 2008
Time: 3 Hrs

HIGH VOLTAGE ENGINEERING

1- (a) Write an engineering brief, aided with neat sketches, on the production of power frequency A.C. high voltage. Explain the methods of voltage regulations.

(b) Series resonant circuits are essential in high voltage labs to eliminate unwanted harmonics. Explain the statement showing why and the advantages of these circuits.

(c) A single care 132kV, 50Hz, $120mm^2$ H.V. cable is connected to a transformer and an alternator having the following parameters:

Inductance of transformer / phase = 0.03H
Inductance of cable = 0.01H
Resistance of transformer / phase = 0.7Ohm

Knowing that the electrical resistance of the cable is 0.15 ohm/km and its capacitance is equal to 0.25 μF/Km, determine: The length of the cable required to produce resonance at power frequency? If the 9^{th} harmonic has 5% of the fundamental produced voltage, what would be the voltage across the cable if resonance occurs at this harmonic.

2- (a) Describe the tests on high voltage equipments at high frequency damped oscillations using a Tesla Coil. Mentioning the equation for high frequency conditions and the condition for stable frequency in both primary and secondary circuits of the Tesla Coil.

(b) Write an account on the production of H.V d.c. Draw the construction circuit of the the Cockcroft-Waltan doubler using 4 units. Then find the output voltage and its regulation.

(c) A Van de Graaff electrostatic generator with its high voltage terminal immersed in SF_6 gas having a relative permittivity of 2.6 and an electric strength of 6.5 MV/m. The belt width is 0.6m and driven at a speed of 28 m/s. The system capacitance is 0.25 nF and the designing factor of safety is 2. Determine the rate of building up of voltage and the charging current. If the remnant voltage V_o = 100kV and the corona constant = $0.6 * 10^{-9}$ and the load current is 1mA. Find the terminal voltage. $\varepsilon_o = 8.854 * 10^{-12}$ F/m.

3- (a) Enumerate the ionization process in gaseous dielectrics, hence find the value of current passing (i) when an initial current (i_o) is produced by ultraviolet. The first Townsed coefficient is (α) and the second Townsend coefficient is (δ). Using Townsend criterion, prove Paschen's law determine the mini. Sparking potential and the corresponding pressured-distance product.

(b) Consider a Townsend discharge in a gas between two plane parallel electrodes in which there is zero concentration at the cathode (with no proton current and negligible emission). There is a constant volume ionization due to an external sources of (n) ions.cm^{-3}/sec. of charge (e). Show that the current density (J) A/m^2 at any distance (x) cm from the cathode is given by:

$J=(n \cdot e \ / \alpha)[\exp.(\alpha \cdot x) - 1]$

Where, e: is the electronic charge, α: is the first Townsend coefficient of ionization.

(c) A 4-stage Cockcroft-Walton doubler d.c, high voltage generator with capacitance on each stage of 0.05μF, the load current is 5mA and the a.c transformer voltage is 50kV at power frequency. Determine:

i. The output voltage regulation.
ii. The net output voltage.
iii. The optimum number of stages and the maximum output voltage.

4- (a) Solid insulating materials suffer from electromechanical breakdown. Explain briefly, how and find out the maximum electric field that produces mechanical collapse in the material in terms of its permittivity and Yong's modulus of elasticity.

(b) Explain briefly, the mechanism of breakdown of solid dielectrics by partial discharges.

(c) Explain briefly, the streamer (kanal) mechanism. Calculate the space charge field to produce streamer.

(d) Explain, briefly, the mechanism of breakdown in liquid dielectrics.

Good Luck ....

Prof. Dr. Ahmed A. Hossam Eldin

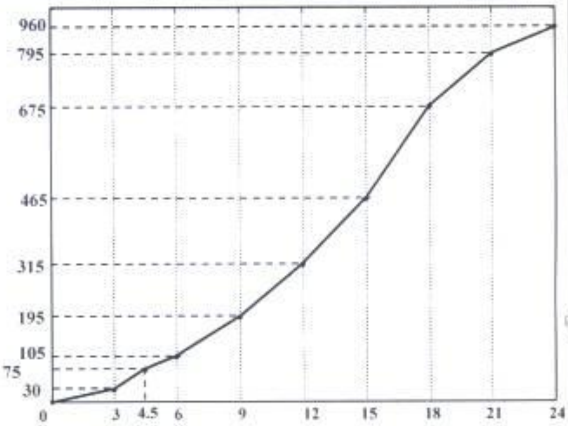
كهرباء قوى   لائحة قديمة

Tanta University
Faculty of Engineering
Electrical Power and Machines Engineering

لائحة قديمة

Third year
Final Examination 2007-2008
Generation and economy of electrical energy
Total time: Three hours

1-a) For the load energy curve shown in the figure, draw the daily load curve and find: the total consumed energy, the average load demand and the load factor. Draw the load duration curve.



