Title: Generation and economy of electrical energy	**Course Code: EPM3110**	**Year: Third year**
Date: January 2010 (First term)	**Allowed time: 3 hrs**	**No. of Pages: (2)**

Problem number (1) (30 Marks)

a) A residential load has the following energy consumption through one day:

Time (h)	4	8	13	18	20	22	24
Accumulative energy consumption (kWh)	60	140	250	525	695	855	935

Draw the daily load curve and find the average power and load factor. (10 points)

b) Compare in detail between hot reserve and cold reserve showing the importance of each type (10 points)

c) The initial investment value of an equipment with a life time of 20 years is 100,000 L.E. and its salvage value is 30,000 L.E. After four years, the equipment is damaged and the insurance paid 80,000 L.E. to the company. If the company uses the sinking-value method of depreciation with an annual rate of compound interest of 5%, find the total additional money that the company has to pay to purchase the new equipment. (10 points)

Problem number (2) (30 Marks)

a) The incremental fuel costs in \$/MWh for four generating units are given by: $\frac{dF_1}{dP_1} = 0.0085P_1 + 3.5$, $\frac{dF_2}{dP_2} = 0.011P_2 + 3.2$, $\frac{dF_3}{dP_3} = 0.008P_3 + 3.6$ and $\frac{dF_4}{dP_4} = 0.013P_4 + 2.9$
For a load demand of 1100 MW, find the optimal incremental fuel cost and the optimal allocation of load between the four units. The minimum and maximum loads on each unit are respectively 100 and 350 MW. (10 points)

b) The fuel costs of three plants are: F_1=200+7 P_1+0.008 P_1^2 \$/h, F_2=180+6.3 P_2+0.009 P_2^2 \$/h and F_3=140 + 6. 8P_3+ 0.007 P_3^2 \$/h, where the power is in MW and the power limits are: (10 MW $\le P_1 \le$ 85MW), (10MW $\le P_2 \le$ 80MW) and (10 MW $\le P_3 \le$ 70 MW). Determine the optimal dispatch of generation and the total cost when the total load demand is 150 MW. Assume that the power loss in transmission system is given as: $P_{loss} = 0.0218P_1^2 + 0.0228P_2^2 + 0.0179P_3^2$, where all quantities are specified in per unit on a 100-MVA base. Begin with a lambda value of 8 and penalty factors of unity and use tolerance of 0.02. (10 points)

c) Explain in detail a tariff method for electrical energy that can be used to prevent the high reactive power consumption. (10 points)

Problem number (3) (30 Marks)

a) Compare between losses in steam power plants and diesel power plants. Discuss the impact of these losses on the efficiency of these power plants. (10 points)

b) Explain the following terms: spillway, surge tank, control rods and combustion chamber. (10 points)

c) Compare between fuel cells and photovoltaic as two sources of electric energy regarding: principle of operation, advantages and disadvantages. (10 points)

Good Luck

Course Examination Committee

Dr. Ahmed Refaat Azmy
Dr. Mohamed Abo El Azm
Dr. Fayza Safan
Prof. Kamal Shebl

Course Coordinator: Dr. Ahmed Refaat

Tanta University

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

Faculty of Engineering

Course Title: Automatic Control Principles
Date: 26 January 2010 (First term)

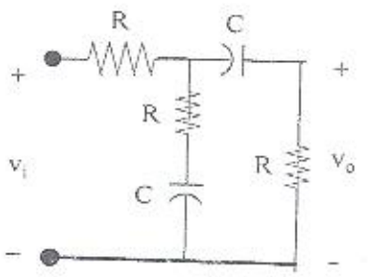
Course Code: CCE3170
Allowed time: 3 hrs

Year: 3rd
No of Pages: (2)

Answer the following questions

Problem number (1) **(21 Marks)**

[a] Find the transfer function for the following circuit $V_0(s)/V_i(s)$ (9 Marks)



