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Tanta University

Department of Electrical Power and Machines Engineering

Faculty of Engineering

Final Exam 2022-2023			
3rd Year: Electrical Power and Machines Engineering		3 hours	Marks:120
Date: January 10, 2023	Course: Electric Machines (2)	Code: EPM3111	

Answer all the following questions:

Question One [35 Marks]

[a] **Explain**, with all necessary **graphs** and **equations**, the theory of operation of real single-phase transformers. **Answer** should include all derivations of magnetic flux, flux linkage, flux leakages, and the induced EMFs. ***[15 Marks]***

[b] Starting from primary voltage, **explain**, with equations and figures, the effect of the magnetization curve of a typical transformer core on the magnetization current. **Show** the figure with three different magnetization curves one of them for the ideal transformer. Then, **plot** the core-loss current and the total excitation current in the transformer. ***[20 Marks]***

Question Two [45 Marks]

[a] A single-phase 10-kVA, 480/120-V transformer is to be used as an autotransformer tying a 600-V distribution line to a 480-V load. When it is tested as a conventional transformer, the following values are measured on the primary (480-V) side of the transformer: ***[25 Marks]***

Open-circuit test (measured on secondary side)	Short-circuit test (measured on primary side)
$V_{OC} = 120\ V$	$V_{SC} = 10\ V$
$I_{OC} = 1.6\ A$	$I_{SC} = 10.6\ A$
$P_{OC} = 38\ W$	$P_{SC} = 25\ W$

i. **Find** the per-unit equivalent circuit of this transformer when it is connected in the conventional manner. **What** is the efficiency of the transformer at rated conditions and unity power factor? **What** is the voltage regulation at those conditions?

ii. **Sketch** the transformer connections when it is used as a 600/480-V step-down autotransformer.

iii. **What** is the kilovoltampere rating of this transformer when it is used in the autotransformer connection?

iv. **Answer** the questions in (i) for the autotransformer connection.

[b] **Write** down, with all necessary **figures**, the line/phase currents and line/phase voltages for a standard Δ-Δ connected transformer and for an open-delta transformer. **How** much power can an open-delta deliver compared to a standard three phase delta transformer? **What** happens to the rest of the open-delta bank's rating? ***[20 Marks]***

Question Three [40 Marks]

[a] **Explain**, with equations and waves, the problem of current inrush. Why switching the primary of the transformer at 0 degree of input voltage is the worst case of inrush current and 90 degrees is the no problem case?

[15 Marks]

[b] **Explain**, with equation(s) and figure(s), the effect of different voltage ratios on parallel operation of two transformers at: (a) load switch open; (b) load switch closed.

[10 Marks]

[c] **Estimate** the unit regulation at full load and 0.8 power factor lagging, for a 300 KVA, 50 Hz, 6600/400 V, 3-phase, delta/star, core-type transformer. The data given is:
H.V. winding:- Outside diameter = 36 cm, inside diameter = 29 cm, area of conductor = 5.4 mm^2
L.V. winding:- Outside diameter = 26 cm, inside diameter = 22 cm, area of conductor = 170 mm^2, length of coils = 50 cm, voltage per turn = 8V, resistivity =0.021 ohm per m and mm2.

[15 Marks]

Good Luck and Best Wishes ... ***Prof. Dr. Abdelsalam Ahmed***

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Tanta University

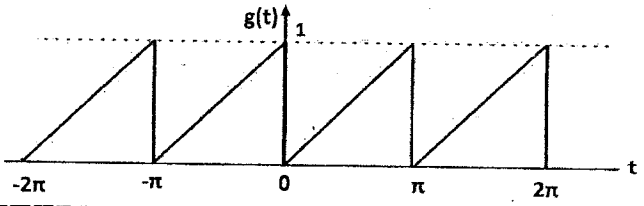
Electronics and Electrical Communications Department

Faculty of Engineering

Course	Electrical communications	2022/2023 First Semester Exam	Course Code	EEC3143
Year	3^{rd} Year		Total Marks	50
Date	17/1/2023 (**Final Exam**)	No. of pages: (2) Pages	Allowed Time	3 hrs
Remarks: Answer **ALL** the following Questions.				