1-b) Define the following terms, which are all related to the wind turbines: Blade pitch angle, cut in speed, upwind turbines and power coefficient "C_p".

1-c) A small distribution station has an initial investment value of 2 million L.E. and a salvage value of 0.5 million L.E. and is designed to operate for 20 years. Find the annual unit depreciation using the diminishing-value method. Also, find the value of the station and the set aside money after the fifth year.

2-a) Discuss the importance of the ramp rate, start-up time and shut-down time on the choice of the operating and standby unit and the distribution of reserve power on different power plants.

2-b) Draw the variation of the total cost with energy according to Hopkinson rate and Doherty rate methods and compare between the two methods.

3-c) Prove that the optimal allocation of any load between the working power plants in a certain network is achieved when the incremental fuel costs of all units are equal.

2-d) What is the difference between soft and hard constraints? Give details about the importance of the constraints in determining the operating point in power systems.

3-a) Explain in details the meaning of load dispatch and its importance in power system operation.

3-b) The incremental fuel costs in \$/MWh for a plant consisting of three units are given by: $\frac{dF_1}{dP_1} = 0.01P_1 + 3.2$, $\frac{dF_2}{dP_2} = 0.012P_2 + 2.8$ and $\frac{dF_3}{dP_3} = 0.008P_3 + 3.0$. Calculate the saving in \$ in the case of a load demand of 600 MW when the optimal dispatch is used compared to distributing the load equally between the three units. The minimum and maximum loads on each unit are respectively 100 and 300 MW.

3-c) What is the meaning of the Input-output curve of a generating units and its importance regarding the economic issue. Explain the curves that can be extracts from this curve.

3-d) Classify Steam power plants according to all possible methods and explain their advantages and disadvantages.

4-a) Draw the schematic configuration of hydroelectric power plant and explain the function of its components

4-b) Discuss in details the methods of extracting electric power from nuclear power stations.

4-c) What are the components of the gas power plants and how can the efficiency of such units be increased? Mention the advantage and disadvantages of gas power plants.

4-d) Why diesel power plants are not widely used.

4-e) Compare between horizontal-axis and vertical-axis wind turbine.

Good luck

Tanta University
Faculty of Engineering
Computer Engineering and
Automatic Control Department

Course Title: Automatic Control **Time allowed: 3 hour**

3rd year undergraduate

Final Exam

Answer the following problems :

1. The schematic diagram of a servomechanism is given in the figure shown below. The system constants are as follows:

Synchro sensitivity, K_s	= 1 volt/deg.
Amplifier gain, K_A	= 20 volt/volt
Motor torque constant, K_c	= 10^{-5} N.m/volt
Load inertia, J_L	= 1.5×10^{-5} g.m2
Viscous friction, f_L	= 1×10^{-5} Nm/rad/sec
Tachometer const., K_t	= 0.2 volt/rad/sec

Motor inertia and friction are assumed to be negligible.

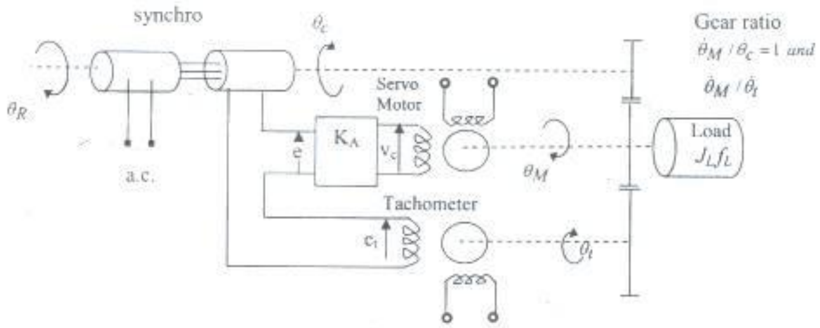


Fig. 1

a) Find the value of ξ assuming that the tachometer is disconnected. Determine also the steady-state error corresponding to an input velocity of 1 rad/sec.

b) Determine ξ when the tachometer is included as part of the system.

c) The tachometer is now removed and the amplifier is replaced by a proportional Plus integral amplifier whose output voltage is given by $V_c = K_A e + K_A \int e$, compare the steady-state behavior of the system with that of, part (a).