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

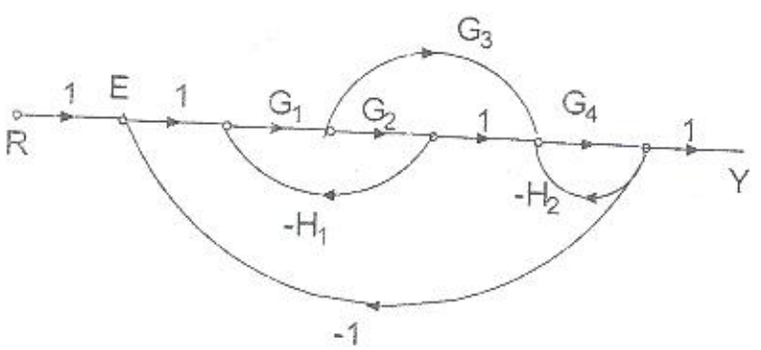
1) Compute the rise time and the percentage overshoot for the step input (5 Marks)
2) The error constants (5 Marks)
3) The steady state error for step input (2 Marks)

Problem number (2) **(23 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) $s^5+8s^4+2s^3+4s^2+2s+4=0$
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 $Y(s)/R(s)$ (10 Marks) and $Y(s)/E(s)$. (4 Marks)



P.T.O.

Problem number (3) (13 Marks)

Consider a unity negative feedback system with a forward transfer function

$$G(s) = \frac{k(s+3)}{s(s+2)}.$$

1) Draw the root locus for this system, (7 Marks)
2) Determine the damping ration for maximum oscillatory response. (2 Marks)
3) What is the value of k at this point of the locus? Find the closed-loop transfer function? (4 Marks)

Problem number (4) (17 Marks)

[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 (7 Marks) and in controllable form (3 Marks).

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

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

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

(ii) Determine whether the given system in (b-i) is stable, completely state controllable, and observable or not. (4 Marks)

Problem number (5) (11 Marks)

[a] Given a system described by the dynamic equations

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

where

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

(i) The characterstic equation. (3 Marks)

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

[b] Sketch the Bode diagram for a system having an open loop transfer function given by $G(s) = \frac{10(1+0.5s)}{(1+0.2s)^2(1+0.1s)}$ (5 Marks)

Tanta University

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

Faculty of Engineering

Course Title: Automatic Control systems
Date: 24 / 1 / 2010 (First term)

Course Code:
Allowed time: 3 hrs

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

Remarks: (answer the following questions)

Problem number (1) (Marks)

For the system shown in Fig 1

a) Obtain the transfer function?

b)

c) Draw the equivalent block diagram?

Problem number (2) (Marks)

For block diagram shown in Fig 2

a) Determine the overall transfer function based on block diagram reduction?

b) Define

1) Plant 2) disturbance 3) process 4) feedback control

c) What is the difference between open loop and closed loop control system?

Problem number (3) (Marks)

a) What are the classifications of automatic controllers?

Drive the transfer function for PID controller?

b) Draw the block diagram for PID controller?

Problem number (4) (Marks)

Consider the following system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 3 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

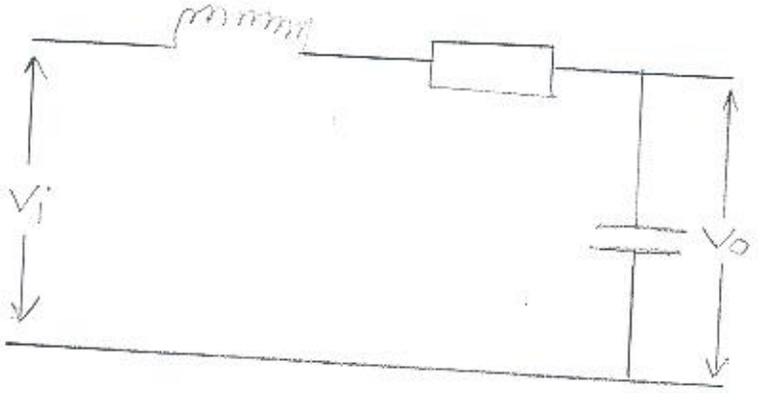
$$y = \begin{bmatrix} 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

a) Is this system completely controllable and observable?

P.T.O.

b) Design a full-order observer that has un-damped natural frequency of 10 rad/s and a damping ratio of 0.5?

c) Design a state feedback controller that has closed loop poles located at -2 and -4?