Question # 1: (10) Marks

(a) Find the complex fourier series for the peroidic signal shown.
(b) Draw the magnitude spectrum.
(c) Calculate the average power.



Question # 2: (15) Marks

(a) Given the time domain signal $g(t) = rect(\frac{t}{T})cos2\pi f_c t$.
  (i) Draw the signal in time domain
  (ii) Find the Fourier Transform of that signal and sketch its spectrum
(b) Find the Fourier Transform for $f(t) = rect(\frac{t-2}{4}) + 5 + 10\delta(t)$
(c) Explain how a **non-linear** device can be used for **generation** of AM wave.

Question # 3: (15) Marks

(a)For an AM signal $S(t) = 2[1 + 0.8cos(2\pi f_m t)]cos2\pi f_c t$. if Ka= 0.5
  (i) Find the modulation index(u), carrier amplitude and the modulating signal amplitude
  (ii) Draw S(t) in time domain and draw the spectrum for fm = 1kHz and fc = 800kHz.
  (iii) The Band width of the modulating signal and the Bandwidth of modulated signal .
  (v) Find Pc , PDSB , efficiency and comment.
(b) Explain with diagram the detection of AM wave using single diode and capacitor.
(c)Explain with diagram how a **blanced modultor** can be used for the generation of DSB-SC.

Question # 4: (10) Marks

(a) Explain with diagram how to generate **FM** from **PM** and **PM** from **FM**.
(b)A receiver picked up an FM signal , $S(t) = 10cos[10\pi \times 10^6 t + 0.7sin(1600\pi t)]$.
If the modulating signal amplitude is 4V.
(i) Find the frequancy deviation , bandwidth and the carrier power.
(ii)Draw the **spectrum** of the FM signal **in details**.

Good Luck

Course Coordinator: *Dr.Nessim Mahmoud*

Tanta University

Department: Elec. Power and Machines Engineering
Total Marks: 90 Marks

Faculty of Engineering

Title: Generation and economy of electrical energy	**Course Code: EPM3110**	**Year: Third year**
Date: January 22nd 2023 (First term)	**Allowed time: 3 h**	**No. of Pages: (2)**

الامتحان مكون من ٤ أسئلة فى صفحتين

Problem number (1) (20 Marks)

a) Explain, in detail, the need for the hot reserve and how to select the units that will provide this kind of reserve power. **(5 points)**

b) A generator has an initial cost of 30 ML.E. and a salvage value of 5 ML.E. at the end of the 25th year. Find the value of the equipment and the accumulated set aside money using the three depreciation methods at the end of the 10th year using an annual rate of compound interest of 5%. Comment on the results. **(5 points)**

c) Explain in detail tariff methods for electrical energy that can be used to prevent the high reactive power consumption. **(5 points)**

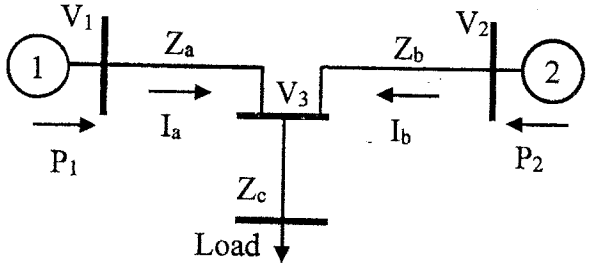
d) Choose two different constraints that **must** be taken into account and explain their importance for the operation of power systems. **(5 points)**

Problem number (2) (25 Marks)

a) Illustrate the flowchart to obtain the solution of optimal economic dispatch problem considering the system losses. **(5 points)**

b) The incremental fuel costs of three generators are given as follows: $\frac{dF_1}{dP_1} = 0.02P_1 + 3.3$, $\frac{dF_2}{dP_2} = 0.015P_2 + 4.0$ and $\frac{dF_3}{dP_3} = 0.004P_3 + 6.2$, all in (LE/MWh). If the total load demand is 1200 MW, find the incremental fuel cost of the system and the optimal allocation of load between the units. The minimum and maximum capacities of the first two units are, respectively, 150 and 500 MW. The minimum and maximum capacities of the third unit are, respectively, 120 and 450 MW **(7 points)**

c) For the network shown, the impedances of the line sections are: $Z_a = 0.03 + j0.09$ pu, $Z_b = 0.025 + j0.08$ pu and $Z_c = 0.05 + j0.1$ pu. The voltage $V_3 = 1.0\angle 0\ pu$ and the currents from the two generators are: $I_a = 0.66\angle -30\ pu$ and $I_b = 0.7\angle -25\ pu$. Calculate the coefficients of the loss formula and derive the loss equation using the exact formula.



