M.Tech. (PEPS) Sem I
Advanced Power Electronics.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(A Government Aided Autonomous Institute)

End Semester Exam **November 2015**

Total Marks: **100** Duration: **3 Hour**
CLASS: **M.Tech . (PEPS)** **Semester: I** Program: **M. Tech**

Name of the Course: **Advanced Power Electronics** Course Code: **MTPX 111**

- Question no.1 is compulsory
- Attempt any **FOUR** question out of **SIX** questions
- Answers to all sub questions should be grouped together
- Figures to the right indicate full marks
- **Assume suitable data if necessary and justify the same.**

Master file.

Q.1. Explain the following in brief. **(20)**

a) What is the effect of switching frequency on the operation of inverter?
b) As firing angle increases, the rectifier consumes reactive power, justify the statement in brief.
c) What are the advantages of space vector modulation over sine-triangle PWM for the control of three phase inverter.
d) Compare buck, boost and buck-boost regulator.

Q.2a) For three phase, full wave controlled rectifier, draw the waveform of instantaneous output voltage and instantaneous voltage across any one thyristor for:
firing angle, α=120 degree and overlap angle, μ=30 degree **(15)**
Note: Use graph paper

b) What are the issues of line commutated rectifiers. **(05)**

Q.3a) Prove that the six active vectors in VSI occupies the six vertices of hexagon. What should be the maximum magnitude of space vector so that the locus of space vector synthesized using space vector modulation technique (SVM) is a circle. What will be the corresponding magnitudes of line and phase voltages. **(10+02+03)**

b) A three phase Induction Motor with rating 400V and 50 Hz is connected to the constant torque load with variable speed. The available source is 200V dc. Suggest the suitable power electronics converter circuits. **(05)**

Q.4a) What is ac voltage regulator. Explain the application where ac voltage regulators are used. Draw the load voltage and load current waveform for RL load. Discuss the limitation of this converter for the control of output voltage. **(14)**

M.Tech. (PEPS) Sem I.

Advanced Power Electronics. Dt. 19/11/15

b) The separately excited dc motor is used in speed reversible electrical drive. Suggest the suitable power electronics converter for the four quadrant operation of a drive and draw the diagram. Show the four quadrants of drive (quadrants showing voltage and current).

(02+02+02)

Q.5a) The three phase inverter is operating in square wave mode. Draw the three phase voltages and line current waveform of any one phase when the three phase inverter supplies star connected RL load. What is the harmonic spectrum in the output voltage? **(12)**

b) In space vector modulation PWM technique, explain how the voltage space vector is synthesized. Derive the expression for the T1, T2 and Tz. Discuss the application of voltage vectors in one sampling period. **(08)**

Q.6a) Draw the output voltage and current waveform when a single phase full bridge inverter is feeding:
(i) RL load
(ii) RLC load ($X_C > X_L$)
Comment on the requirement of devices used in inverter for the above loads. **(10)**

b) A three phase fully controlled bridge rectifier is fed with 400 V, 50 Hz supply. The source inductance is 10 mH per phase. Calculate the average dc voltage of the bridge when the load current is 100 A and firing angle alpha is 60 degrees. (Assume load current is continuous and constant). **(06)**

c) For boost converter, draw the inductor current and capacitor voltage waveform for the continuous conduction case. **(04)**

Q.7a) Explain the operation of single phase full wave half controlled rectifier with R-L-E load. Draw the output voltage and source current waveform. Derive the expression for average output voltage.
Assume load current is continuous and constant. **(08)**

b) What are the advantages of switched mode rectifier **(SMR).** Explain the operation of single switch SMR. Draw the waveform of source current and load voltage. **(12)**

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M.Tech. (PE&PS) Sem I · Dt. 26/11/15
Dynamics of Linear Systems.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam

November 2015

Max. Marks: **100** Duration: **4 Hrs.**

Class: **M.Tech** Semester: **I** Program: **Power Electronics & Power System**

Name of the Course: **Dynamics of Linear Systems** Course Code : **MTPX114**

Instructions:

Master file.

1. **Question No 1 is compulsory.**
2. Attempt any **four** questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Question No		Maximum Marks
Q1	Answer any **FOUR** of the following.	
(a)	State the properties of State Transition Matrix.	05M
(b)	Explain the need of compensator.	05M
(c)	Explain the effect of pole-zero cancellation in Transfer Function.	05M
(d)	Differentiate between modern control approach & classical control approach.	05M
(e)	Explain norms of vectors and matrices in detail.	05M
Q2(a)	Find the transfer function for the following SSM: $\dot{x}_1 = -3x_3$ $\dot{x}_2 = x_1 - 6x_3 + u$ $\dot{x}_3 = x_2 - 7x_3$	10M
(b)	Explain of Discretization of Continuous Time State System.	05M
(c)	State & Prove Lyapunov criterion for stability	05M
Q3(a)	Determine SSM for following MIMO system for which equations are given as : $\dot{y}_1 + 3\dot{y}_2 + y_2 = 2u_1 + 3u_2$ $\ddot{y}_1 + 6\dot{y}_2 = 60u_1 - 30u_2$	10M
(b)	Explain separation principle of Observer Design.	05M
(c)	State & Prove Cayley-Hamilton Theorem.	05M
Q4(a)	Find STM $\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x$	10M
(b)	Explain the Pole Placement Design for Controller in MIMO System.	05M

(1)

M.Tech. (P.E. & P.S.) Sem I.

