Problem number (3) (15Marks)

Consider unity negative feedback systems with a forward transfer function G(s), Draw the root locus of the following system

[a] $\mathbf{G(s)H(s)} = \dfrac{\mathbf{2k}}{\mathbf{(s+1)(s+2)(s+5)}}$.

[b] $\mathbf{G(s)H(s)} = \dfrac{\mathbf{k(s+2)}}{\mathbf{s(s^2+2s+2)(s+4)}}$.

For what values of gain K does the systems become unstable?

Problem number (4) (22 Marks)

[a] For the system that have the following transfer function

$$\frac{Y(s)}{U(s)} = \frac{(s+4)(s^2+s+2)}{s(s+3)(s^2-s+1)}$$

Give the state space in pole-zero form (9 Marks) and in a controllable form. (4 Marks).

[b] For the following system (9 Marks)

$$\dot{\underline{X}} = \begin{bmatrix} 0 & 1 \\ -4 & -5 \end{bmatrix} \underline{X} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 \end{bmatrix} \underline{X}$$

Find: 1) The characterstic equation.
2) Eigen values of matrix A
3) The matrix $\Phi(t)$.
4) Check controllability and observability.

Problem number (5) (12Marks)

[a] Given a system described by the dynamic equations (3 Marks)

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

where

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

Find the transfer function $Y(s)/U(s)$.

[b] For a system having an open loop transfer function given by

$$G(s) = \frac{200(1+0.2s)}{s(s+2)(s+10)^2},$$

1) Sketch the Bode diagram. (5 Marks)
2) Find the gain margin , phase margin and a system stability. (4 Marks)

Tanta University

Department: Elec. Power and Machines Engineering
Total Marks: 85 Marks

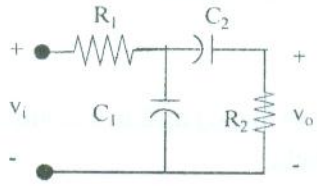
Faculty of Engineering

Course Title: Automatic Control Principles	Course Code: CCE3170	Year: 3rd
Date: January 2012 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

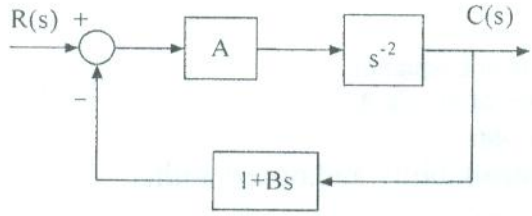
Answer the following questions

Problem number (1) (17 Marks)

[a] Find the transfer function for the following circuit $V_0(s)/V_i(s)$ (8 Marks)



b) The block diagram of a servomechanism is shown below.



1) Determine the values of A and B so that the peak time is 5 sec, and the maximum overshoot is 50% in unit-step response. (6 Marks)

2) Find the error constants. (3 Marks)

Problem number (2) (19 Marks)

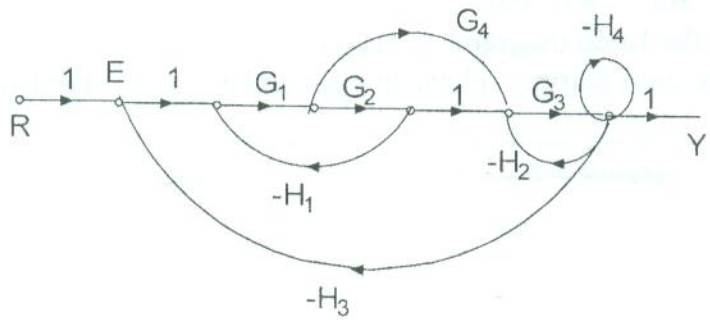
[a] The characteristic equations of linear control systems are given below. Apply Routh-Hurwitz criterion to determine the root distribution and the system stability. (9 Marks)

1) $s^6 + 8s^5 + 18s^4 + 24s^3 + 41s^2 - 32s - 60 = 0$

2) $s^3 + 8s^2 + 19s + 12 = 0$

3) $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$

[b] Using signal flow graph, find the transfer function of the system



Y(s)/R(s) (10 Marks) .

b- **State only, which of the following statement is True or False** [5]

1- For two winding transformer, the core flux depends on load percentage.

2- It is a common practice that transformer efficiency matches full load condition.

3- Transformer core is laminated to reduce hysteresis loss

4- Heat exchanger is used only in forced cooling system.