Fig(1)

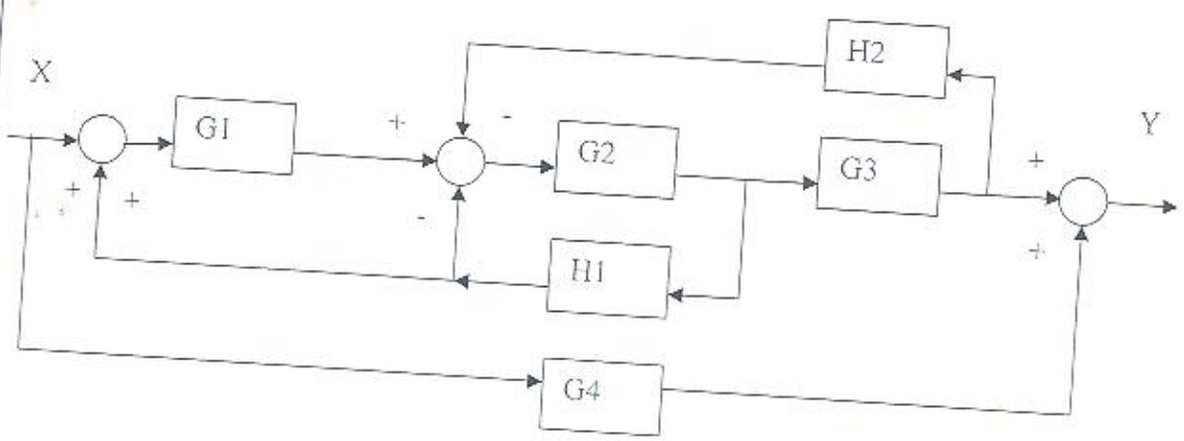


Fig 2

Greeting sentence (Optional)

Course Examination Committee

Prof.
Dr.

Prof.
Dr.

Course Coordinator:

Dr. Magdy G. El-ghatwary

Tanta University

Electrical Power and Machines Department
Total Marks: 120 Marks
Course: Electrical Machine 2 Code: EPM3111
Third Year Time: 3:00 hrs First Term
Date: Jan 24, 2010 Pages: 2

Faculty of Engineering

ANSWER THE FOLLOWING QUESTIONS, ASSUME ANY MISSING INFORMATION AND SUPPORT YOUR ANSWER WITH DIAGRAMS AND SKETCHES

Question 1: Marks: **30**

Copy the question to your answer sheet and select the correct answer(s). Support your answer with diagrams, graphs, equations or calculations whenever required.

1. When the transformer loading changes from no-load condition to full-load condition, the magnetic flux density inside the transformer core will….. 2
   a- increase b- decrease
   c- cause saturation d- become zero

2. The main purpose of using core in a transformer is to …. 2
   a- decrease iron loss b- prevent eddy current loss
   c- reduce transformer size d- guide the magnetic flux

3. The primary and secondary windings of ordinary 2-windings transformer always have…. 2
   a- different number of turns b- same volume of cupper
   c- common magnetic circuit d- same apparent power ratings

4. The voltage applied to the high voltage side of a transformer during short circuit test is 3% of its rated voltage. The core losses will be …. percent of the rated core loss. 2
   a- 9 b- 0.9
   c- 0.333 d- 0.09

5. The saving in Cu achieved by converting 2-windings into an auto transformer is determined by…. 2
   (Support your answer with equations)
   a- voltage transformer ratio b- load on secondary
   c- size of transformer core d- Operation (step up or step down)

6. Instrument transformers are used on ac circuits for extending the range of …. 2
   a- ammeters b- voltammeters
   c- wattmeter's d- non of the above

7. The successful parallel operation of two transformers necessitates the two transformers have….. 2
   1- equal impedances 2- equal equivalent impedance percentage
   3- equal equivalent impedance 4- same rated input voltage

8. Before removing the ammeter from a current transformer, its secondary must be short-circuited in order to avoid …. 2
   a- excessive heating of core b- high secondary EMF
   c- increase in iron loss d- non of the above

9. The Buck-boost transformers are practically useful in applications where …. 2
   a- precise measurements are required b- loads are sensitive to voltage changes
   c- a little higher than rated voltage d- a little lower than rated voltage