Dynamics of Linear systems Dt. 26/11/15

(c) Explain the need for observer. 05M

Q5(a) Given below is system TF . Develop SSM for given transfer function . 08M

$$T.F.=\frac{(s+3)}{(s+5)(s+6)}$$

Represent in

i) Controllable Phase Variable Form
ii) Observable Phase Variable Form
iii) Controllable Canonic Variable Form
iv) Observable Canonic Variable Form

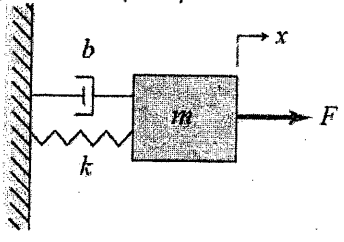
(b) Consider SSM 12M

$$\dot{x} = \begin{bmatrix} 2 & 0 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = [1 \quad -1]\, x$$

Design state feedback controller so that closed loop poles are at $s = -1 \pm j$.

Q6(a) Develop SSM for spring mass damper system. 06M



(b) Consider 14M

$$T.F.=\frac{(s+7)}{s(s+5)(s+3)}$$

Determine SSM in controllable phase variable form so that error poles have a peak overshoot at 16 % and settling time of 4 sec. Use Transformation Method.

Q7(a) Develop Lead Compensator if plant TF 14M

$$G_{plant}(s)=\frac{K}{s(s+2)}$$

To meet following specification :

i) $K_v = 20$
ii) $PM > 50^\circ$
iii) GM > 10 db

(b) Discuss lag compensator design procedure using Bode plot Technique. 6M

(2)

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M.Tech. Elect. Sem I.
Modeling & Analysis of Electrical Machines.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam
November 2015

Max. Marks: 100 Duration: 4 Hours
Class: M.Tech. Semester: I Program: Electrical
Name of the Course: Modeling and Analysis of Electrical Machines

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Master file.

Q.1.a) Explain the phenomenon of Rotating MMF from the below given equation. **(07)**

$$\mathbf{MMF}_s = \left(\frac{N_s}{2}\right)\sqrt{2}I_s\left(\frac{3}{2}\right)\cos\left[\omega_e t + \theta_{ei}(0) - \phi_s\right]$$

Q. 1. b) Derive the relationship of variables between one reference frame rotating at ω_x and another at ω_y. **(07)**

Q.1.c) Explain the advantages of dynamic models of electrical machines. **(06)**

Q. 2 a) Explain the energy conversion principal graphically. **(10)**

Q. 2 b) Derive an expression for the electromagnetic torque of the elementary rotational device as shown in **Fig. 1.** This device consists of two conductors. Conductor 1 is placed on the stationary member and conductor 2 is placed on rotor. **(10)**

M.Tech. Elect. Sem I. Dt. 24/11/15

Modeling & Analysis of Electrical Machines.

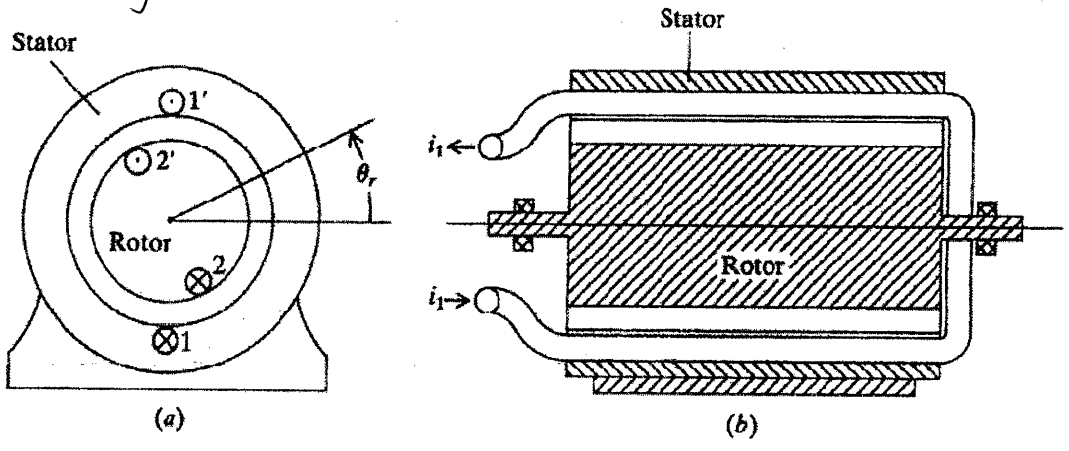

Fig. 1

Q. 3. a) The transformation for the a 2-phase set to the arbitrary reference frame is **(10)**

$$\mathbf{f}_{qds} = \mathbf{K}_{2s}\mathbf{f}_{abs}$$

where

$$(\mathbf{f}_{qds})^T = [f_{qs} \quad f_{ds}]$$
$$(\mathbf{f}_{abs})^T = [f_{as} \quad f_{bs}]$$
$$\mathbf{K}_{2s} = \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix}$$

1) Determine $[K_{2s}]^{-1}$

2) Depict the transformation in vector diagram.

(2)

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M.Tech. Elect. Sem I Dt. 24/11/15

Modeling & Analysis of Electrical Machines.