(5 points)

d) The incremental costs (LE/MW) of 3 power plants are: $\frac{dF_1}{dP_1} = 0.4\,P_1 + 3.5$, $\frac{dF_2}{dP_2} = 0.3\,P_2 + 6$ and $\frac{dF_3}{dP_3} = 0.5\,P_3 + 4$. The minimum and maximum power of the three units are: 100 and 750 MW, respectively. Find the optimum scheduling for a system load of 1800 MW assuming a tolerance of 17 MW. Start with a lambda of 250 and penalty factors of 1.04 for all units. The loss formula is given as follows with powers are in per unit on an 800 MVA base: $P_{loss} = 0.015\,P_1^2 + 0.02\,P_1\,P_2 + 0.033P_2^2 + 0.012\,P_1\,P_3 + 0.023\,P_2\,P_3 + 0.015P_3^2$. **(8 points)**

Problem number (3) (20 Marks)

a) A power station supplies a certain load with an average demand of 17 MW and a load factor of 0.5. If the utilization factor is 0.8, **calculate** the plant capacity and the capacity factor. **(5 points)**

b) **Define** the overall efficiency of steam power plants, and **state** the functions of superheater, economizer, and condenser. **(5 points)**

c) **Draw** the layout of nuclear power plants, and **discuss** how the fission process occurs and **how** it can be regulated. **(6 points)**

d) With a clear sketch, **draw** the schematic diagram of gas power plants considering efficiency improvement methods, and **state** their main applications. **(4 points)**

Problem number (4) (25 Marks)

a) **Describe** the construction and operation principles of fuel cells **(5 points)**

b) **Discuss** the advantages and disadvantages of hydraulic power plants. **(5 points)**

c) For the maps given in Fig. 1, discuss in detail how the optimal sites of PV (S1-S5) and WT (W1-W11) power plants can be selected. **(10 points)**

d) In the context of COP27, **explain** the definition and **discuss** the benefits of hybrid renewable energy systems in improving the performance indices of the electrical grid. Support your answer with clear sketches. **(5 points)**