5- Oil immersed transformer with natural oil circulation and forced air external cooling is designated **ONAD**

c- Calculate the core and window area required for a 1000 KVA, 6600/400 V, 50Hz, single phase and core-type transformer. Use the following design data: [10]

- Maximum flux density of 1.25 Tesla
- Current density of $2.5A/m^2$
- Voltage per turn of 30V
- Window space factor of 0.32

You may rationally assume other necessary values according to your perspective.

Question 4:

Marks [30]

a- Numerate the conditions required to operate two single-phase transformers in parallel. [5]

b- Describe the operation of autotransformer as step-up transformer. Write down the formulas the shows the relations between supply current and load current. [5]

c- Two single-phase transformers of equal voltage ratio are operating in parallel and supplying a load of 500A at 0.8 power factor lag. The equivalent impedance of the two transformers are (2+j3) and (2.5+j5) ohms respectively. Calculate the current supplied by each transformer and ratio of *KW* of the two transformers. [10]

d- A balanced 3-phase load of 150KVA at 1000V, 0.866-lag power factor is supplied from 2000V, 3-phase mains through three identical single-phase transformers connected in start-delta. Find the current in the windings of each transformer and the power factor at which they operate in each case. Explain your answer with essential diagrams. [10]

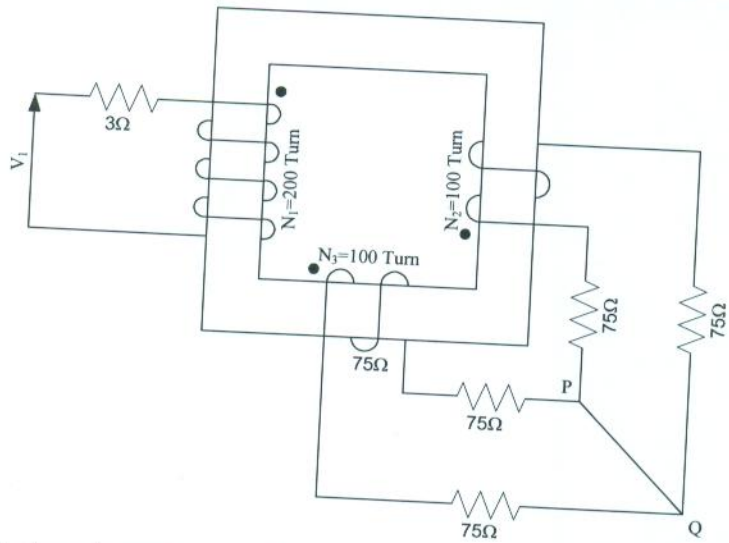
Question 5:

Marks [30]

a- A 600 KVA, single-phase transformer when working at unity power factor has an efficiency of 92% at both full load and half load. Determine its efficiency, when it operates at unity power factor and 60% of full-load. [10]

b An ideal transformer has 200 primary turns. Each of secondary and tertiary [10]

- windings has 100 turns. The transformer is used in the circuit shown. If the secondary voltage is 150V, find the power input the current at the branch PQ.



c- The excel sheet below is used to solve the exact equivalent circuit of a single-phase transformer using the MS-Excel's complex number operations. The letter "I" is used to indicate input values, as shown in the Key table. What are the formulas in the cells listed below? [10]

- G5
- D15
- D19
- H25
- H29

Solution of Single Phase Transformer Using Exact Circuit

I	Freq	Hz	50.0000	Omega	Rad/Sec	314.1593	
I	R1	Ohm	0.010	Im		0.173173249768269-0.863998597306391	
I	L1	H	0.010		Mag	0.88118273	
	X1	Ohm	3.142		Ang	-78.66625504	
I	Rc	Ohm	500.000	Iw		0.271433247043974+0.05440398092702661	
I	Lm	H	0.500		Mag	0.276831719	
	Xm	Ohm	157.080		Ang	11.33374496	
I	R2	Ohm	0.010	I0		0.444606496812243-0.809594878803612i	
I	L2	H	0.100		Mag	0.923644306	
	X2	Ohm	31.416		Ang	-61.22566055	
	VL		120	I1		1.31063190059668-1.309594878803611	
I		Mag			Mag	1.852780269	
I		Ang	120		Ang	-44.97732373	
	IL		0	V1		139.843943491421+31.30636606520021	
I		Mag	0.866025403784439-0.5i		Mag	143.3053282	
I		Ang	1		Ang	12.61854998	
		Cos(phi)	-30	S1		142.285276772159+224.170034284875i	
	ZL		0.866025404		P1	142.2852768	
		Mag	103.923048454133+60i		Q1	12843.99686	
		Ang	120	S2		103.923048454133+60i	
	E		30		P2	103.9230485	
		Mag	135.716623521987+27.20199046351331		Q2	3437.746771	
		Ang	138.4158596	Reg		16.26%	
			11.33374496	Eff	Eta	73.04	