Q.3. b) For the diagram shown in **Fig. 2,** draw the resultant axis of windings. Prove the same by considering appropriate vectors of individual coils. **(10)**

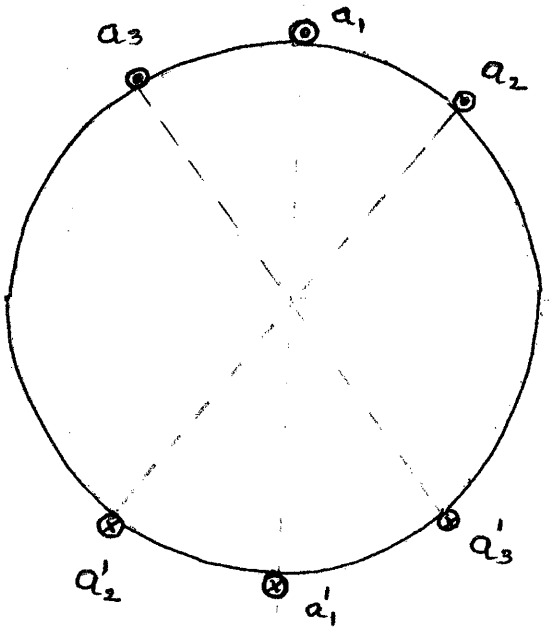

Fig. 2

Q.4) For the arrangment shown in **Fig.3**, derive the expression for voltage equations expresed in terms of machine variables referred to the stator windings. **(14)**

Also derive the torque eauation for the same arrangement. **(06)**

Q.5) Derive the dynamic model of Induction Machine in arbitrary referrnece frame in terms of current as variables. Also draw the equivalent circuit. **(20)**

Q.6) For the arrangment shown in **Fig.3**, derive the expression for voltage equations expresed in terms of machine variables referred to the stator windings. **(14)**

Also derive the torque eauation for the same arrangement. **(06)**

Q7) a) Explain the steady state and dyanamic torque-speed characteristics of induction machines. Use appropriate figures for explanation **(10)**

M.Tech. Elect. Sem I. Dt. 24/11/15

Modeling & Analysis of Electrical Machines.

Q7) b) Explain the need of sinusoidal distributed winding. Draw MMF distribution in space.

(10)

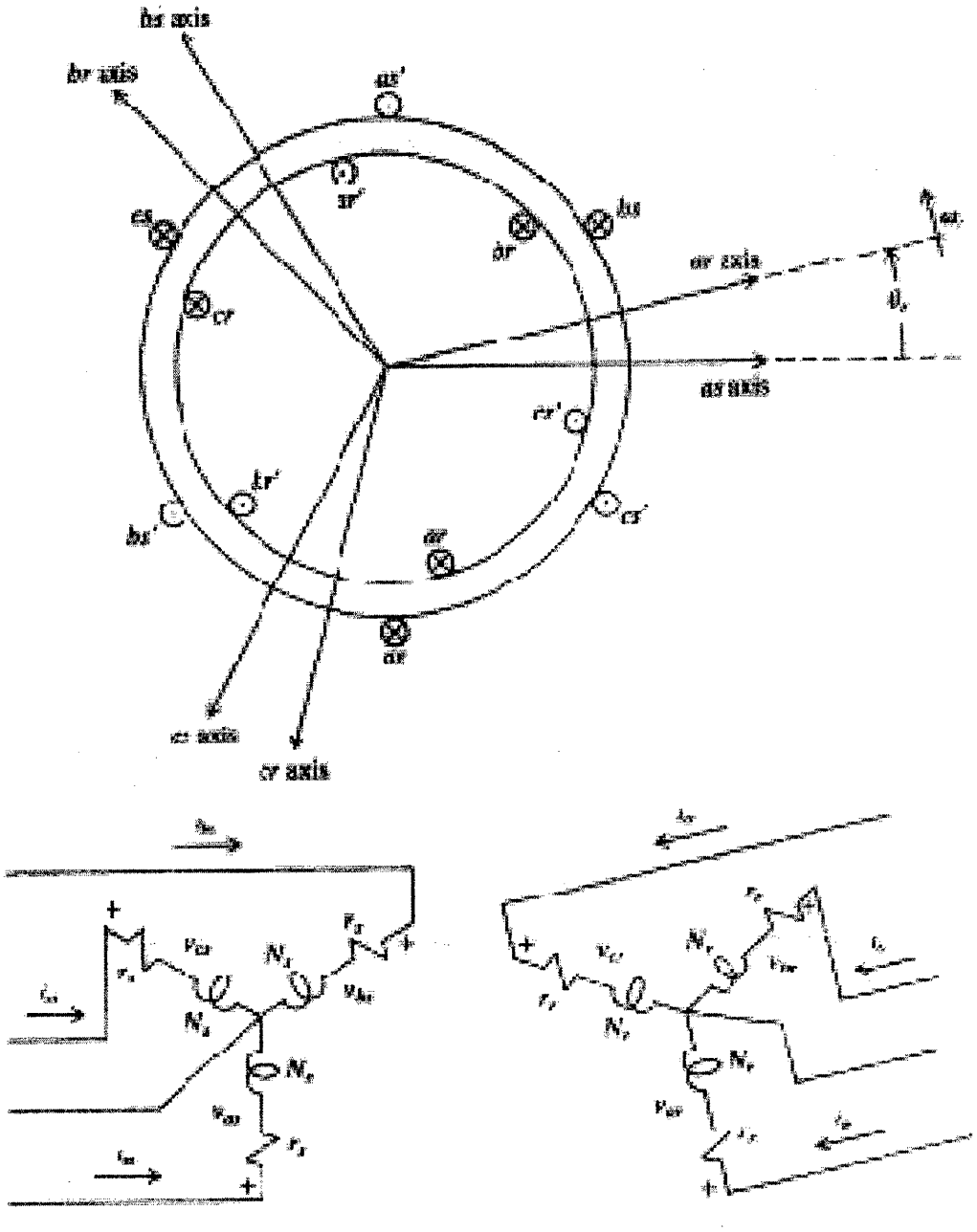

Fig.3

4

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M.Tech. Elect. sem I. Dt. 24/11/15

Modeling & Analysis of Electrical Machines.