2. a) The block diagram of a servomechanism is shown in figure below. Determine the value of system gain K and tachometer gain K_t so that the maximum overshoot to a unit step response is 40 percent and peak time is 0.8 second.

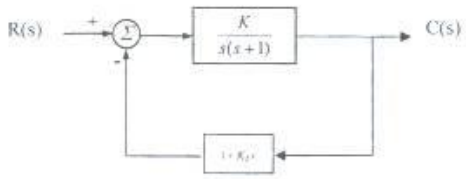


Fig. 2

b) Consider a unity feedback system having an open-loop transfer function :

$$G(j\omega) = \frac{K}{j\omega(1+j0.2\omega)(1+j0.5\omega)}$$

By the use of Nyquist stability criterion on the direct polar plot, determine:

(i) The gain margin "GM" and phase margin "PM" for K=1.

(ii) The open-loop gain for a gain margin of 20 db.

(iii) The open-loop gain for a phase margin of 45°.

3. Draw a rough sketch for the root locus plot of a unity feedback system with an open-loop transfer function:

$$G(s) = \frac{K}{s(s+2)(s+5)}$$

a) find the range for values of K for which the system has damped oscillatory response.
b) What is the greatest value of K which can be used before continuous oscillations occur.
c) Determine the frequency of continuous oscillations.
d) Find the value of K so that the dominant pair of complex poles of the system has a damping ratio of 0.5.

4. Draw Bode diagrams for the sytem with transfer function :

$$G(s) = \frac{1000(s+2)}{s(s+5)(s^2+6s+10)}$$

Find the gain margin and phase margin.

5. The figure represents a plot for the log magnitude curve of a forward transfer function $G(j\omega)$ of a unity feedback system (the drawing is not to scale):

i) Find the system transfer function G(s)
ii) Find the gain margin and phase margin.
iii) Is the closed loop system stable?.
iv) If an amplifier of gain K is added in cascade with the forward transfer function found above, find the limiting value of K for a stable operation of the system.

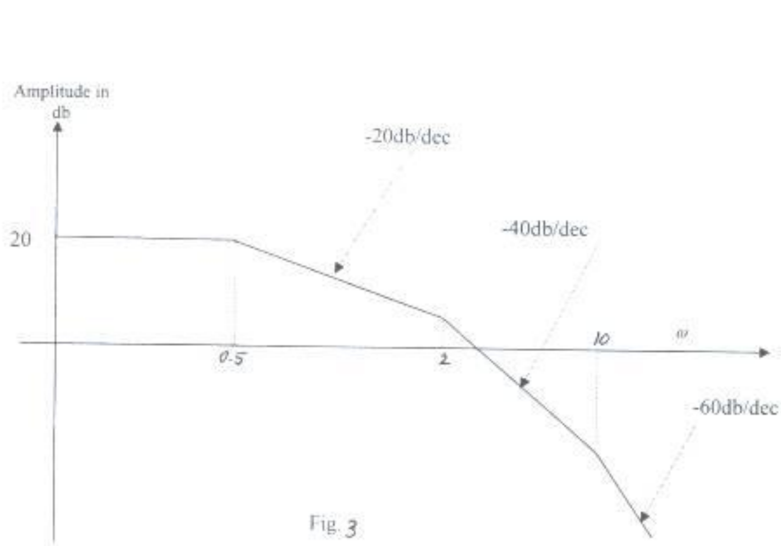


Fig. 3

6. Consider a unity feedback system with an open-loop transfer function of,

$$G(s) = \frac{K}{s(s+1)(s+4)}$$

The system is to be compensated according to the following design specifications :

Damping ratio, $\zeta = 0.5$,

Natural frequency, $\omega_n = 2$ rad/sec.

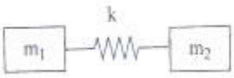
Design a suitable compensator for this system such that it achieves the above design requirements .