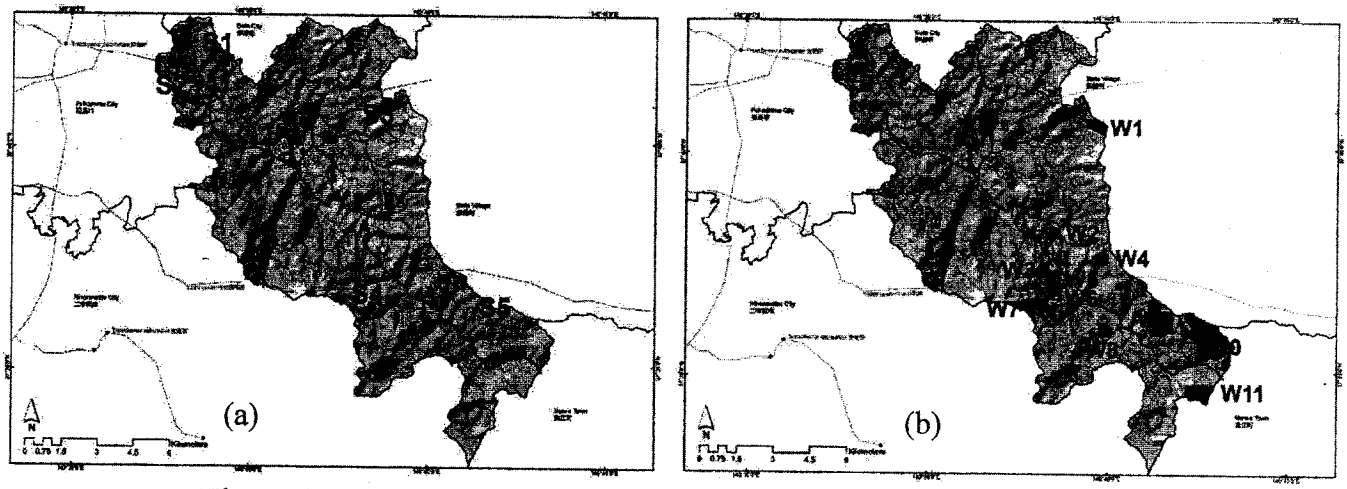


Fig. 1 (a) Solar PV power plants (b) Wind turbine power plants

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Good Luck

Course Examination Committee

Prof. Ahmed Refaat Azmy Dr. Mohamed Elkadeem

Tanta University

Department: Computers and Automatic Control
Marks: 85 Marks

Faculty of neering

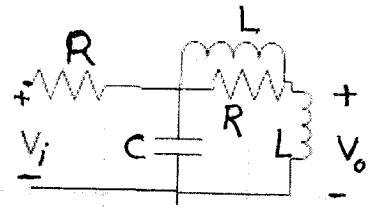
Course Title: Automatic control Engineering	Year: 3rd	Course Code: CCE3170
Date: 24 /1/ 2023	Allowed time: 3 hrs.	Pages: 2

Remarks: answer the following 4 questions

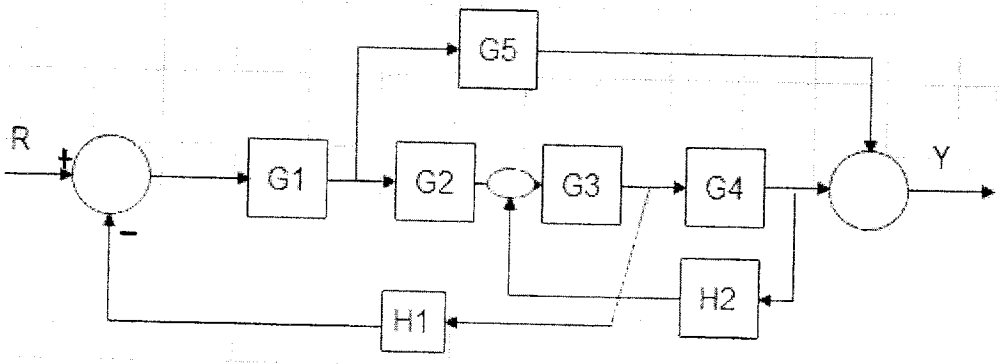
Question Number 1:

(20 Marks)

[a] **Find the transfer function for the following circuit** (8 Marks)



[b] **Determine the transfer function using signal flow graph.** (12 Marks)



Question Number 2:

(20 Marks)

[a] **For each of the following characteristic equations, find the root distribution and determine whether the system is stable, marginally stable, or unstable:** (12 Marks)

i) $S^6+S^5 + 2S^4 + 2S^3 + 3S^2 + 2S + 5 = 0$

ii) $S^7 + 3S^6 + 3S^5+ S^4+ S^3+ 3S^2 + 3S + 1 = 0$

iii) $S^6 + 2S^5 + 8S^4 + 15S^3 + 20S^2 + 16S + 16 = 0$

iv) $S^5 + 2S^4 + 3S^2 + 4S + 8 = 0$

[b] **For the system has the transfer function $\frac{5}{s^2 + s + 6}$, assuming unity negative feedback**

1) Compute the peak time and the percentage overshoot for the step input (4 Marks)
2) The error constants (2 Marks)
3) The steady state error for unit step input (2 Marks)

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Question Number 3: (24 Marks)

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

$$G(s) = \frac{7}{(s+3)} \frac{(s+5)}{(2s^2+7s+8)}$$

in the pole-zero form (8 Marks) and other form (4 Marks)

[b]The open loop T.F. of a negative feedback system is given as: (12 Marks)

$$G(s)H(s) = \frac{k}{(s-2)(s+4)(s+7)}$$

1) Sketch the root locus.
2) Determine the range of K for system stability
3) Find the value of K at critically damped response