10. The size of transformer depends on 2
1- Utilization 2- Cooling system
3- rated apparent power 4- Cu conductor size

11. The relation between window factor and coil's ampere-turn is 2
1- linear proportional 2- inverse proportional
3- Second order 4- they are independent

12. The increase of operating frequency, ….. the transformer size. 2
1- increases 2- decreases
3- does not change 4- increase or decrease

13. From single phase transformer output equation, the area window depends on 2
1- operation frequency 2- window factor
3- winding factor 4- voltage's waveform factor

14. The three phase transformers used for distribution are immersed in oil tank in order to 2
1- isolate the windings 2- protect the core against heat rise
3- provide normal heat distribution 4- fix the transformer to the floor

15. Stepped cored of transformers' core provides the following merits …. 2
1- reduce size 2- reduce volume of iron used
3- reduce manufacturing cost 4- reduce volume of copper used

Question 2: Marks: 30

a- Discuss the experimental steps required to determine the efficiency and regulation of loaded single phase transformer. Descript the required equipments and connections. Support you answer with diagrams and mathematical formulas. 15

b- The following test data were obtained from short-circuit and open-circuit tests of 50KVA, 2400/600V, 50Hz transformer. 15

$V_{OC} = 600$ V $V_{SC} = 76.4$ V
$I_{OC} = 3.34$ A $I_{SC} = 20.8$ A
$P_{OC} = 484$ W $P_{SC} = 754$ W

Determine:
i- The equivalent circuit parameters referred to the high voltage side.
ii- regulation and efficiency at rated load and 0.92 power-factor lagging.

Question 3: Marks: 30

a- A 200KVA, 4000/500V, 50Hz, core type transformer, operating at no-load in the step-up mode, draws a magnetizing current equals to 2 percent of rated current. The core has a mean length of 3.15m, and is operated at a flux density of 1.55T. The magnetic field intensity is 360AT/m. Determine: 10
i- The magnetizing current ii- the number of turns in the two coils
iii- the core flux iv- the cross-sectional area of the core

b- A 10KVA, 500/440V, 25Hz single phase transformer has copper, eddy current and hysteresis losses of 1.5, 0.5 and 0.6 per cent of output on full load. What will be the percentage losses if the transformer is used on 10KV, 50Hz system keeping in the full load current constant? Assume unity power factor operation. Compare the full load efficiencies for the two cases. 10

c- Two single-phase transformers of equal voltage ratio are operating in parallel and supplying a load of 1000A 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

Question 4: Marks: 30

a- The parameters of a 2300/230V, 50Hz transformer are given as follows: 15

R_1=0.286Ω R'_2=0.319Ω R_c=250Ω

X_1=0.73Ω X'_2=0.73Ω X_m=1250Ω

The secondary load impedance Z_L=j0.23Ω. Using exact equivalent circuit with rated output voltage; calculate the load current, input power factor, efficiency and voltage regulation.

b- A 400 turn auto transformer, operating in step-down mode with 25% tap, supplies a 4.8KVA at 0.85 lagging power factor. The input to the transformer is 2400V, 60Hz. Neglecting the small losses and leakage effect. Determine: 15

1. The load current
2. The input line current
3. apparent power conducted and apparent power transformed

With Best Wishes

قوى كهربية قديم

Tanta University		Mechanical Power Engineering Department Course Title: Elective Course (1) ME3108 (Mechanical power stations)		Faculty Of Engineering

Dept	Elec. Power and Machines Eng	Date	January 21st 2010
Year	3rd , (old curriculum) 1997	Allowed time	3 hrs
Final exam	January (First term)	Total Marks	85 Marks
		Academic Number	2009/2010

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

يسمح للطالب باستخدام جداول وخرائط البخار

Question (1) (18 marks)

In a steam power plant, the initial pressure and temperature of steam are 28 bar and 320 °C respectively and the exhaust pressure is 0.08 bar. After expansion to 10 bar the steam is reheated to 250 °C and after further expansion to 3.5 bar it is again reheated to 200 °C.

a) Sketch the flow diagram of the plant and the corresponding cycle on T_S diagram
b) Calculate the thermal efficiency of the plant
c) Compare this efficiency with that of Rankine cycle for the same initial conditions and final temperature

(Neglect the pump work)