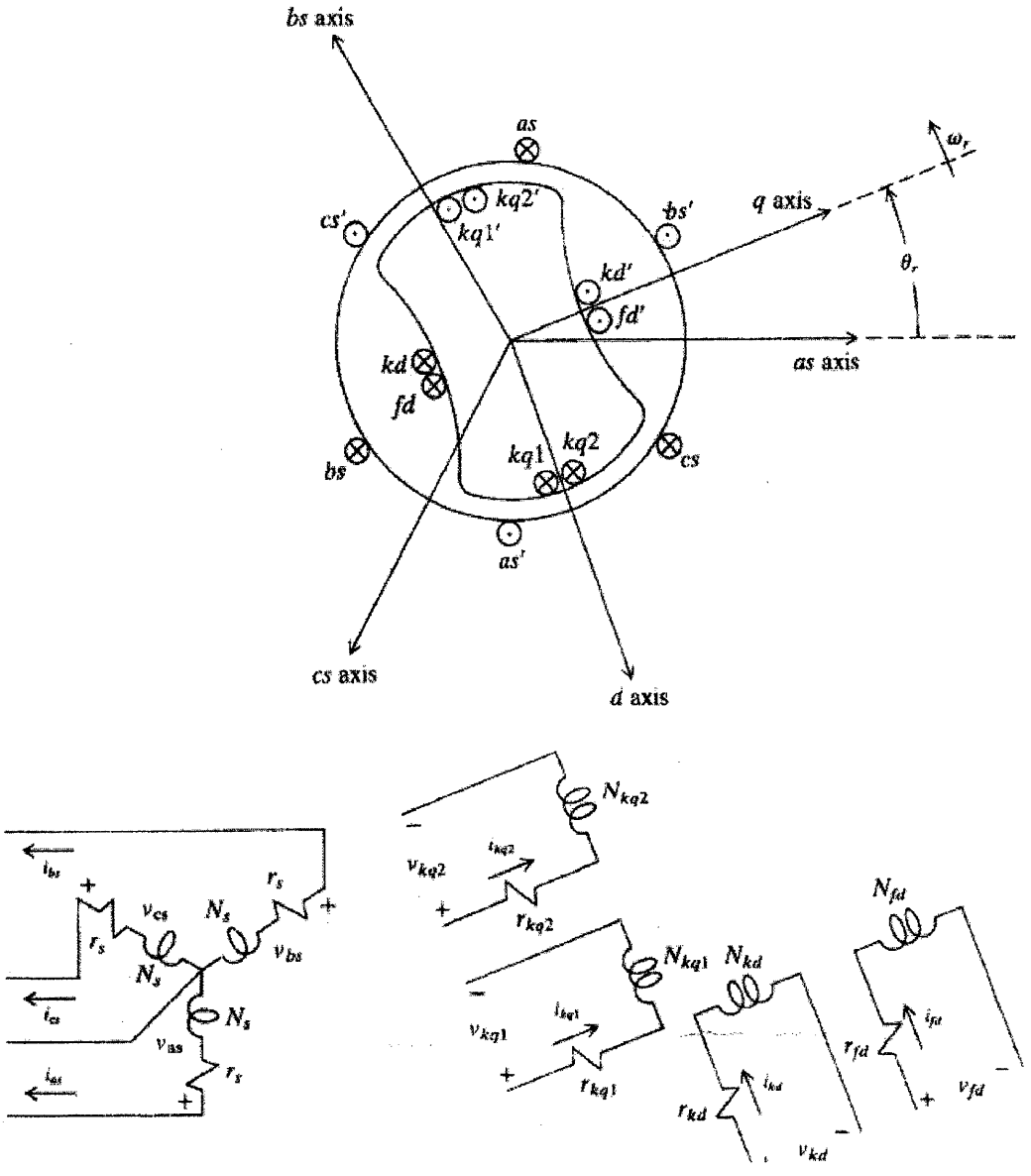

Fig.4

5

5/5

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28/11/2015

M.Tech. (PEPS) Sem I.
Power system planning & Reliability.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam

November 2015

Max. Marks: 100 Duration: 4 Hours

Class: M. TECH. (PEPS) Semester: I Program: M.TECH.

Name of the Course: Power System Planning and Reliability (PSPR)

Course Code : MTPX117

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Master file.

