Tanta University
Faculty of Engineering
Third year
Full mark: 90

Subject: Economic operation of power systems
Final examination 2008-2009
Time allowed: Three hours
Date: 18/1/2009

لائحة حديثة

(1-a) What is the difference between soft and hard constraints? Give examples of each type and mention the importance of the constraints in the operation of the power system. (7 mark)

(1-b) The input fuel in (Btu/h) for a power plant with min. and max. power of 20 and 100 MW respectively is given by: $F=(50+4*P+0.015*P^2)*10^6$, where P is the generated power in (MW). Plot the input-output curve of the plant. Calculate the heat rate and plot its curve against the output power. Assuming a fuel cost of $0.15*10^{-6}$ \$/Btu, calculate the incremental fuel cost in \$/MWh and plot its curve against the output power (7 mark)

(1-c) Draw the flow chart to obtain the solution of the economic dispatch problem neglecting the system losses. (7 mark)

(2-a) Choose the best answer: (3 marks each)

(i) The diversity factor for a large number of loads may be in the range of:

a) 1.0 b) 1.02 c) 1.1 d) 1.5 e) 2

(ii) The capacity factor can be used to calculate:

a) average demand b) rated capacity d) maximum demand e) connected load

(iii) Reserve power can be obtained from:

a) standby units and boilers b) speed governor c) valve position d) boilers

(iv) The load factor of a power station having a maximum power of 25MW, connected load of 50MW and an average demand of 15MW is:

a) 1.667 b) 0.6 c) 0.3 d) 1.33 e) 2 f) 0.5

(2-b) The initial investment value of an equipment with a life time of 25 years is 1 million L.E. and its salvage value is 0.2 million L.E. After ten years, a fire damaged the equipment, where its salvage value was 10000 L.E. The owner purchased a new equipment for 1.1 million L.E. If the owner uses the diminishing-value method of depreciation, find the total additional money that the owner has to pay to purchase the new equipment. (7 mark)

(2-c) A company uses the sliding-scale tariff method, where each kilowatt hour costs 0.1 LE. In addition, the customer has to pay a penalty if the power factor is lower than 0.85. The penalty is defined as 500 LE multiplied by the difference between the critical and the actual power factor. Calculated the total cost of the consumed energy in the following cases: (a) the total consumed energy is 1000 kWh at a power factor of 0.72and (b) the total consumed energy is 1200 kWh at a power factor of 0.82. (7 mark)

P.T.O.

(3-a) The incremental fuel costs in \$/MWh for a plant consisting of three units are given by:

$\frac{dF_1}{dP_1} = 0.015P_1 + 3.4$, $\frac{dF_2}{dP_2} = 0.018P_2 + 2.6$ and $\frac{dF_3}{dP_3} = 0.01P_3$. Calculate the saving in \$ in the case of a load demand of 800 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. (7 mark)

(3-b) The incremental fuel costs in \$/MWh for 3 generating units are given as: $\frac{dF_1}{dP_1} = 0.009P_1 + 3.5$, $\frac{dF_2}{dP_2} = 0.012P_2 + 3$ and $\frac{dF_3}{dP_3} = 0.008P_3 + 3.6$. The minimum and maximum loads on each unit are respectively 100 and 350 MW and the load demand is 800 MW. The loss formula is given as: $P_{loss} = 0.00014\,P_1^2 + 0.00008\,P_1 \cdot P_2 + 0.00009\,P_2^2 + 0.0001P_3^2 + 0.00012\,P_2 \cdot P_3$, where P is in MW. Find the optimal load allocation among the generators *using only two iterations*. Start with a lagrange multiplier value of 6 and penalty factors of unity. (7 mark)

(4-a) Classify steam power plants with all possible ways and mention the losses in each part showing how can you calculate the efficiency of each part. (8 mark)

(4-b) Mention in details the main parts of the hydroelectric power plants and explain the function of each part. (7 mark)

(4-c) Discuss the advantages and disadvantages of nuclear power plants. (7 mark)

4-d) Discuss the main reasons of using the renewable energy sources as an alternative to the conventional centralized power stations and compare between fuel cells and wind turbine as renewable energy sources. (7 mark)