جامعة طنطا – كلية الهندسة
قسم هندسة الحاسبات والتحكم الآلي
امتحان الفصل الدراسي الأول للعام الجامعي ٢٠٠٧/٢٠٠٨

الفرقة الثالثة قسم هندسة القوى الكهربية (جديدة)
المادة : أسس التحكم الآلي
الزمن : ثلاث ساعات   يناير ٢٠٠٨

Attempt the following six questions:

Q(1): Two objects mass m_1 and m_2 are attached at opposite ends of a spring having spring constant k, as shown in Figure, the entire apparatus is placed on a highly varnished table. Show that, if stretched and released from rest, the masses oscillate with respect to each other with period $2\pi\sqrt{\dfrac{m_1 m_2}{k(m_1+m_2)}}$.



Q(2): [a] The characteristic equations of linear control systems are given below. Apply Routh-Hurwitz criterion to determine the values of K for system stability.

1- $s^3 + 4Ks^2 + (K+5)s + 10 = 0$

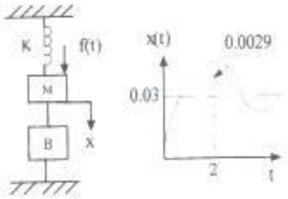
2- $s(s^3 + 3s + 3) + K(s+2) = 0$

[b] Find the root distribution of the following equations:

1- $s^6 + 2s^5 + 8s^4 + 15s^3 + 20s^2 + 16s + 16 = 0$

2- $s^4 + 2s^3 + 10s^2 + 20s + 5 = 0$

Q(3): Figure below shows a mechanical vibratory system. When 8.9 N of force is applied to the system, the mass oscillates, as shown in Figure. Determine M, B and K of the system from this response curve.



Q(4): For positive values of K, plot the root locus for unity feedback control systems having the following open-loop transfer functions:

(a) $G(s) = \dfrac{K}{s(s^2 + 5s + 6)}$ (b) $G(s) = \dfrac{K(s+2)}{s^2 + 4s + 8}$

For what values of gain K does the system become unstable in each case? Find also the value of k at which the damping ratio is 0.866 .

Q(5): [a] Sketch the Bode diagram for a system having an open loop transfer function given by

$$G(s) = \frac{K(1+0.5s)}{s(1+0.2s)^2(1+0.1s)}$$, assuming K=1.

(i) Determine the gain margin and phase margin and whether the system is stable.
(ii) Determine the value of k so that the system will have a phase margin angle of 45°.

[b] Find a state space model for a control system having the transfer function:

$$G(s) = \frac{4(s+3)}{(s+2)(s^2+6s+5)}$$

in the CCF and Pole-Zero form.

Q(6): [a] Given a system described by the dynamic equations

$$\frac{dx(t)}{dt} = Ax(t) + bu(t) \qquad y(t) = cx(t)$$

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -1 & -2 \end{bmatrix} \qquad b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \text{ and } \quad c = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix}$$

(i) The characterstic equation.
(ii) Find the transfer function $Y(s)/U(s)$.

[b] (i) For the following system draw the state diagram.

$$\dot{\underline{X}} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}\underline{X} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u$$

$$y = \begin{bmatrix} 3 & 1 \end{bmatrix}\underline{X}$$

(ii) Determine whether the given system in (b-i)is completely state controllable and observable or not.

مع أطيب الأمنيات بالتوفيق والنجاح

نظم التحكم الآلي ٣ باور

Tanta University
Faculty of engineering
Subject: Automatic Control System

Computer and control Dept.
3 rd year (Electrical Power)
Time allowed: 3 Hours

Attempt all the following questions:

Question No.(1)

Give a representation for the armature control dc-motor. Point out the elements A, b and c.

Question No.(2)

In a linear system, $A = \begin{bmatrix} 3 & 0 & -2 \\ 4 & 8 & 5 \\ 0 & 6 & 8 \end{bmatrix}$, $b = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$, and $c = [1 \quad 0 \quad 1]$.

Check:

a) The system Controllability
b) The system Observability

Question No.(3)

Find the eigenvalues for the system given in Question(2).

Question No.(4)

Drive a state-space representation for the following components:

1- A step-up transformer
2- A field controlled dc-motor.