Question No.		Maximum Marks
Q1(a)	Give a brief description on bathtub curve. What exactly bathtub curve identify?	05
(b)	Define reliability and availability of the power system.	05
(c)	Explain the load forecast uncertainty in case of spinning generating capacity reliability evaluation.	05
(d)	Explain the frequency and duration method for transmission system reliability evaluation.	05
Q2(a)	What do you really understand about Reactive Power Planning? What all are the objective optimization problem in Reactive Power Planning?	10
(b)	Write in brief about Transmission Network Planning, what are the parameters which should be taken into consideration for making plan for transmission network?	10
Q3(a)	What is series parallel component in reliability analysis? Write down all aspects about series component, parallel component, and series parallel component.	10
(b)	The circuit shown in the Figure 1, is made of 12 components. Derive the general expression for the reliability of the model and hence evaluate the system reliability as well as unreliability if all components are having reliability of 0.96?	10

M.Tech. (PEPS) Sem I.

Power System Planning & Reliability. (PSPR) Dt. 28/11/15

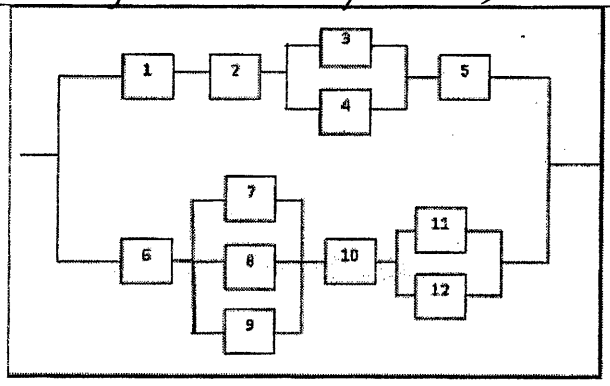


Figure 1.

Q4(a)	What does the term reliability symbolize about? Why it's been calculated. What do you understand by the term power system reliability?	10
(b)	What do you understand by the term planning? Why it is necessary to do power system planning? What are the areas where planning is necessary? Write in brief about whether sensitive and non-whether sensitive load forecasting.	10
Q5(a)	Derive the expression for probability associated with derated capacity levels. Draw the modified state space diagram for a unit with one derated state and hence modify the expression.	10
(b)	Explain about the data requirements for composite system reliability evaluation.	10
Q6(a)	A power system contains the following generating capacity. 3 x 40 MW Hydro units FOR = 0.005 1 x 50 MW Thermal unit FOR = 0.02 1 x 60 MW Thermal unit FOR = 0.02 The annual daily peak load variation curve is given by a straight line from the 100% to the 40% points. (a) Calculate the loss of load expectation for the 190 MW and 200 MW peak load values. (b) Calculate the loss of load expectation for 250 MW and 260 MW peak load values, given that another 60 MW thermal unit with a FOR of 0.02 is added to the system.	10
(b)	State and describe the different system and load point indices for composite generation and transmission system.	10
Q7(a)	Explain the average interruption rate method for transmission system reliability evaluation with suitable hypothetical system example.	10
(b)	Explain a recursive algorithm for generating capacity model building and calculate the system capacity outage probability sequentially for the case of no derated states. The required system data is as given in following table. Each unit in table has an availability and unavailability of 0.98 and 0.02 respectively.	10

Unit No.	Capacity (MW)	Failure Rate (*f*/day)	Repair Rate (*r*/day)
1	25	0.01	0.49
2	25	0.01	0.49
3	50	0.01	0.49

M-Tech. Elect - Sem I
Protection in Power System.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058.

End Semester Exam

November 2015

Max. Marks: 100 Duration: 4 Hours

Class: M.Tech. (Electrical) Semester: I

Name of the Course: **Protection in Power System**

Course Code : MTPX 112

Instructions:

1. Question No. 1 is **compulsory**.
2. Attempt any four questions out of remaining six.
3. Answers to all sub-questions should be grouped together.
4. Draw neat diagrams and assume suitable data if necessary.

Master file.

Ques. No.		Max.Marks
Q 1. (a)	Define/describe the following relay terminology: (i) IDMT relay (ii) Reset time (iii) MHO relay (iv) Back-up protection	4
(b)	Draw the block diagram of a static relay with time delay. Describe the working of the same.	6
(c)	Describe the duality between amplitude and phase comparators used in static relays.	10
Q 2. (a)	What are the advantages and limitations of microprocessor based relays over static relays and electromagnetic relays?	5
(b)	Describe SCADA architecture, its features and functioning with neat block diagrams.	15
Q 3. (a)	Describe the functioning of Intel-8255 interfacing device.	10
(b)	Explain the complete working of circulating current type and opposed voltage type wire pilot relays. Support with respective diagrams.	10
Q 4. (a)	With an interfacing diagram and flowchart explain microprocessor based impedance relay or directional relay. (Explain any one out of the two types).	10
(b)	Discuss synthesis and working of reactance relays using static comparators.	10
Q 5.	Classify, draw and describe the types of amplitude and phase comparators used in static relays. (Except vector product type comparators).	20
Q 6. (a)	Explain the concept of back-up protection.	7
(b)	List the advantages of static relays over electromagnetic relays.	6
(c)	Describe the types of faults in power systems.	7
Q 7. (a)	Describe the concept of zones of protection.	5
(b)	What are the essential qualities of protection?	5
(c)	Describe the working and diagrams of induction disc type relays.	10

Library
6/1/16

M.Tech. (Elect) Sem I - Dt. 06/01/16.
Modeling & Analysis of Electrical Machines.

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)
Munshi Nagar, Andheri (West), Mumbai – 400058.