Key
I Input Value

Notes:
1- Write down your answer neatly
2- Use diagrams and curves to support your answers
3- Start the answer of each question in new sheet
4- Answer all questions

Question 1:

Marks [20]

a - Numerate the steps required to perform the turns-ratio test for a single-phase transformer. Show the connection and measurement devices required and side of connection. [10]

b - A 250/500V transformer gave the following results: [10]
- Direct current test on low voltage side:
  4 Volt 11.52 A
- Short circuit test with low-voltage windings short circuited:
  20 Volt 12 A 100W
- Open circuit with measurement devices on low-voltage side:
  250 Volt 1 A 80 W

Determine the equivalent circuit parameters to the most accurate extend possible. Draw the equivalent circuit parameters symbols and values.

Question 2:

Marks [20]

a - The parameters of a 2300/230V, 50Hz transformer are given as follows: [20]

$R_1 = 0.286\Omega$ $R'_2 = 0.319\Omega$ $R_c = 250\Omega$
$X_1 = 0.730\Omega$ $X'_2 = 0.730\Omega$ $X_m = 1250\Omega$

The load is an inductive load in parallel with a resistive load. With rated output voltage, the current of resistance and inductance is equal to 30A each. Using exact equivalent circuit; Calculate the following:

- Load current
- Load power factor
- Input power
- Core loss
- Efficiency
- Voltage regulation

Question 3:

Marks [20]

a- **Write down only the missing parts of the following statements** [5]

1- The ..... is changed while the transformer is energized. This is known as .....

2- .... tests the accumulated gas found due to internal faults.

3- Oil may be found in transformer system in ....., ... and .....

4- ... ... core is used to increase the net iron area inside a certain former.

5- The ... ... voltage windings is wound closer to the transformer limbs.

c) The fuel cost in "$/h" of three different power plants are: $F_1=100+8.2P_1+0.018P_1^2$, $F_2=120+5.3P_2+0.02P_2^2$ and $F_3 = 80 + 8P_3 + 0.04P_3^2$, where the power is in MW and the power limits are 350 MW and 800 MW. Determine the optimal dispatch and the total cost when the total load demand is 1800 MW. The total power loss is given as: $P_{loss} = 0.025P_1^2 + 0.02P_1P_2 + 0.03P_2^2 + 0.012P_1P_3 + 0.04P_2P_3 + 0.015P_3^2$. All quantities are in per unit on a 2000 MVA base. Begin with a lambda value of 35 and penalty factors of unity and use a tolerance of 0.003 p.u. (15 points)

Problem number (3) (30 Marks)

a) Discuss in detail the main sources of losses in different parts of steam power plants. Define all kinds of efficiencies of the plant and show how you can increase its thermal efficiency. (9 points)

b) Define the task of the following components in hydraulic power plants: the spillway, the pressure tunnel, the surge tank and the valve house. (7 points)

c) Aided with net sketches, describe the principles of operation of gas-turbine power plants. (7 points)

d) Discuss the advantages and disadvantages of fuel cells. (7 points)