Good Luck

(Dr. Ahmed Refaat Azmy et al)

حد بة

بسم الله الرحمن الرحيم*لا اله الا الله محمد رسول الله

جامعة طنطا – كلية الهندسة بسبرباي قسم هندسة القوى والألات الكهربية الفرقة: الثالثة

امتحان الفصل الدراسي الأول ٢٠٠٨/٢٠٠٩ م مقرر "الآت كهربية (٢)" الزمن ١٨٠ دقيقة

التاريخ:الخميس ٢٠٠٩/١/٢٩م النهاية العظمي: ١٢٠ درجة

Ansawer all the quistions

1.a)Describes the construction of single-phase and three three-phase power transformers.

.b) For a real transformer has the following data,

*Single-phase , core-type and has a square cross-sectio area , the turns ratio=100. Hw=Ww = 0.5m. Ai = 0.075 m^2 ,

*No-load current =5A. secondary rated voltage = 318.198 sin(2200t/7) v

*constat design: E_t =25 v, K_w =0.27, J= 2.3 A/mm^2 .

Determine: (1) the relative permebalty of the iron core.& (2) the rated KVA.

2.a)Explain why a leading power factor load leads to cause a rise in secodary voltage above the no-load rated value?

.b)The following data per phase were obtained from short-circuit and open-circuit testes of three-phase delta/delta 150KVA, 2400v/600v, 50hz transformer;

Item	No-load	Short-circuit
Voltage (v)	600	76.4
Current (A)	3.34	20.8
Power (w)	484	754

Determine: 1- the per phase equivalent parameters refered to high-side.

2- regulation at rated load and 0.90 leading power factor.

3- transformer efficiency at full-load and 0.8 lagging power factor.

3.a)Make a comparison between a two winding transformer and the corresponding autotransformer.

.b) Three 7200/600 v, 500KVA transformers are operating in parallel from 7200 v source. The percent impedances are;

Za= 5.34 %; Zb= 6.08 %; Zc= 4.29 %

What percent of the total current is supplied by eash transformer?

4.a)What is the optimum conditions for parallel operation of transformers? What happen if any one of them is ignored?

.b) Two 50KVA, 60 Hz transformers have the following voltage ratios and equivalent low-side impedances;

Transformer	Voltage ratio (v)	Req. (ohm)	Xeq. (ohm)
A	4800 / 482	0.0688	0.1449
B	4800 / 470	0.0629	0.1634

The transformers are connected in parallel and operated from a 4800 v, 60 Hz supply. Calculate the circuilating current.

5.a) Drive the output equation of the single phase transformer design.

.b) Design a three-phase power transformer has the following data;

- 1000 KVA, 500 Kv / 132 Kv, 50 Hz, core type.
- B_m=1.4T, K_w= 0.25, E_t= 50 v, current density = 2.5 A/mm^2, Ki=0.9
- Hw/Ww = 3, Ai = 0.6 d^2 , d_{ml}= 0.9d, iron density = 7.8 g/cm^3 .

Not that your design will incluode:

*Transformer main dimensions.

*Windings number of turns and diametres.

*Cost of the iron core if 1.0 Kg costes 5 E.L.

الحمد لله رب العـــــلمين

Tanta University — **3rd year Power**
Faculty of Engineering — **Electrical Communications**
Time : 3 Hours. — **Jan. 2008.**

Answer the following Questions:

1. (a) Explain the following terms:
   (i) Information capacity (ii) Thermal noise (iii) Correlated noise

   (b) If an amplifier has a bandwidth B = 30 kHz and a total noise power N= $2x\ 10^{-7}$, determine the total noise power if the bandwidth increases to 50 kHz. ($K = 1.38 \times 10^{-23}$ Jouls / K)

   (c) For a nonlinear amplifier with sine wave input frequencies of 3 kHz and 5 kHz , determine the first three harmonics present in the output for each input frequency and the cross product frequencies produced for values of m and n of 1 and 2.