Question Number 4: (21 Marks)

[a] Given a system described by the dynamic equations

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

where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -5 & -2 \end{bmatrix} \qquad b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \text{ and } \quad c = [2 \quad 5 \quad 4]$$

i) Find the characteristic equation. (2 Marks)
ii) Find the transfer function Y/U. (3 Marks)

[b] For the following system

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix} X + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u$$

$$y = [1 \quad 3]X$$

i) Draw the state diagram and Find the transfer function. (4 Marks)
ii) Determine whether the system is stable, completely state controllable and observable. (6 Marks)

[c] 1- Explain three properties of the system and give an example for each.
2- Define the system order and the state of the system. (6 Marks)

The end

Physics and Engineering Mathematics Department

Tanta University	Electrical Power Dep.	Faculty of Engineering
Date: **Jan 12th, 2023** (1st term)	Course Title: **Engineering Mathematics (4)**	Total Marks: **70**
Allowed time: **3 hours**	Course Code: **PME3114** **FINAL EXAM**	No. of pages: **2**

Please answer the following questions:

D2

Question (1) **(20Marks)**

(a) If function given by $f(x) = \frac{x+k}{25}$; $x = 1, 2, 3, 4, 5$ is probability distribution of a discrete random variable X, find:

(a-1) value of k.

(a-2) $P(x = 4.5)$, $P(2 \le x < 5)$.

(a-3) Cumulative function $F(x)$.

(a-4) The mean, variance, and standard deviation of the distribution.

(b) The data represent the scores of 45 students in Statistics are given as follow:

Score	20-25	25-30	30-35	35-40	40-45	45-50	50-55
Number of students	2	5	8	10	7	10	3

(b-1) Find the mean and the standard deviation of this grouped data.

(b-2) Find the median and the mode.

(c) A random sample of **30** items is drawn from a lot. If the lot is **10%** defective, determine the probability that such sample will contains:

(C-1) No defectives. (C-2) More than two defectives. (C-3) The mean value of defectives.

Question (2) **(20Marks)**

(a) Find the value Determine the multiple linear regression of x_1 on x_2 , x_3 from the given data:

x_1	-3.7	3.5	2.5	11.5	5.7	10
x_2	3	4	5	6	2	3
x_3	8	5	7	3	1	2

(a-1) Predict the value of x_1 when $x_2 = 7$, $x_3 = 6$.

(a-2) Calculate r_{12} , r_{13}, r_{23}, $R_{1.23}$ and $R_{12.3}$.

(b) Find the value of C if $P(\mu - C\sigma \le x \le \mu + C\sigma) = 0.823$.

(c) Determine **98%** confidence interval on μ which represent the mean of a population. If we take a sample with size 25, mean 174.5, and standard deviation **6.9** ?

Please, consider page 2/2

Question (3) **(30Marks)**

(a) The joint probability density of two continuous random variables (X, Y) is given by:

$$f(x,y) = \begin{cases} \frac{1}{3}xy^2 & , for\ 0 \le x \le 1, \quad 0 \le y \le 1 \\ 0, & elsewhere \end{cases}$$

(a-1) Find the marginal probability density function of X and Y .

(a-2) Calculate the covariance between X and Y.

(a-3) Determine the correlation of X and Y and its type.

(b) If we are told that the probability person scores a goal is 0.78, the probability that he will make his fifth goal on his eighth shot?

(c) A company gets its products from four places, 35% from the first, 15% from the second, 25% from the third and 25% from the fourth place. Delivered product is defective with probability 8%, 10%, 6% and 12% if it comes from the first, the second, the third and the fourth, respectively. we choose a product randomly:

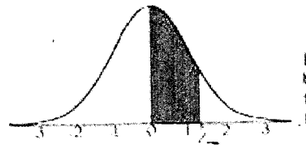
(c-1) Find Probability that delivered product is defective.

(c-2) If product is defective, find probability it comes from the second or the third place.

