INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad -500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	**POWER ELECTRONIC CONTROL OF AC DRIVES**
Course Code	:	BPE004
Class	:	M. Tech II Semester
Branch	:	Electrical and Electronics Engineering (power electronics and electrical drives)
Year	:	2016– 2017
Course Faculty	:	S. Srikanth, Assistant Professor

OBJECTIVES

This course should enable the students to:

I. Understand various converters used in AC drives.
II. Distinguish the speed control of induction motors with various power electronics converters.
III. Understand the speed control of synchronous motors with various power electronics converters.
IV. Apply the knowledge of reluctance motor drives.

S. No	Question	Blooms Taxonomy Level	Course Outcome
	UNIT -1 **INDUCTION MOTOR DRIVES**		
Group-1 SHORT ANSWER QUESTIONS			
1	What are advantages of induction motor?	Remember	1
2	What are the applications of slip ring induction motor?	Remember	1
3	Define rotor current frequency	Create	1
4	Draw the equivalent circuit of an induction motor	Understand	1
5	What are the advantages of variable frequency control?	Understand	1
6	What are the disadvantages of variable frequency control?	Understand	1
7	What are the limitations of v/f control?	Remember	1
8	What is constant torque mode operation?	Remember	1
9	Draw the speed torque characteristics of induction motor	Remember	1
10	Define slip speed control	Remember	1
11	Define starting torque write the expression for starting torque.	Remember	1
12	Define maximum torque write the expression for maximum torque.	Remember	1
13	Define running torque and write the expression for running torque.	Remember	1
14	Write the expression for slip at maximum torque	Remember	1
Group – II LONG ASNWERS QUASTIONS			
1	Explain torque production in an induction motor.	Remember & Understand	1
2	Explain induction motor characteristics in constant torque and field weakening regions.	Understand	1

S. No	Question	Blooms Taxonomy Level	Course Outcome
3	Explain speed torque characteristics with variable voltage operation, variable frequency operation, constant v/f operation and variable stator current operation.	Understand	1
4	Sketch the mechanical characteristics of a there phase induction motor with V/f method	Evaluate	1
5	A three phase SCIM drives a blower type load. No load rotational losses are negligible. Show that rotor current is maximum when the motor runs at a slip of 1/3. Find also an expression for maximum rotor current	Understand	1
6	What happens to the performance of AC motor if the stator voltage control technique is adopted with frequency being constant	Understand	1
7	Explain the speed torque characteristics in constant torue and fiel weakening region	Understand	1
8	Explain the induction motor characteristics with variable stator current operation	Remember	1
9	A 3-ph 20KW, 4-pole, 50Hz, 400V delta connected induction motor has the following parameters per phase R1=0.6 ohm, R2=0.4 ohm, X1=X2=1.6 ohm. If magnetizing reactance is neglected and operated at 200V, 25Hz with DOL starting. Calculate the current and power factor at the instant of starting and under the maximum torque conditions. Compare the results	Understand	1
10	A three phase squirrel cage induction motor is developing torque of 1500 synchronous watts at 50 Hz and 1440 rpm (synchronous speed is 1500 rpm). If the motor frequency is increased to 75Hz using constant power mode, determine the new value of torque developed by the motor at constant slip.	Remember	1
UNIT – II **STATOR SIDE CONTROL OF INDUCTION MOTOR DRIVES**			
Group-1 SHORT ANSWER QUESTIONS			
1	Draw the speed torque characteristics with variable voltage.	Remember	2
2	What is the importance of v/f control?	Understand	2
3	Draw the speed torque characteristics with change in v/f values.	Understand	2
4	What are the applications of variable frequency drives?	Remember	2
5	What are the advantages of current controlled voltage fed inverter drive?	Remember	2
6	What are the advantages of voltage controlled voltage fed inverter drive?	Remember	2
7	Define slip regulation	Remember	2
8	List the disadvantages of v/f control	Remember	2
9	What are the differences between VSI and CSI?	Remember	2
10	List the converters used for the control of induction motor through stator side.	Understand	2
Group – II LONG ASNWERS QUASTIONS			
1	Explain the operation of these phase voltage source inverter fed these induction motor drive with 1800 conduction with the help of circuit diagram and waveforms. Also sketch speed-torque characteristics for sub-synchronous speeds?	Remember	2
2	Explain the operation of three-phase star-connected squirrel cage induction motor when fed from a three phase A.C. controllers for its starting and speed control purpose. Give neat circuit diagram, necessary waveforms and speed-torque characteristics.	Understand	2
3	Discuss in detail the current fed inverter control of induction motor drive.	Create	2