Good Luck

Course Examination Committee

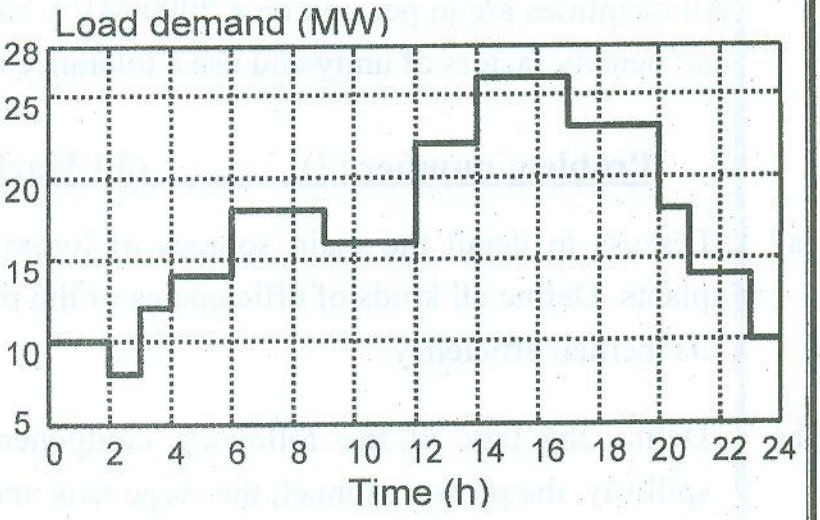
Dr. Ahmed Refaat

Title: Generation and economy of electrical energy **Course Code: EPM3110** **Year: Third year**
Date: January 2012 (First term) **Allowed time: 3 hrs** **No. of Pages: (2)**

الإمتحان مكون من ٣ أسئلة فى صفحتين

Problem number (1) (25 Marks)

a) For the load curve shown in the figure, find the maximum load, the minimum load, the average power, the consumed energy, the load factor and the demand factor assuming that the connected load is 60 MW. Draw the energy curve for this load curve. (10 points)



b) Compare between hot reserve and cold reserve. (5 points)

c) A machine has an initial cost of 100000 L.E. and a salvage value of 9000 L.E. at the end of the 15th year. Using the diminishing-value method of depreciation, calculate the depreciation at the end of the: 4th year and the 6th year. If the sinking-value method is used instead of the diminishing-value method, what is the saving of the actual paid money at the end of the lifetime? Assume an annual rate of compound interest on the investment capital of 5%. (10 points)

Problem number (2) (35 Marks)

a) Explain in detail two different tariff methods for electrical energy that can be used to prevent the high reactive power consumption. What is the importance of this kind of tariffs? (10 points)

b) The incremental fuel costs in \$/MWh for three generating units are given by: $\frac{dF_1}{dP_1} = 0.08P_1 + 6.5$, $\frac{dF_2}{dP_2} = 0.04P_2 + 10$ and $\frac{dF_3}{dP_3} = 0.12P_3 + 7.4$. For a load demand of 1000 MW, find the optimal incremental fuel cost and the optimal allocation of load between the three units. The minimum and maximum loads on each unit are respectively 200 and 600 MW. (10 points)

TABLE IV

Values of $t_{\alpha,\nu}$[†]

ν	$\alpha = .10$	$\alpha = .05$	$\alpha = .025$	$\alpha = .01$	$\alpha = .005$	ν
1	3.078	6.314	12.706	31.821	63.657	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
inf.	1.282	1.645	1.960	2.326	2.576	inf.

[†]Based on Richard A. Johnson, Dean W. Wichern, *Applied Multivariate Statistical Analysis*, 2nd ed., © 1988, Table 2, p. 592. By permission of Prentice-Hall, Inc., Englewood Cliffs, N.J.

TABLE III

Standard Normal Distribution

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Also, for $z = 4.0$, 5.0, and 6.0, the probabilities are 0.49997, 0.4999997, and 0.499999999.

Tanta University

Physics & Engineering Mathematics Department
Total Marks: 70 Marks

Faculty of Engineering

Course Title: Engineering Mathematics (4) Year: Third year Electrical Power and Machines Engineering.
Course Code: PME3114 Date:11 /1/ 2012 Allowed time: 3 hrs No. of Pages: 1 for problems and 1 for tables.

Remarks: (Answer the following questions. Assume any missing data…)

Problem number (1) (16 Marks)

(a) It is found that in manufacturing a certain article, defects of a first type occur with probability 0.1 and defects of a second type with probability 0.05 (assume independence between the two types of defects). What is the probability that an article (chosen randomly)
(i) does not have both kind of defects? (ii) is defective?
(iii) has only one type of defects, given that it is defective?
(b) If X is uniformly distributed with mean 1 and variance 4/3, find p(x<0).
(c) If A and B are mutually exclusive events, $p(A) = 0.4$, $p(B) = 0.3$ *find* $p(A/\overline{B})$.

Problem number (2) (20 Marks)

(a) The probability density function of the R. V. X is
$f(x) = k\,e^{-3x}$ *for* $x > 0$ *and* $f(x) = 0$ *otherwise* . Find
(i) k (ii) $p(0.5 \le x \le 0.8)$ (iii) the distribution function $F(x)$
(iv) the moment generating function (v) use (iv), find the variance of x.
(b) Derive formulas for the expected value and the variance of the binomial distribution.
(c) Suppose that 4% of screws made by a machine are defective. If the screws are packaged 100 per box, what is the Poisson approximation of the probability that a given box contains more than 3 defective screws?