(d) An electric institute published figures on the number of kilowatt hours used annually by various home appliances. It is claimed that a vacuum cleaner uses an average of **46** kilowatt hours per year. Test the hypothesis that $\mu = 46$ kilowatt hours per year against the alternative that $\mu \neq 46$ kilowatt hours per year if a random sample of **40** homes included in a planned study indicates that vacuum cleaners use an average of **42** kilowatt hours per year with a standard deviation of **11.9** kilowatt hours per year. Use a **0.05** level of significance?

Best of Luck Dr. Eman Elghamry, and Examination committee

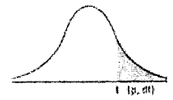
STANDARD NORMAL TABLE (Z)



Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

Numbers in each row of the table are values on a t-distribution with (df) degrees of freedom for selected right-tail (greater-than) probabilities (p).



df/p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	43178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460
z	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635	2.57583	3.2905
CI			80%	90%	95%	98%	99%	99.9%

D3

Department: Electrical Power and Machines Engineering

Tanta University | Total Marks: 70 Marks | Faculty of Engineering

Course Title: High Voltage Engineering	Course Code: EPM521	Year: Fifth level
Date: 15/1/2023	Allowed time: 3 hrs	No. of pages: (3)

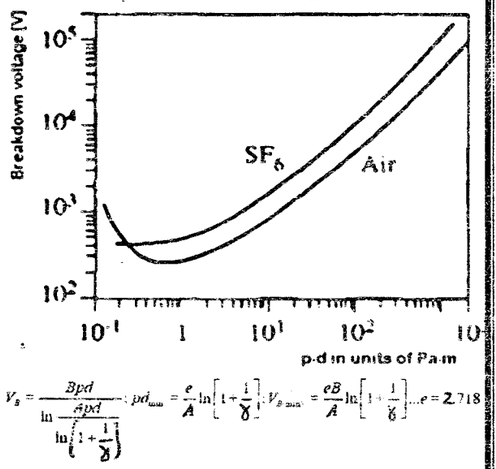
Answer all the following questions:

Question (1) **(20 Marks)**

a) Three measurements of the current between two parallel plates were 1.22, 1.82 and 2.22 of the initiating photocurrent I_o at distances 0.005, 0.01504 and 0.019 m, respectively. E/p and p were maintained constant at 12 kV/m.kPa and 0.133 kPa, respectively. Determine the distance and voltage at which the current becomes self-sustaining

b) The above curve above illustrates the breakdown voltages V_B of SF_6 and Air as a function of the pressure/electrode separation gap product pd. Consider two parallel electrodes having a gap of d = 5 mm in a gas pressure of P = 760 torr. **(8 Marks)**

- Name this curve.
- Calculate the pressure electrode spacing, in units of Pa.m. (NOTE: 1 torr = 133.33 Pa).
- Is the breakdown voltage of SF_6 always higher than that of Air?
- Find out the value of secondary ionization coefficient for air Use the curve to justify your answer.



c) If f_1 is the frequency at which all positive ions can just be cleared from the gap during on half-cycle and f_2 is the frequency at which all electrons can just be cleared from the gap during on half-cycle, describe with only sketches the change of breakdown voltage as a function of frequency. **(2 Marks)**

d) Complete the following sentences: **(5 Marks)**

1. ..... is the state of an atom when an electron moves to higher energy level with a relatively long lifetime before returning to its normal energy level.
2. After the appearance of initial electron, the time required for the ionization processes to develop and cause breakdown of the gap is called .....
3. In long gaps under non-uniform field, the possible breakdown mechanism is .....
4. Photons are characterized by:((a) No mass and no energy (b) No mass and no charge (c) No charge and no energy (d) A quantum of energy with positive charge (e) Both *a* and *b*.)
5. peak voltage for breakdown in case of high AC voltage at high frequency is ..... the DC breakdown voltage (similar to, lower than, higher than, not related to, delayed than)

Question (2) **(20 Marks)**

a) In an experiment, the breakdown voltage V_B of transformer oil sample were measured at different gap spacings d and the results were summarized into the table below. Determine the power law dependence and determine if this oil acceptable or not. **(5 Marks)**