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4	Explain how speed and flux control in current fed inverter drive can be achieved by Volts / Hertz control.	Understand	2
5	Constant torque loads are not suitable for AC voltage controller fed induction motor drive. Why?	Understand	2
6	Using 3-phase solid state AC voltage controllers explain clearly how it is possible to achieve 4-quadrant operation of 3-phase induction motors	Remember	2
7	Draw a closed loop block diagram for the 4 quadrant operation of 3 induction motor speed control technique. Mention the merits of the above method of speed control	Understand	2
8	Explain the mechanical characteristics of a three phase induction motor with stator frequency control.	Understand	2
9	Explain how voltage and frequency are varied in voltage source inverter fed induction motor drives	Remember	2
10	In which way a static Kramer control is different from static scherbius drive	Remember	2
11	A 3-phase, 400V, 50Hz, 4-pole, 1440 rpm delta connected squirrel cage induction motor has a full load torque of 48.13 N-m. Motor speed is controlled by stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate the motor torque at 1200rpm.	Apply	2
12	A 400V, 50Hz, 3-phase squirrel cage induction motor develops full load torque at 1470 rpm. If supply voltage reduces to 340 V, with load torque remaining constant, calculate the motor speed. Assume speed–torque characteristics of the motor to be linear in the stable region. Neglect stator resistance.	Apply	2
13	At 50 Hz the synchronous speed and full load speed are 1500 rpm and 370 rpm respectively. Calculate the approximate value speed for a frequency of 30 Hz and 80% of full load torque for inverter fed induction motor drive.	Apply	2
14	A 440V, 50Hz, 6 pole star connected wound rotor motor has the following parameters. R_S=0.5 ohm, R'r=0.4 ohm, X_S=X_r'=1.2 ohm, Xm=50 ohm, stator to rotor turns ratio is 3.5. Motor is controlled by static rotor resistance control. External resistance is chosen such that the breakdown torque is produced at standstill for a duty ratio of zero. Calculate the value of external resistance. How duty ratio should be varied with speed so that the motor accelerates at maximum torque.	Apply	2
UNIT-III ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES Group-1 SHORT ANSWER QUESTIONS			
1	What are the different types of rotor resistances control in induction motor	Remember	3
2	What are the types of slip power recovery system	Remember	3
3	What are the advantages of Kramer system	Remember	3
4	What are the advantages of static scherbius drive	Remember	3
5	Define vector control in induction motor.	Remember	3
6	List the methods of vector control.	Remember	3
7	Compare direct and indirect methods of vector control	Understand	3

S. No	Question	Blooms Taxonomy Level	Course Outcome
8	Draw the speed torque characteristics of rotor resistances control	Remember	3
9	Define direct torque control in induction motor.	Remember	3
10	Define indirect torque control in induction motor.	Remember	3
Group – II LONG ASNWERS QUASTIONS			
1	Discuss the working of these phase slip-ling induction motor when static Scheribus scheme is employed for its speed control. Draw a neat circuit, speed-torque characteristics and being out salient features of this drive.	Remember	3
2	What is vector control with respect to induction motor? Explain the operation of induction motor when direct method of vector control is adopted.	Remember	3
3	Explain in detail different modes of operation of static scberibus drive.	Remember	3
4	Discuss in detail the following vector control methods of induction motor drive: a) Adaptive Control b) Self tuning regulator model reference control	Understand	3
5	Draw the speed-torque characteristics of a rotor resistance controlled induction motor and explain the effect of rotor resistance variation	Understand	3
6	Draw and explain closed loop operation for a static Kramer controlled drive	Remember	3
7	Explain the direct methods of vector control of induction motor.	Remember	3
8	Explain the indirect methods of vector control of induction motor.	Understand	3
9	Explain the principles of vector control.	Apply	3
10	**A** 440V, 50Hz, 6 pole, 970rpm star connected 3-ph wound rotor motor has the following parameters referred to stator. Rs=0.1 ohm, R'r=0.08 ohm, Xs=0.3 ohm, Xr'=0.4 ohm, stator to rotor turns ratio is 2. Motor speed is controlled by static scherbius drive. Drive is designed for a speed range of 25% below the synchronous speed. Max. value of firing angle 165 deg, calculate (i) transformer turns ratio, (ii) torque for a speed of 780rpm and α=140 deg.	Apply	3
UNIT-IV **CONTROL OF SYNCHRONOUS MOTOR DRIVES** **Group-1 SHORT ANSWER QUESTIONS**			
1	Write torque equation of synchronous motor	Remember	4
2	What are the different methods for variable frequency control in synchronous motor	Remember	4
3	What are the advantages of voltage source inverter	Remember	4
4	What are the advantages of current source inverter	Remember	4
5	What are the possible methods to provide variable voltage variable frequency to synchronous motor fed from VSI	Understand	4
6	What is square wave inverter	Understand	4
7	What is PWM inverter	Understand	4
8	What is chopper with square wave inverter	Remember	4
9	Define torque angle	Remember	4