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2. (a) Sketch the block diagram of integrated circuit waveform generator and explain its operation

   (b) Sketch the block diagram of a PLL and describe how loop acquisition is accomplished with a PLL from an initial unlocked condition until frequency lock is achieved

   (c) Determine the hold- in range for a PLL with an open loop gain of K_L =20 kHz / rad

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3. (a) Sketch the block diagram of a multiple crystal frequency synthesis and explain its operation.

   (b) Describe the relationship between the carrier and sideband powers in an AM DSBFC wave. .

   (c) For an AM DSBFC modulator with carrier frequency f_c = 100 kHz and a maximum modulating signal $f_{m(max)}$ = 5 kHz , determine
   (i) Frequency limits for the upper and lower sidebands.
   (ii) Bandwidth
   (iii) Upper and lower side frequencies produced when the modulating signal is a single frequency 3 kHz.

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4. (a) Sketch the block diagram of a high level AM DSBFC transmitter and explain its operation.

   (b) For a receiver with IF ,RF, and local oscillator frequencies of 455 kHz,1100 kHz, and 1555 kHz, respectively ,determine
   (i) Image frequency
   (ii) Image frequency rejection ratio for a preselector Q = 100

(c) Determine the net receiver gain for an AM receiver with the following gains and losses: RF amplifier = 30 dB , IF amplifier = 44 dB, Audio amplifier = 24 dB , preselector loss = 2 dB, mixer loss = 6 dB , detector loss = 8dB

Good Luck

25/1/2009 امتحان

Tanta University	Third Year
Faculty of Engineering	Final-Term Examination 2008-2009
Electrical Power and Machines	High Voltage Engineering
Engineering Department	Allowable Time: 3 hours

Answer the following questions:
Use neat sketches and support your answers with suitable equations:

First Question:

1-a Describe Townsend's first and second ionization coefficients. How is the condition for breakdown obtained in a Townsend discharge? (3 points)

1-b Explain the Streamer theory of breakdown in air at atmospheric pressure. (3 points)

1-c What is Paschen's law? How do you account for the minimum voltage for breakdown under a given 'p x d' condition? (4 points)

1-d What will the breakdown strength of air be for small gaps (1 mm) and large gaps (20 cm) under uniform field conditions and standard atmospheric conditions? (5 points)

Second Question:

2-a Explain briefly the various theories that explain breakdown in commercial liquid dielectrics. (4 points)

2-b Explain briefly the different mechanisms by which breakdown occurs in solid dielectrics in practice. (3 points)

2-c State the main differences among the gas, liquid and solid dielectrics. (3 points)

2-d Calculate the surface tension of an insulating liquid contain a globule with 1.1 μm radius and $\varepsilon_{r2} = 1.2$ with a voltage drop of 180 volt across it. The liquid has $\varepsilon_{r1} = 2.3$ and the breakdown field strength is 488.85 kV. (5 points)

Third Question:

3-a Explain briefly the different types of rectifier circuits for producing high dc voltage. (5 points)

3-b What is the principle operation of a resonant transformer? How is it advantageous over the cascade connection transformers? (4 points)

3-c A Cockcroft-Walton type voltage multiplier with 10 stages is constructed with capacitors of 100 nF each. If the load current is 2.5 mA and the percentage regulation is 4.2%, calculate the percentage ripple and the optimal number of stages for minimum voltage drop if the supply frequency is 50 Hz. (6 points)

Fourth Question:

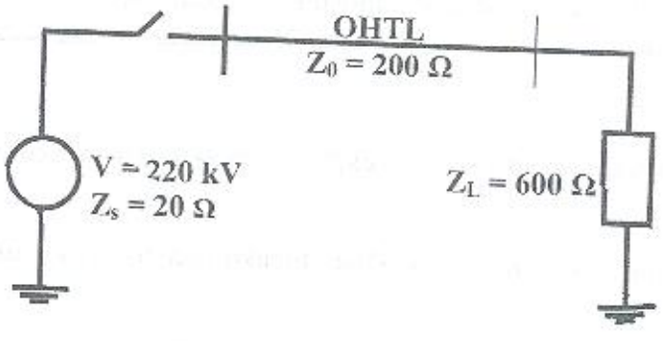
4-a Give the basic circuit for measuring the peak voltage of (a) ac voltage, and (b) impulse voltage. What is the difference in measurement technique in the above two cases? (4 points)