Question (2) (18 marks)

(A)- Prove that the thermal efficiency of the Otto cycle is as follow:

$$\eta_{Otto} = 1 - \frac{1}{r^{\gamma-1}}$$

Where: r = compression ratio

(B)- An air standard Otto cycle has a compression ratio of 8. The pressure and temperature at the beginning of compression are 1 bar and 27 °C respectively. The heat transfer to the air per cycle is 1600 kJ/kg of air. Determine the following:

a)- the pressure and temperature at each corner of the cycle
b)- The thermal efficiency of the cycle

Question (3) (19 marks)

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:

a) The specific output
b) The plant efficiency

Note: the process in the compressor and the turbine may be assumed as isentropic.

Question (4) **(16 marks)**

(A)- 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.

(B)- The average heat transfer from a person to the surroundings when he is not actively working is about 940 kJ/hr. Suppose that in a theatre containing 1200 persons, the ventilation system fails:

(a)- How much does the internal energy of the air in the theatre increase during the first 15 minutes after the ventilation system fails?

(b)- Considering the theatre and all people as the system, and assuming no heat transfer to surrounding, how much does the internal energy of the system change?

Question (5) **(14 marks)**

(A)- Heat is supplied to a heat engine at the rate of 2720 kJ/min. If the engine produces 13.42 kW, calculate the thermal efficiency and the rate at which heat is rejected from the engine?

(B)- A person claims to have designed an engine that receives 52.5 kJ of heat and produces 13 kJ of useful work, when operating between a source temperature of 60 °C and a sink temperature of 0 °C. Is this claim valid?

All the best

Course Examination Committee : Dr. Y. EL-Samadony
Course Coordinator : Prof. Abdel Naby Kabeel

c) Explain in detail a tariff method for electrical energy that can be used to prevent the high reactive power consumption. (10 points)

Problem number (3) **(30 Marks)**

a) Compare between losses in steam power plants and diesel power plants. Discuss the impact of these losses on the efficiency of these power plants. (10 points)

b) Explain the following terms: spillway, surge tank, control rods and combustion chamber. (10 points)

c) Compare between fuel cells and photovoltaic as two sources of electric energy regarding: principle of operation, advantages and disadvantages. (10 points)

Good Luck

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Prof. Kamal Shebl

Course Coordinator: Dr. Ahmed Refaat

قوى قديم

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 2010 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

Problem number (1) **(30 Marks)**

a) A residential load has the following energy consumption through one day:

Time (h)	4	8	13	18	20	22	24
Accumulative energy consumption (kWh)	60	140	250	525	695	855	935

Draw the daily load curve and find the average power and load factor. (10 points)

b) Compare in detail between hot reserve and cold reserve showing the importance of each type (10 points)

c) The initial investment value of an equipment with a life time of 20 years is 100,000 L.E. and its salvage value is 30,000 L.E. After four years, the equipment is damaged and the insurance paid 80,000 L.E. to the company. If the company uses the sinking-value method of depreciation with an annual rate of compound interest of 5%, find the total additional money that the company has to pay to purchase the new equipment. (10 points)

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b) The fuel costs of three plants are: $F_1=200+7\ P_1+0.008\,P_1^2$ \$/h, $F_2=180+6.3\ P_2+0.009\,P_2^2$ \$/h and $F_3=140+6.8P_3+0.007\,P_3^2$ \$/h, where the power is in MW and the power limits are: ($10\ MW \le P_1 \le 85MW$), ($10MW \le P_2 \le 80MW$) and ($10\ MW \le P_3 \le 70\ MW$). Determine the optimal dispatch of generation and the total cost when the total load demand is 150 MW. Assume that the power loss in transmission system is given as: $P_{loss} = 0.0218P_1^2 + 0.0228P_2^2 + 0.0179P_3^2$, where all quantities are specified in per unit on a 100-MVA base. Begin with a lambda value of 8 and penalty factors of unity and use tolerance of 0.02. (10 points)

P.T.O

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c) Compare between fuel cells and photovoltaic as two sources of electric energy regarding: principle of operation, advantages and disadvantages. (10 points)

Good Luck

Course Examination Committee

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Dr. Mohamed Abo El Azm
Dr. Fayza Safan
Prof. Kamal Shebl