مع أطيب الأمنيات بالتوفيق و النجاح

Tanta University
Faculty of Engineering
Electrical Power and Machines Department — 3^{rd} Year

Electrical Machine
Final Exam 2007/2008
3:00 hr

Attempt all questions

Question 1:

a) State true or false providing reasonable explanations:

1- The stator copper loss is considered negligible in the blocked rotor test of three-phase induction motor.
2- Three-phase induction motor cannot operate when one phase is disconnected.
3- Frequency control can be applied to three-phase synchronous motor as well as three-phase induction motor.
4- The delta-star switch is a staring method of three-phase induction motor.
5- The three-phase induction motor can stably operate at very low speed at normal supply frequency.
6- Hydraulic power plants utilize turbo generators with two rotor poles
7- The maximum torque of three-phase induction motor depends only on the supply voltage.
8- The copper loss of induction motor varies linearly with supply voltage
9- The damper winding of synchronous motor increases the input power factor.
10- The increase of rotor resistance of three-phase wound rotor induction motor increases the slip of maximum torque.

Question 2:

a) Demonstrate the following phenomena:

(a) cogging (b)Crawling

b) Explain the principle of operation of double cage motor.

c) 115V, 3-phase, 6-pole, 60Hz, Y-connected induction motor is rated 3.73KW. The equivalent circuit parameters are:

$R_1=0.45\Omega$ $R'_2=0.40\Omega$

$X_1=0.80\Omega$ $X'_2=0.80\Omega$

$X_m=30\Omega$

The stator core loss is 50W and rotational loss is 150W. For a slip of 0.04, find (a) input current (b) input power factor (c) airgap power (d) rotor cupper loss (e) output torque (f) efficiency.

Question 3:

a) Discuss with necessary diagrams the different methods of induction motor starting.

b) What are the different methods used to control the speed of three-phase induction motor? Clarify the principle of each method with equations and graphs.

c) A 400V, Y-Y connected wound-rotor induction motor has 0.06Ω rotor resistance and 0.3Ω stand still reactance per phase. Find the additional resistance required in the rotor circuit to make the starting torque equal to maximum torque of the motor.

Question 4:

a) Illustrate briefly the effect of varying excitation upon the armature current and power factor of a synchronous motor when input power is maintained constant.

b) A 400V, 50Hz, 3ϕ, 37.3KW, star-connected synchronous motor has a full-load efficiency of 88%. The synchronous impedance of the motor is (0.2+j1.6Ω) per phase. If the excitation of the motor is adjusted to give a leading power factor of 0.9, calculate for full load (a) the induced emf (b) the total mechanical power developed.

Question 5:

a) Explain the conditions required to synchronize a three phase synchronous generator with the power system.

b) Find the no-load phase and current voltages of a start-connected 3-phase, 6-pole alternator which runs at 1200 rpm, having flux per pole of 0.1Wb sinusoidally distributed. Its stator has 54 slots with double layer windings. Each coil has one turn and the coil is chorded by 1 slot.

c) Two three phase 6.6KV, Y connected synchronous generators, A and B, operating in parallel to supply a load of 300KW at 0.8 power factor lagging. The synchronous impedance per phase of the machine A is 0.5+j10 and of B is 0.4+j12Ω. The excitation of machine A is adjusted that it delivers 150A at a lagging mower factor, and the governors are set that the load is shared between the two machines equally. Determine for each machine (a) the armature current (b) power factor (c) induced voltage (d) power angle.

All best wishes

محطات قوى ميكانيكية   قوى كهربية

Tanta University
Department of Electrical Power and Machines Engineering
Elective Course (1) Mechanical power stations

يصرح باستخدام جداول وخرائط البخار

Third Year (old curriculum) **3 hours exam**
January 2008

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

PROBLEM 1

In a 4500 kW power plant, the steam pressure and temperature at the turbine inlet are 90 bar and 500 °C respectively. The steam expands isentropically in the first stage turbine to the dry and saturated condition. Then it is reheated at a constant pressure to a temperature of410 °C, and enters the turbine second stage. The expansion is also isentropic in this stage and a part of the steam is bled, when it becomes dry and saturated, to a closed feed water heater. The remaining steam continues expanding to the condenser pressure of 0.1 bar. If the heating is ideal, and the bled steam is condensed to saturated water in the feed heater, where the condensate is returned to the feed line after the heater:

a)- Draw the plant flow diagram and the cycle on T-S chart

b)- Calculate the net work, heat addition and the cycle thermal efficiency.

c)- Determine the steam flow rate in the cycle

d)- Find the specific steam consumption, S.S.C.

Neglect the pump work.