Gap spacing (cm)	0.4	0.6	1	1.2
Breakdown voltage (kV)	91.6	131.68	208	244.87

b) A cylindrical gas filled void of diameter 0.2 mm and thickness 0.15 mm is contained within a slab of solid dielectric with a thickness of 2 cm. The breakdown strength of the gas within the void is 5 MV/m. To cause a breakdown across the void a voltage of 75 kV is required across the dielectric. When a breakdown occurs inside the void the voltage across void drops to 250 V. **(6 Marks)**

- Calculate the voltage across the void when breakdown occurs.
- Calculate the permittivity of the solid insulating material.
- Calculate the number of partial discharge pulses per second for an applied voltage of 150 kV across the dielectric.

c) Plot the graphical representation of the following: **(4 Marks)**

1. Breakdown due to suspended particles in liquid dielectrics.
2. Rate of energy loss from electrons to lattice and energy gain by electrons in solid dielectrics at three different electric fields $E_1 > E_2 > E_3$.

d) Complete the following sentences: **(5 Marks)**

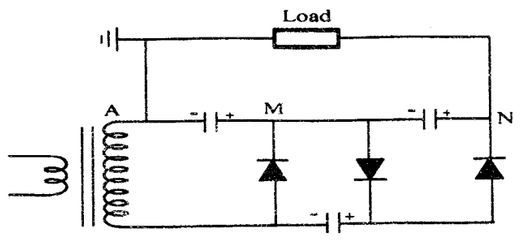
1. In pure liquids, the considered breakdown mechanism is .....
2. For organic dielectric material, the breakdown on surface usually occurs due to .....
3. In lightning phenomenon, which of the followings is observable by naked eyes (pilot streamer – stepped leader – return stroke – charge separation in the cloud).
4. For operating power frequency voltages, a surge arrester has to be a (Conductor- Non-conductor- Semiconductor)
5. Sphere gaps are used to measure.(DC voltage - AC voltage- Impulse voltage- All of these)

Question (3) **(15 Marks)**

a) An impulse generator with each condenser rated for 0.12 μF and 130 kV. The load capacitor is 1200 pF and the series resistance is 1000 Ω. Find the number of stages and the damping resistance needed to produce a 3.396/60 μs impulse wave. **(4 Marks)**

b) A high-voltage, 50 Hz 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. If this signal was measured by a sphere gap at a temperature of 25 °C and pressure of 735 torr, what is the measured value that will be obtained from the table? Assume that the air density factor is equal to the correction factor. **(4 Marks)**

c) In the following figure if the voltage at point A is an AC voltage of 10 kV_{peak} and 50 Hz, draw the voltage waveforms at point M and point N for the first five cycles of the input AC voltage. **(4 points)**



d) Complete the following sentences **(3 Marks)**

1. To reduce the size and cost of the insulation in cascaded transformers .....is used.
2. The voltage efficiency of an impulse generator is given by .....
3. In a multistage impulse generator, for producing very high voltages, a bank of capacitors is (charged in parallel and then discharged in series – charged in series and then discharged in parallel - charged in parallel and then discharged in parallel – charged in series and then discharged in series)

Question (4) **(15 Marks)**

a) Complete the following sentences **(8 Marks)**

1. ..... 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.
2. In Van de Graaff generators output voltage is controlled by .....
3. The following two methods are used for protecting substations against lightning stroke ..... and .....
4. The attenuation factor for resistive potential divider will be ..... without compensation.
5. Which of the following method or technique cannot be used for the measurement of high dc voltages? (Sphere gaps – Electrostatic voltmeter – Peak voltmeter – Potential divider)
6. Surge impedance of over-head transmission lines is of the order of (20 Ω to 30 Ω – 300 Ω to 500 Ω – 3 kΩ to 5 kΩ – 30 kΩ to 60 kΩ).
7. Spark gap arresters have the following three drawbacks: .....,..... and..... .

b) A single-phase lossless overhead line with ZA = 400 Ω, υA = 3×108 m/s and LA = 30 km is connected to a single phase lossless cable with ZB = 100 Ω, υB = 2×108 m/s and LB = 20 km. At the sending end of line A, there is a generator with neglected internal impedance. At the receiving end of cable B is an open circuit. Find the voltage V (x = 10 km, t = 0.45 ms). **(7 Marks)**

Best wishes:

Dr. Eman Gaber