S. No	Question	Blooms Taxonomy Level	Course Outcome
10	What is the advantage of constant margin angle control	Remember	4
11	What are the factors effecting speed of synchronous motor?	Remember	4
Group – II LONG ASNWERS QUASTIONS			
1	Discuss different control strategies of synchronous motor with reference to its characteristics.	Analyze	4
2	Explain in detail about operation of synchronous motor with neat diagram and also explain its characteristics.	Understand	4
3	Explain the designing and operation of maximum permissible torque speed control scheme with its implementation strategy	Understand	4
4	Draw the block diagram of a closed loop synchronous motor drive fed from VSI and explain	Understand	4
5	Describe self-controlled and a loop commutated inverter controlled synchronous motor drives in detail and compare them	Understand	4
6	Describe separate controlled mode and self-controlled mode of operation of a synchronous motor drive in detail and compare them	Understand	4
7	Explain i. constant torque angle control ii. unity power factor control	Remember	4
8	Describe the flux weakening algorithm with constant torque mode controller and flux weakening controller	Apply	4
9	A 6MW, 3-ph, 11KV,Y connected, 6 pole, 50Hz, 0.9(lead) pf synchronous motor has Xs=9ohm, Rs=0, rated field current is 50A. Machine is controlled by variable frequency control at constant V/F ratio upto the base speed and at constant V above base speed determine the Torque and field current for the rated armature current, 750rpm and 0.8 leading pf.	Remember	4
10	A3 phase, 400V, 50Hz, 6 pole, star connected round-rotor synchronous motor has Z_S=0+j2Ω. Load torque, proportional to speed squared, is 340N- m at rated synchronous speed. The speed of the motor is lowered by keeping V/f constant and maintaining unity Pf by field control of the motor. For the motor operation at 600rpm, calculate a) supply voltage b) armature current.	Apply	4
UNIT-V VARIABLE RELUCTANCE MOTOR DRIVE Group-1 SHORT ANSWER QUESTIONS			
1	Draw the reluctance motor speed torque characteristics	Remember	5
2	List the advantages of variable reluctance motor drive	Remember	5
3	List the applications of variable reluctance motor drive	Remember	5

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4	Explain the working principle of dc servo motor	Remember	5
5	Explain the working principle of brushless dc motor	Remember	5
6	List the applications of dc servo motor drive	Remember	5
7	Describe the control principles of variable reluctance motor	Remember	5
8	List the advantages of brushless DC motor drive	Understand	5
9	List the advantages of brushless DC motor drive	Understand	5
10	Explain the operation of variable reluctance motor drive.	Understand	5
Group – II LONG ASNWERS QUASTIONS			
1	Discuss the working of a three-phase BLDC motor drive when fed from voltage source inverter on closed loop operation. Draw neat circuit diagram.	Create	5
2	Write short notes on Variable reluctance motor drive.	Understand	5
3	Explain in detail torque production and operation of variable reluctance motor drive	Remember	5
4	Explain the operation and characteristics of current controlled brushless DC servo drives.	Understand	5
5	Describe the operation of current control in variable reluctance motor drive	Understand	5
6	Discuss the working of sinusoidal type of BLDC motor drive	Remember	5
7	Discuss the operation of current controlled BLDC motor drive	Understand	5
8	Explain the principle of operation of servo drive and its applications	Understand	5
9	Explain the control principles of variable reluctance motor	Remember	5
10	List the applications and advantages of dc servo motor drive	Understand	5

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