Course Coordinator: Dr. Ahmed Refaat

Tanta University

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

Faculty of Engineering

Course Title: Energy Conversion	Course Code: EPM2143	Year: 2rd Computer and Control Engineering
Date: Jan. 23rd 2010 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

Remarks: (answer the following questions… assume any missing data… answers should be supported by sketches if possible)

Question number (1) **(16 Marks)**

a) A single-phase, 100 KVA, 1000/100 V transformer gave the following test results:
Open circuit test: 100 V, 6 A, 400 W
Short circuit test: 50 V, 100 A, 1800 W
(i) **Derive** an approximate equivalent circuit referred to the high voltage side
(ii) **Determine** the voltage regulation at full load, 0.8 leading power factor
(iii) **Draw** the phasor diagram for condition (ii) (11 Marks)

b) **Write down** the energy balance equation for the motor mode. **Prove** that the motion and current changes ($d\theta$ and di respectively) affect the flow of the electrical energy. (5 Marks)

Question number (2) **(14 Marks)**

a) **Summarize**, aiding with appropriate drawing(s), the conditions for build-up voltage of a shunt generator. (3 Marks)

b) **Draw** the external characteristics (i.e the relation between the terminal voltage and the load current) of different types of dc generators. (3 Marks)

c) A 4-pole, 220-V shunt dc motor has 500 lap-wound conductors. It takes 30-A from the supply. The field winding resistance is 110 Ω and the armature resistance is 0.1 Ω. The flux per pole is 30 mWb. **Calculate the following**:
(i) The motor speed (ii) The developed torque (iii) The developed power in HP (8 Marks)

Question number (3) **(14 Marks)**

a) **Define** the synchronous speed. **Show how** the direction of this speed can be determined and reversed. (3 Marks)

b) **How** does the increase in the rotor resistance affect the breakdown slip, the starting torque, the breakdown torque? **Illustrate** your answer with suitable drawing(s). (3 Marks)

c) A three-phase, 460-V, 50-Hz, 4-pole, star connected wound-rotor induction motor has the following equivalent circuit parameters: R_1=0.2 Ω, R_2=0.25 Ω, X_1=X_2=1.1 Ω, X_m=34 Ω. **Determine the following:**
(i) The starting torque
(ii) The breakdown torque, the speed at which it occurs and corresponding power
(iii) The external resistance required in each phase of the rotor circuit such that the maximum torque occurs at starting (8 Marks)

P.T.O.

Question number (4) **(12 Marks)**

a) **Write down** the conditions for connecting two synchronous generators in parallel. (2 Marks)

b) A three-phase, 10-KVA, 460-V, 50-Hz, 4-pole, star connected synchronous machine has a negligible stator winding resistance and a synchronous reactance of 10 ohms per phase at rated terminal voltage. The machine is first operated as a generator in parallel with a three-phase, 460-V, 50-Hz power supply.

(i) **Determine** the excitation voltage and power angle when the machine is delivering rated KVA at 0.8 PF lagging. **Draw** the phasor diagram for this condition.

(ii) With the field current as in (i) the prime mover is slowly increased. **Determine** the maximum power the generator can supply. **What** are the corresponding values of stator current and power factor? (10 Marks)

Question number (5) **(14 Marks)**

a) A 220-V, 50 Hz, 1 HP universal motor runs at 3000 rpm and takes 1-A when connected to a 220-V dc source. **Determine** the speed and the power factor of the motor when it is connected to a 220-V, 50-Hz supply and is loaded to take 1-A (rms) of current. The motor resistance and inductance are 10 Ω and 0.2 H respectively. (3 Marks)

b) A four phase (stator poles) permanent magnet stepper motor has two rotor poles.

(i) **Explain briefly** the principle of operation of this motor

(ii) **Determine** the sequence of excitation for **90° step and 45° step** (4 Marks)

c) Aiding with the double revolving field theory, **Show why** a single phase induction motor can not start by itself. **Explain briefly** how this motor can start. **Illustrate** your answer with suitable drawing(s). (4 Marks)

d) **Give short notes** on the following:

(i) Reluctance motors

(ii) Servo motors (3 Marks)

WITH MY BEST WISHES

Dr. Said M. Allam