Problem number (3) (17 Marks)

(a) A manufacturer knows from experience that the resistance of resistors he produces is normal with $\mu = 150\,ohms$ *and* $\sigma = 5\,ohms$. What percentage of the resistors will have resistances between 148 *ohms and* 152 *ohms*? Also between 140 *ohms and* 160 *ohms*?

(b) A study was made on the amount of converted sugar in a certain process at various temperatures. The following data were recorded.

Temperature x	1	1.1	1.2	1.3	1.4	1.6	1.7
Converted sugar y	8.1	7.8	8.6	9.7	9.5	9.8	10.1

(i) Compute the correlation coefficient (ii) Find the regression line of y on x and y(1.5).
(c) Assume that a sample of lengths of 20 bolts (taken from normal population) with mean 10.20 cm and variance 0.04 cm. Determine 98% confidence interval for the mean the population μ .

Problem number (4) (17 Marks)

(a) If we have finite population of four observation 6, 8, 10, 12, find the sample distribution of the means if we draw a random sample of size n = 2 and sampling is without replacement.
(i) Find the mean and variance of the distribution of means.
(ii) Estimate the mean and variance of the population using the results in (i).
(b) Assume a normal population with standard deviation 2. Using a sample contains n elements with mean $\bar{x} = 8.0$. Find the required value of n to obtain a 97% confidence interval of length 0.4
(c) A firm sells oil in cans containing 1000 g oil per can and is interested to know whether the mean weight differs significantly from 1000 g at 5% significance level, in which case the filling machine has to be adjusted. Set up a hypothesis and an alternative and perform the test, assuming normality and using a sample of 20 fillings have a mean of 996 g and standard deviation of 5 g.

P.T.O. For Tables

Good luck Dr. Manal Mohamed Hekal

	TANTA UNIVERSITY FACULTY OF ENGINEERING DEPARTMENT OF POWER & ELECTRICAL MACHINES EXAMINATION (*third* YEAR)		
	COURSE TITLE: Electrical Communications		COURSE CODE: EEC3143
DATE:18/1/2012	TERM: FIRST	TOTAL ASSESSMENT MARKS: 50	TIME ALLOWED: 3 HOURS

Answer the following questions

PROBLEM # ONE (10mark)

I. **Write short notes about the following:**

a. **Energy and power signals.**
b. **Bandwidth in different AM modulation techniques.**
c. **Interrelation between frequency modulation and phase modulation.**
d. **Frequency deviation and phase deviation.**
e. **Modulation and its benefits.**

PROBLEM # TWO (8 mark)

II. **Find Fourier transform for the following signals**

a. **Sgn(t)**
b. **A sinc(2Wt)**
c. **3rect(t/30) u(t)**
d. **rect((t-1)/2)+tri((t-3)/3)**

PROBLEM # THREE (16 mark)

I. **Explain, with the aid of drawing, how to generate and demodulate DSB-TC wave.**

II. **Consider the message signal**

m(t)=20 Cos (2□t) and carrier signal C(t)=50 Cos (100□t)

a. **Sketch the resulting AM wave for 75% modulation.**
b. **Evaluate the total power; carrier power and sideband power hence calculate efficiency.**
c. **Calculate Bandwidth required for transmission.**

PROBLEM # FOUR (16 mark)

I. **How many FM audio channels could be broadcasted in FM band (88-108MHz) if frequency deviation equals 75 kHz?**

II. **An audio signal with amplitude A_m =4V, and frequency f_m-1200Hz is used to modulate the frequency of a carrier signal with modulation sensitivity k_f = 5652 *rad/sec/volt***

a. **Write down the equation of the modulated signal.**
b. **Calculate the maximum frequency deviation.**
c. **Calculate the modulated signal bandwidth.**

Good Luck,

Dr. Salwa Serag Eldin

لا تحسبن العلم ينفع وحده ما لم يتوج ربه بخلاق

Question (3) **(17 Marks)**

a) The total voltage ripple of a Cockcroft-Walton type voltage multiplier is 20 kV at a supply frequency of 90 Hz. If the load current is 2.5 mA and the circuit capacitances is 0.05 μf, calculate the number of stages and the percentage regulation. Also, calculate the maximum secondary voltage of the supply assuming that the optimum number of stages for minimum voltage drop is 18 stages. (4 Marks)

b) How resonant transformers can be used to generate high voltage alternating voltages. What is the disadvantage of this method? (3 Marks)

c) Explain how to control the waveshape of an impulse generator and then, draw a 3-stage Marx impulse generator. (4 Marks)

d) Draw the schematic diagram of Van de Graff generator and mention two main advantages for this generator. (4 Marks)

e) Complete the following sentences: (2 Marks)

1- Tesla coil is used to generate .....