Re Exam
Jan. 2016

Max. Marks: 100 Duration: 4 Hours

Class: M.Tech. Semester: I Program: Electrical

Name of the Course: Modeling and Analysis of Electrical Machines

Instructions:

1. Question No 1 is compulsory.
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Master file.

Q.1.a) Explain the phenomenon of Rotating MMF from the below given equation. **(06)**

$$\mathrm{MMF}_s = \left(\frac{N_s}{2}\right)\sqrt{2}I_s\left(\frac{3}{2}\right)\cos\left[\omega_e t + \theta_{ei}(0) - \phi_s\right]$$

Q. 1. b) Derive the arbitrary reference frame equivalent circuits for 3 phase RL circuit. Draw the equivalent circuit. **(10)**

Q.1.c) Explain the advantages of dynamic models of electrical machines. **(04)**

Q. 2 a) Consider,

$$f_{as} = \cos t \qquad f_{bs} = \frac{1}{2}t \qquad f_{cs} = -\sin t$$

Resolve f_{as}, f_{bs} and f_{cs} into f_{ds} and f_{qs} for $t = \frac{\pi}{3}s$ and $\theta = \frac{\pi}{4}rad.$ and show these resolved quantities clearly into vector diagrams. **(10)**

M.Tech. (Elect) Sem I Dt. 06/01/16.
Modeling & Analysis of Electrical Machines.

Q. 2 b) Derive an expression for the electromagnetic torque of the elementary rotational device as shown in **Fig. 1.** This device consists of two conductors. Conductor 1 is placed on the stationary member and conductor 2 is placed on rotor.

(10)

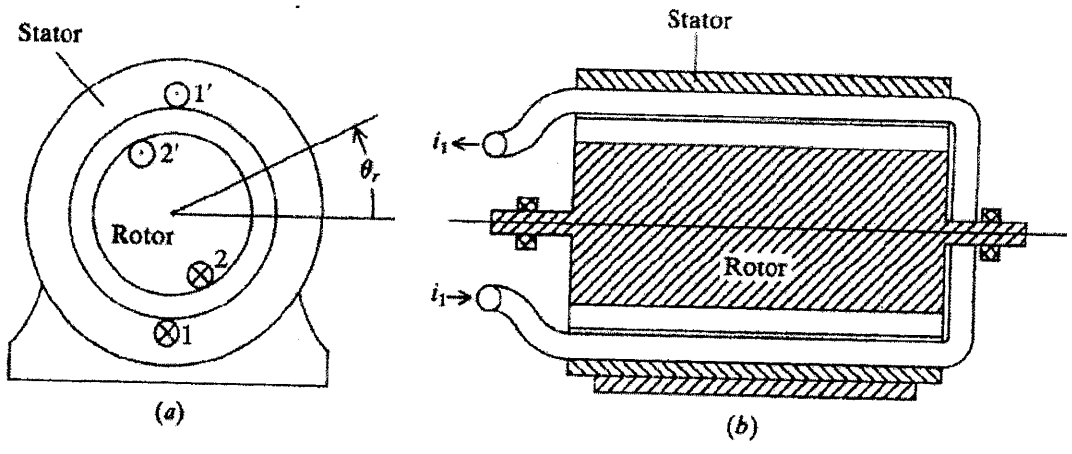


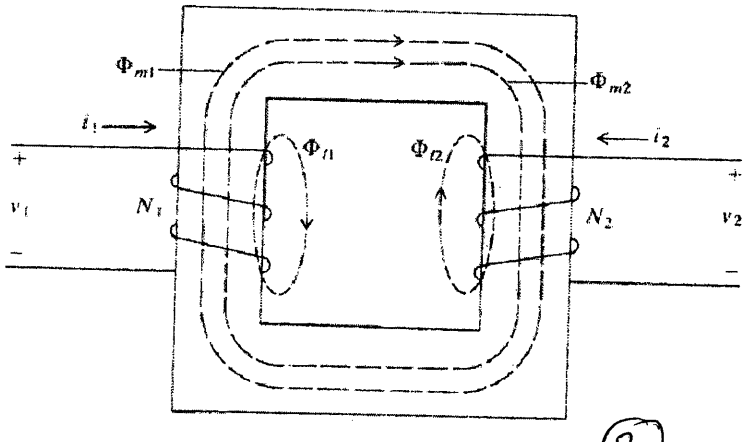
Fig. 1

Q. 3. a) Show that in synchronously rotating reference frame constant amplitude balanced set will appear as constants.

(10)

Q.3. b) Derive an equivalent circuit for the figure shown in **Fig. 2** with coil 1 selected as reference.

(10)



(2)

Fig. 2

M.Tech. (Elect) Sem I - Dt. 06/01/16.
Modeling & Analysis of Electrical Machines.

Q.4) For winding arrangment the **Fig.3** which is elemintary 3 phase 2 pole wye-connected synchronous machine derive the relations for inductances, voltage equations and flux linkages. **(20)**

Q.5) Derive the dynamic model of Induction Machine in arbitrary referrnece frame in terms of flux linkages as variables. Also draw the equivalent circuit. **(20)**