4-b State the relative advantages and disadvantages of using a series resistance microammeter and a potential divider with an electrostatic voltmeter for measuring high dc voltages? Why are capacitance voltage dividers preferred for ac voltage measurements? (5 points)

4-c To measure a high ac voltage, a high ohmic resistance with a magnitude of 50 kΩ is used. Assume that the residual capacitance is 20 nF. Calculate the equivalent impedance of the high ohmic resistance at a frequency of 50 Hz. (6 points)

Fifth Question:

5-a For the system shown in the following figure, draw the voltage Lattice diagram up to 6τ and draw the variation of the voltage with the time at the load terminals. Calculate the voltage at the midpoint of the line at 3τ. (5 points)



5-b A step of voltage E is applied to one end of an overhead line which has a surge impedance of 300 Ω, 10 miles long and a velocity of propagation of $\upsilon_1 = 1.87$ mile/μsec. The other end of the line is connected to a cable with a surge impedance of 30 Ω, 30 miles long and a velocity of propagation of $\upsilon_2 = 0.2\ \upsilon_1$. The far end of the cable is connected to a shunt capacitor of 3.86 μF. Draw the lattice diagram and calculate the voltage at the far end of the cable at the time when the first reflection arrives at the line-cable junction. (5 points)

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

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

Tanta University *Faculty of Engineering* *Physics & Mathematics Dept.* *Third Year Electrical Power* *Final First Term Exam*	*Engineering Mathematics (4)* *Code : PME3114* *Date : 22/1/2009* *Total Mark : 70* *Time Allowed: 3 Hours*

Answer the following questions:

[1] 15 Marks

(a) A certain item is manufactured by three factories, say A, B and C. It is known that A turns out twice as many items as B, and that B and C turn out the same number of items (during a specific production period). It is known that 8% of the items produced by A and B are defective, while 4% of those manufactured by C are defective, one item is chosen at random:
i) What is the probability that the chosen item is defective?
ii) If the chosen item was defective, what is the probability that it come from factory C?

(b) Three cards are drawn without replacement from a deck of 52 playing cards, what is the probability that they are all aces?

(c) The mean and variance of binomial distribution are 4 and 3 respectively; find $P(x \geq 1)$.

[2] 22 Marks

(a) Use the moment generating function to obtain the mean and variance of the random variable X whose density function is given by:

$$f(x) = \frac{1}{2}e^{-|x|}, \qquad -\infty < x < \infty$$

(b) If X is a random variable its density function is given by

$$f(x) = \begin{cases} kx(1-x), & 0 < x \leq 1 \\ 0, & \text{otherwise} \end{cases}$$

i) Find the value of k.
ii) Find the cumulative distribution function>
iii) Find $P(x<0.2)$

(c) Derive a formula for the mean, variance and moment generating function for the Poisson distribution.

[3] 15 Marks

(a) If $X \sim N(\mu, \sigma^2)$, such that $P(\mu - k\sigma \leq x \leq \mu + k\sigma) = 0.823$; find the value of k.

(b) The probability that a student pilot passes the written test for a private pilot license is 0.7; find the probability that the student will pass the test on the third try.

(c) The grads of a class of 9 students on a midterm examination (X) and on the final examination (Y) are as follows:

Midterm (X)	77	50	71	72	81	94	96	99	67
Final (Y)	82	66	78	34	47	85	99	99	68

i) Compute the correlation coefficient.
ii) Find the linear prediction equation.
iii) Estimate the final examination grade pf student who received a grade of 85 on the midterm examination.