PROBLEM 2

- (A)- Prove that the thermal efficiency of the Diesel cycle is as follow: $\eta_D = 1 - \frac{1}{r^{\gamma-1}} \frac{r_c^{\gamma} - 1}{\gamma (r_c - 1)}$

  Where: r = compression ratio
  r_c = cut-off ratio

- (B)- An air standard Diesel cycle with a compression ratio of15. The pressure and temperature at the beginning of compression are 1 bar and 27 °C respectively. Heat supplied at constant pressure is 2850 kJ/kg of air. Determine the following:

a)- The thermal efficiency of the cycle
b)- The cut-off ratio of the cycle

PROBLEM 3

An open cycle gas turbine plant consists of a compressor, a combustion chamber, a heat exchanger and a turbine. Air is compressed from 1.01 bar and 20 °C to 6.5 bar. Heat is added to increase the temperature to 770 °C. Expansion takes place in the turbine after which the gases pass through the heat exchanger. Pressure drop in the air side of the heat exchanger together with the pressure drop in the combustion chamber is 0.07 bar and in gas side of the heat exchanger is 0.05 bar. If the effectiveness of the regenerator is 0.6 and the gases leave it at a pressure of 1.05 bar. Calculate the specific output and the plant efficiency. The process in the compressor and the turbine may be assumed with an isentropic efficiency of 0.85 each.

PROBLEM 4

- (A)- Steam is compressed reversibly and adiabatically from a pressure of 1.4 bar and dryness fraction of 0.9 to a pressure of 14 bar. Determine the final temperature of the steam.

- (B)- An engine receives heat at a rate of 1570 kJ/min at a temperature of 265 °C, and rejects heat at a rate of 1170 kJ/min at a temperature of 42 °C :
  (i)- Calculate the power output of the engine.
  (ii)- Determine the thermal efficiency of the engine?
  (iii)- What would be the maximum attainable efficiency?

PROBLEM 5

- (A)- A household refrigerator is loaded with fresh food and closed. Consider the whole refrigerator and contents as a system. The machine consumes 1.2 KWH of electrical energy in cooling the food. The internal energy of the system is decreased by 5300 KJ as the temperature drops. Find the magnitude and the sign of heat transfer for the process.

- (B)- On a warm summer day, a housewife decided to beat the heat by closing the windows and doors of a room and opening the refrigerator door. Evaluate the final situation of the room temperature.

Good luck

٢ اتصالات نوى كورس

TANTA UNIVERSITY	3rd Year Exam - 1st Semester, 2007/2008
Faculty of Engineering	Elective Course (1): Electrical Communications
Dept. of Electrical Power Engg.	24/1/2008 Time: 3 Hrs Dr. A. Shalaby

Answer the following questions

1- a) Using the properties of the unit impulse function evaluate the following integral

$$\int_{-\infty}^{\infty} \left(3e^{2t}\sin \pi t + t^2 \cos \pi t\right)\delta(t-2)\, dt$$

b) Find the complex Fourier series of the periodic train of unit impulses $\delta_T(t)$ and sketch its magnitude spectrum.

c) Using the result of (1-b) find the Fourier transform of the periodic train of unit impulses $\delta_T(t)$ and sketch its Fourier spectrum.

2- a) Show how the baseband signal can be recovered from a DSB-SC signal by a synchronous demodulator.

b) Write an equation for the ordinary AM signal and define the modulation index. Show how the envelope detector can be used to demodulate the AM signal.

c) A single-sideband (SSB) signal contains 1kW. How much power is contained in the sidebands and how much at the carrier frequency?

3- a) Show how the narrowband PM signal can be generated . Sketch the block diagram, and write the equation and the bandwidth.

b) A frequency-modulated signal which is modulated by a 4-kHz sine wave reaches a maximum frequency of 100.02 MHz and minimum frequency of 99.98 MHz.
   i) Sketch the FM signal
   ii) Find the carrier frequency
   iii) Find the modulation index
   iv) Find the bandwidth .

4- a) What are the communications satellite's orbits and what are the types of each of them? What is the altitude (height) of a communications satellite in the geostationary orbit?

b) Sketch the block diagram of a transponder of a C-band communications satellite (6/4 GHz satellite) and explain the function of each block.

c) Compare between the three basic paths that a radio signal can take through the space. Show the frequency band of each of them. In a direct wave communication system, the transmitter transmits an output power of 100 W at 10 GHz. The transmitting antenna has a gain of 36 dB, and the receiving antenna has a gain of 30 dB. What is the received power at a distance of 40 km.