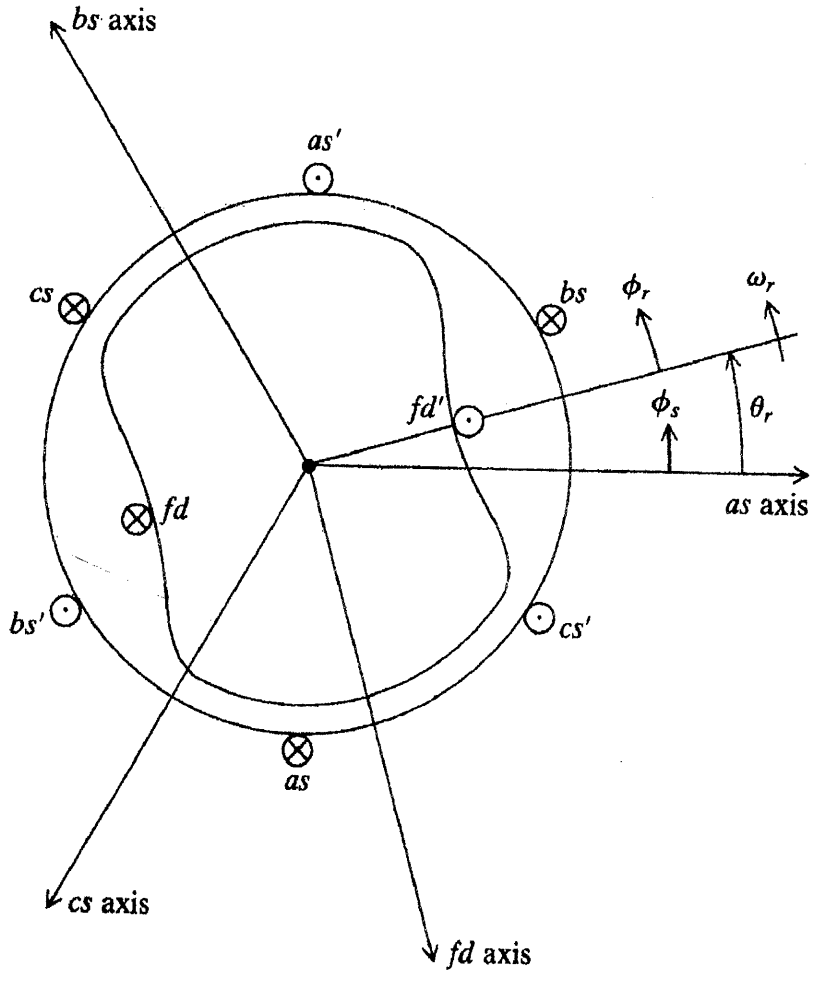
Q.6) For the arrangment shown in **Fig.4**, derive the expression for voltage equations expresed in terms of machine variables referred to the stator windings. **(14)**

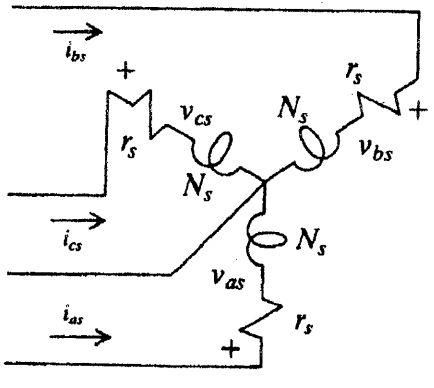
Also derive the torque eauation for the same arrangement. **(06)**

Q7) a) Explain the steady state and dyanamic torque-speed characteristics of induction machines. Use appropriate figures for explanation **(10)**

Q7) b) Explain the need of sinusoidal distributed winding. Draw MMF distribution in space. **(10)**

M.Tech. (Elect) Sem I - D7 · 06/01/16.
Modeling & Analysis of Electrical Machines.





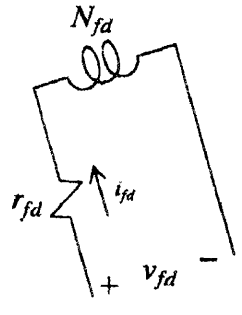


Fig.3

M.Tech.(Elect) sem I. Dt-06/01/16.
Modeling & Analysis of Electrical Machines.