[4]	(a) A machine is producing metal pieces that are cylindrical in shape , a sample of pieces is taken and the diameters are 1.01, 0.97, 1.03, 1.04, 0.99, 0.98, 0.99, 1.01, 1.03 centimeters, find a 95% confidence interval for the mean diameter of pieces from this machine.
18 Marks	(b) All boxes of a certain type of coffee indicate that they contains 21 grams of coffee, a government agency receives many consumer complaints that the boxes contain less than 21 grams. To check the consumer complaints at the 5% level of significance, the government agency buys a sample of 100 boxes of this coffee and finds that the sample mean is 20.5 grams with a standard deviation of 2 grams. Should the government agency order the seller to put more coffee into its boxes?
	(c) If we have a finite population of five observations 3, 5, 7, 9, 11; find the sampling distribution of the mean if we draw a random sample of size 3.

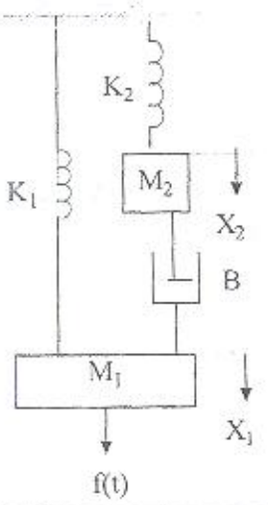
20-1-2009

جامعة طنطا – كلية الهندسة
قسم هندسة الحاسبات و التحكم الآلي
امتحان الفصل الدراسي الأول للعام الجامعي ٢٠٠٨/٢٠٠٩

الفرقة الثالثة قسم هندسة القوي الكهربية
المادة : أسس التحكم الآلي (جديد)
الزمن : ثلاث ساعات يناير ٢٠٠٩

Answer the following questions: **(Maximum degree 70)**

Q(1): For the mechanical system shown, find the transfer function $\mathbf{X_1(S)/F(S)}$.(9 degree)



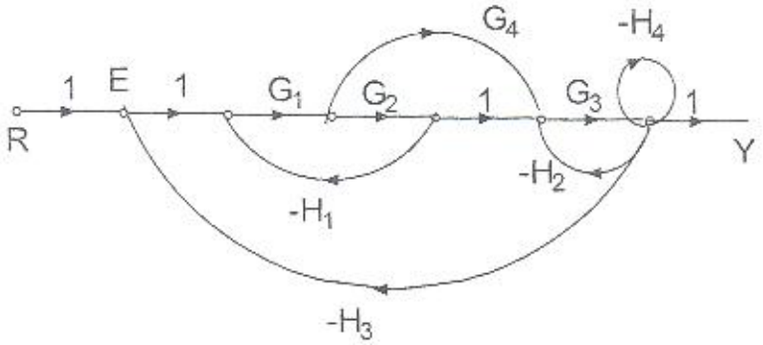
Q(2): **[a]** The characteristic equations of linear control systems are given below. Apply Routh-Hurwitz criterion to determine the root distribution and the system stability. (10 degree)

1- $s^5 + 8s^4 + 2s^3 + 4s^2 + 2s + 4 = 0$

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

3- $s^6 + s^5 + 2s^4 + s^3 + 3s^2 + 2s + 2 = 0$

[b] Using signal flow graph, find the transfer function of the system $\mathbf{Y(s)/R(s)}$ and $\mathbf{Y(s)/E(s)}$.(13 degree)



Q(3): For positive values of K, plot the root locus for unity feedback control system having the following open-loop transfer function $G(s) = \dfrac{K}{s(s+3)(s^2+2s+2)}$.

For what values of gain K does the system become unstable? Find also the value of k at which the damping ratio is 0.5 . (12 degree)

(انظر الصفحة التالية)

Q(4): [a] For the system that have the following transfer function

$$\frac{Y(s)}{U(s)} = \frac{(s+3)(s+4)}{s(s+1)(s^2+3s+5)}$$

Give the state space in pole-zero form and in controllable form. (9 + 3 degree)

[b] (i) For the following system draw the state diagram. (3 degree)

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

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

(ii) Determine whether the given system in (b-i) is stable, completely state controllable, and observable or not. (5 degree)

Q(5): Given a system described by the dynamic equations

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

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. (3 degree)

(ii) Find the transfer function $Y(s)/U(s)$. (3 degree)

مع أطيب الأمنيات بالتوفيق

Tanta University
Faculty of Engineering
Third year
Full mark: 90

Subject: Economic operation of power systems
Final examination 2008-2009
Time allowed: Three hours
Date: 18/1/2009