2- ..... is the process of eliminating the effect of stray capacitance in potential divider by surrounding the resistor with a conducting metal kept at the mean potential of the resistor.

Question (4) **(19 Marks)**

a) Compare between the attenuation factor in the following cases: (4 Marks)

1. Resistive potential divider.
2. Resistive potential divider connected to a measuring cable with capacitance C_m.
3. Resistive potential divider connected to a measuring cable and compensated.
4. Capacitive potential divider.

b) A high-voltage, 50Hz AC signal of amplitude X with a superimposed DC component of Y was measured by a peak voltmeter and an electrostatic voltmeter. The reading of the peak voltmeter was 40 kV and the reading of the electrostatic voltmeter was 30 kV. Find the values of X and Y. What is the reading if a sphere gap was used to measure this signal? (4 Marks)

c) Describe with only sketches the mechanism of lightning stroke. (4 Marks)

d) A single-phase lossless overhead line with $Z_A = 400\ \Omega$, $\upsilon_A = 3 * 10^8$ m/s and $L_A = 30$ km is connected to a single phase lossless cable with $Z_B = 100\ \Omega$, $\upsilon_B = 2 * 10^8$ m/s and $L_B = 20$ km. At the sending end of line A, there is a generator with an impedance of $Z_G = Z_A/4$. At the receiving end of cable B is a short circuit. Calculate the voltage at the line-cable junction at the time 0.4 ms. (7 Marks)

Good Luck

Dr. Diaa-Eldin Mansour

Tanta University

Department: Elec. Power and Machines Engineering
Total Marks: 70 Marks

Faculty of Engineering

Course Title: High Voltage Engineering
Date: Jan 26th 2011 (First term)

Course Code: EPM3112
Allowed time: 3 hrs

Year: 3rd
No. of Pages: (2)

Answer the following questions:

Question (1) (17 Marks)

a) Write down the reaction describing the ionization process in case of ionization by collision and photo-ionization. What is the necessary condition for ionization to occur in terms of mean free path for ionization by collision and wavelength for photo-ionization? (4 Marks)

b) Describe with only sketches the following mechanisms for breakdown in gases: (4 Marks)

1. Anode-directed streamer.
2. Leader mechanism.

c) Describe the dependence of high-frequency breakdown voltage on the frequency for a uniform air gap. (3 Marks)

d) The following data are obtained while studying the breakdown in a gas:

Gap (mm)	0.75	2.0	2.5	3	3.5	4.0	4.5	5.0	5.5	6
Current$\times 10^{-14}$ (A)	4	12	18.66	29	45	69.9	109	242	570	890

The minimum current observed is 4×10^{-14} A. Calculate the values of the Townsend's primary and secondary ionization coefficients. (4 Marks)

e) Complete the following sentences: (2 Marks)

1. The gases in which electron attachment plays an active role are called .....
2. The time that elapses between the application of the voltage sufficient to cause breakdown and the appearance of the initiating electron is called .....

Question (2) (17 Marks)

a) Define the stressed oil volume in commercial liquids. Describe the dependence of the breakdown stress on the stressed oil volume. (3 marks)

b) If the applied field to a liquid is given as $E = 2 * 10^7 X^{1.2}$ V/m and the relative permittivity of the liquid is 2.1, calculate the force acting on an impurity with a relative permittivity of 3.0 and a radius of 20 mm travelling at a distance of 1 cm. (4 marks)

c) If a solid dielectric was subjected to a DC electric field, what is highest field stress before breakdown in case of electromechanical breakdown and thermal breakdown? (4 marks)

d) Describe the electrical discharge phenomenon inside a void in solid dielectrics under alternating voltages. Draw the equivalent circuit and the discharge pattern. (4 marks)

e) Complete the following sentences: (2 Marks)

1- The formation of a permanent conducting path across a surface of solid insulation is called .....
2- In pure liquids, the considered breakdown mechanism is .....