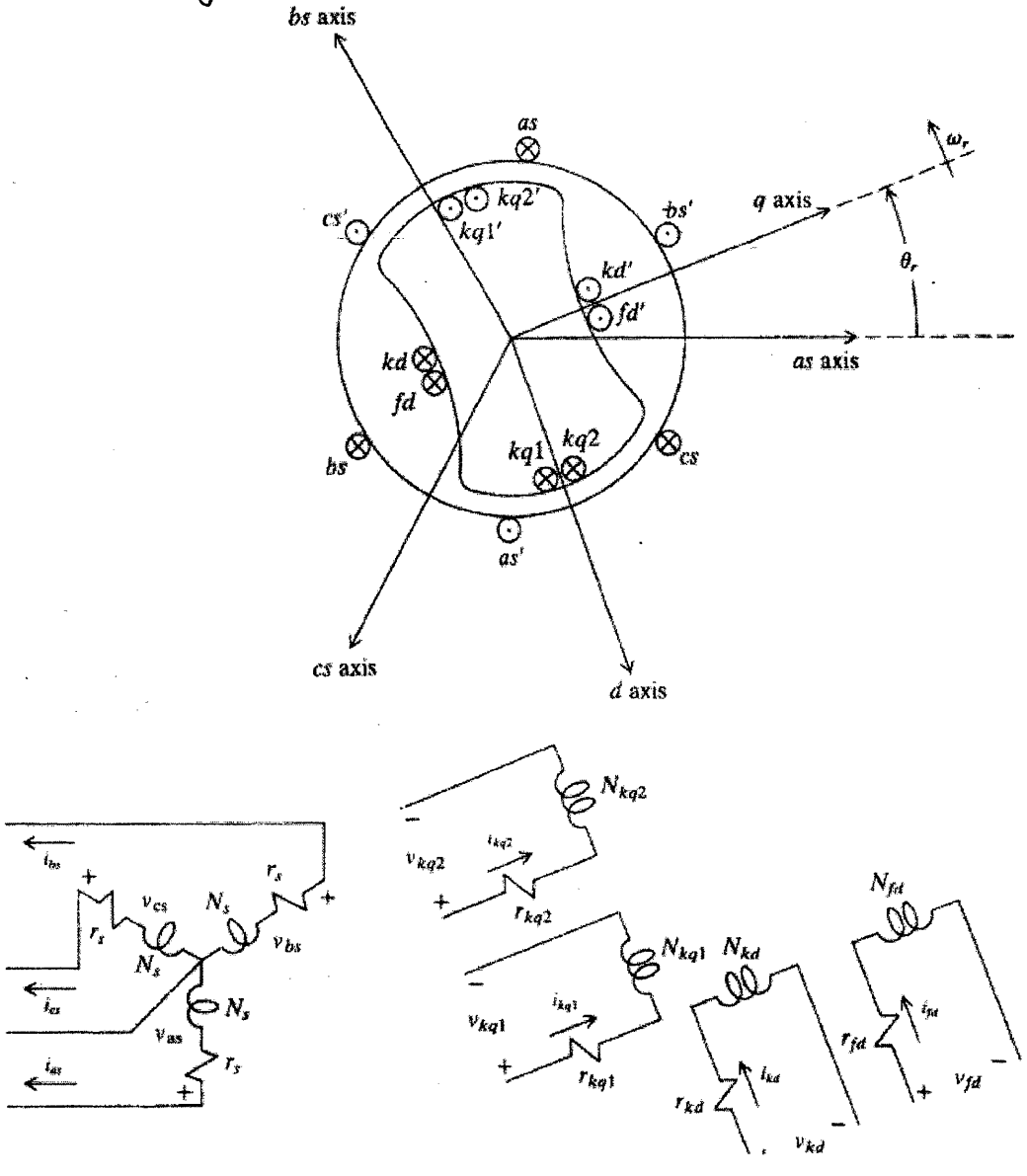


Fig.4

M.Tech. (PEPS) Sem I.
Advanced Power Electronics. Dt-04/01/16.

Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institute)

Re-Examination
January- 2016

Total Marks: **100**
CLASS: **M.Tech . (PEPS)** **Semester: I**
Name of the Course: **Advanced Power Electronics**

Duration: **4 Hour**
Program: **M. Tech**
Course Code: **MTPX 111**

- Question no.1 is compulsory
- Attempt any **FOUR** question out of **SIX** questions
- Answers to all sub questions should be grouped together
- Figures to the right indicate full marks
- **Assume suitable data if necessary and justify the same.**

Master file.

Q.1. Explain the following in brief. **(20)**

a) Compare half bridge and full bridge inverter in brief?
b) As firing angle increases, the rectifier consumes reactive power, justify the statement in brief.
c) What are the advantages of PWM control of three phase inverter.
d) Compare buck, boost and buck-boost regulator.

Q.2a) For three phase, full wave controlled rectifier, draw the waveform of instantaneous output voltage and instantaneous voltage across any one thyristor for:
firing angle, α=30 degree and overlap angle, μ=30 degree **(15)**
Note: Use graph paper

b) As the no. of pulses in the output of rectifier increases, the harmonic spectrum in the output voltage and input current improves. Justify the statement. **(05)**

Q.3a) Prove that the six active vectors in VSI occupies the six vertices of hexagon. What should be the maximum magnitude of space vector so that the locus of space vector synthesized using space vector modulation technique (SVM) is a circle. What will be the corresponding magnitudes of line and phase voltages. **(10+02+03)**

b) A three phase Induction Motor with rating 400V and 50 Hz is connected to the constant torque load with variable speed. The available source is 200V dc. Suggest the suitable power electronics converter circuits. **(05)**

Q.4a) What is ac voltage regulator. Explain the application where ac voltage regulators are used. Draw the load voltage and load current waveform for RL load. Discuss the limitation of this converter for the control of output voltage. **(14)**

b) The separately excited dc motor is used in speed reversible electrical drive. Suggest the suitable power electronics converter for the four quadrant operation of a drive and draw the diagram. Show the four quadrants of drive (quadrants showing voltage and current).

(02+02+02)

Q.5a) The three phase inverter is operating in square wave mode. Draw the three phase voltages and line current waveform of any one phase when the three phase inverter supplies star connected RL load. What is the harmonic spectrum in the output voltage? **(12)**

b) In space vector modulation PWM technique, explain how the voltage space vector is synthesized. Derive the expression for the T1, T2 and Tz. Discuss the application of voltage vectors in one sampling period. **(08)**

Q.6a) Derive the average output voltage for three phase rectifier considering the source inductance Lc H/phase. **(16)**

c) For boost converter, draw the inductor current and capacitor voltage waveform for the continuous conduction case. **(04)**

Q.7a) Explain the operation of single phase full wave half controlled rectifier with R-L-E load. Draw the output voltage and source current waveform. Derive the expression for average output voltage.
Assume load current is continuous and constant. **(08)**

b) What are the advantages of switched mode rectifier **(SMR).** Explain the operation of single switch SMR. Draw the waveform of source current and load voltage. **(12)**