لائحة حديثة

(1-a) What is the difference between soft and hard constraints? Give examples of each type and mention the importance of the constraints in the operation of the power system. (7 mark)

(1-b) The input fuel in (Btu/h) for a power plant with min. and max. power of 20 and 100 MW respectively is given by: $F=(50+4*P+0.015*P^2)*10^6$, where P is the generated power in (MW). Plot the input-output curve of the plant. Calculate the heat rate and plot its curve against the output power. Assuming a fuel cost of $0.15*10^{-6}$ \$/Btu, calculate the incremental fuel cost in \$/MWh and plot its curve against the output power (7 mark)

(1-c) Draw the flow chart to obtain the solution of the economic dispatch problem neglecting the system losses. (7 mark)

(2-a) Choose the best answer: (3 marks each)

(i) The diversity factor for a large number of loads may be in the range of:
a) 1.0 b) 1.02 c) 1.1 d) 1.5 e) 2

(ii) The capacity factor can be used to calculate:
a) average demand b) rated capacity d) maximum demand e) connected load

(iii) Reserve power can be obtained from:
a) standby units and boilers b) speed governor c) valve position d) boilers

(iv) The load factor of a power station having a maximum power of 25MW, connected load of 50MW and an average demand of 15MW is:
a) 1.667 b) 0.6 c) 0.3 d) 1.33 e) 2 f) 0.5

(2-b) The initial investment value of an equipment with a life time of 25 years is 1 million L.E. and its salvage value is 0.2 million L.E. After ten years, a fire damaged the equipment, where its salvage value was 10000 L.E. The owner purchased a new equipment for 1.1 million L.E. If the owner uses the diminishing-value method of depreciation, find the total additional money that the owner has to pay to purchase the new equipment. (7 mark)

(2-c) A company uses the sliding-scale tariff method, where each kilowatt hour costs 0.1 LE. In addition, the customer has to pay a penalty if the power factor is lower than 0.85. The penalty is defined as 500 LE multiplied by the difference between the critical and the actual power factor. Calculated the total cost of the consumed energy in the following cases: (a) the total consumed energy is 1000 kWh at a power factor of 0.72and (b) the total consumed energy is 1200 kWh at a power factor of 0.82. (7 mark)

P.T.O.

(3-a) The incremental fuel costs in \$/MWh for a plant consisting of three units are given by: $\frac{dF_1}{dP_1} = 0.015P_1 + 3.4$, $\frac{dF_2}{dP_2} = 0.018P_2 + 2.6$ and $\frac{dF_3}{dP_3} = 0.01P_3$. Calculate the saving in \$ in the case of a load demand of 800 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. (7 mark)

(3-b) The incremental fuel costs in \$/MWh for 3 generating units are given as: $\frac{dF_1}{dP_1} = 0.009P_1 + 3.5$, $\frac{dF_2}{dP_2} = 0.012P_2 + 3$ and $\frac{dF_3}{dP_3} = 0.008P_3 + 3.6$. The minimum and maximum loads on each unit are respectively 100 and 350 MW and the load demand is 800 MW. The loss formula is given as: $P_{loss} = 0.00014\,P_1^2 + 0.00008\,P_1 \cdot P_2 + 0.00009\,P_2^2 + 0.0001P_3^2 + 0.00012\,P_2 \cdot P_3$, where P is in MW. Find the optimal load allocation among the generators *using only two iterations*. Start with a lagrange multiplier value of 6 and penalty factors of unity. (7 mark)

(4-a) Classify steam power plants with all possible ways and mention the losses in each part showing how can you calculate the efficiency of each part. (8 mark)

(4-b) Mention in details the main parts of the hydroelectric power plants and explain the function of each part. (7 mark)

(4-c) Discuss the advantages and disadvantages of nuclear power plants. (7 mark)

4-d) Discuss the main reasons of using the renewable energy sources as an alternative to the conventional centralized power stations and compare between fuel cells and wind turbine as renewable energy sources. (7 mark)

Good Luck

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