



INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	SOLID STATE ELECTRIC MOTOR DRIVES
Course Code	:	AEE013
Program	:	B. Tech
Semester	:	VI
Branch	:	Electrical and Electronics Engineering
Section	:	A & B
Course Faculty	:	Dr. B. Muralidhar Nayak, Professor Mr. S. Srikanth, Assistant Professor

OBJECTIVES:

The course should enable the students to:	
I	Demonstrate DC drives through phase controlled rectifiers and choppers.
II	Analyze operating principle of four quadrant DC drives.
III	Illustrate the speed control of induction motors through various parameters.
IV	Outline the separate and self control of synchronous motors.

DEFINITIONS AND TERMINOLOGY QUESTION BANK:

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
UNIT - I CONTROL OF DC MOTORS THROUGH PHASE CONTROLLED RECTIFIERS						
1	Define electric drive	The system which is used for controlling the motion of an electrical machine, such type of system is called an electrical drive. In other words, the drive which uses the electric motor is called electrical drive.	Remember	CO1	CLO1	AEE013.01
2	Describe Power Modulator	The power modulator regulates the output power of the source. It controls the power from the source to the motor in such a manner that motor transmits the speed-torque characteristic required by the load	Remember	CO1	CLO1	AEE013.01

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3	Explain the Control Unit	The control unit controls the power modulator which operates at small voltage and power levels. The control unit also operates the power modulator as desired. It also generates the commands for the protection of power modulator and motor. An input command signal which adjusts the operating point of the drive, from an input to the control unit	Understand	CO1	CLO1	AEE013.01
4	Define Sensing Unit	It senses the certain drive parameter like motor current and speed. It mainly required either for protection or for closed loop operation	Remember	CO1	CLO1	AEE013.01
5	Describe Adjustable Speed Drive	A unit comprised of a motor, drive controller and operator's controls either manual or automatic. Is also used to refer to the inverter which is a device used to convert standard sine wave power form into a simulated form for varying speed ranges on the driven equipment.	Remember	CO1	CLO2	AEE013.02
6	Define critical speed	It is the speed that separates continuous conduction from discontinuous conduction mode	Remember	CO1	CLO1	AEE013.01
7	Describe Accelerating Torque	The torque developed from standstill (zero speed) to full speed at nameplate voltage	Remember	CO1	CLO1	AEE013.01
8	Explain Bridge Rectifier	A bridge rectifier converts AC voltage into DC voltage	Understand	CO1	CLO3	AEE013.03
9	Describe Electronic DC Motor Controller	An electronic direct current motor controller is a phase-controlled rectifying system using semi-conductors for power conversion to supply the armature circuit or the armature and shunt field circuits of a direct current motor to provide adjustable speed, adjustable and compensated speed, or adjustable and regulated speed characteristics.	Remember	CO1	CLO3	AEE013.03
10	Define Excitation Current	A term usually applied to the current in the shunt field of a motor resulting from voltage applied across the field	Remember	CO1	CLO1	AEE013.01
11	Define Feedback	As it generally relates to motors (gear-motors) and controls, feedback refers to the voltage information received by a feedback circuit. Depending on a pre-determined potentiometer setting, a motor control can correct the voltage to deliver appropriate speed and/or torque	Remember	CO1	CLO1	AEE013.01
12	Describe Accelerating Time	The time required for a motor to reach full speed from standstill (zero speed) position	Remember	CO1	CLO2	AEE013.02
13	Explain Direct drive	Drives that transmit power to the application directly without gears or other means of power transmission	Understand	CO1	CLO1	AEE013.01

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
14	Define Back EMF	The voltage generated when a DC motor is rotated. This is proportional to motor speed and is present whenever the rotor turns.	Remember	CO1	CLO1	AEE013.01
15	Describe Converter	The process of changing AC to DC or DC to AC or DC to DC. The term “converter” may also refer to the process of changing AC to DC to AC	Remember	CO1	CLO1	AEE013.01

UNIT - II
SPEED CONTROL OF DC MOTORS

1	Describe regenerative braking	Regenerative braking occurs when the back emf exceeds the terminal voltage. In this case the DC motor runs as a DC generator is converting the mechanical power into electrical power which is delivered back to the electrical system. This method of braking is known as regenerative braking	Remember	CO2	CLO4	AEE013.04
2	Describe dynamic braking	Dynamic braking of electric motors occurs when the energy stored in the rotating mass is dissipated in an electrical resistance. This requires a motor to operate as a generator to convert the stored energy into electrical	Remember	CO2	CLO4	AEE013.04
3	Explain plugging in DC motor	It is one method of braking of DC motor. When terminals of supply of the motor running at the speed is reversed by interchanging connections with respect to supply terminals, operation shifts from motoring to plugging region	Understand	CO2	CLO4	AEE013.04
4	Define chopper	Chopper is converter which converts fixed DC voltage into a variable DC voltage	Remember	CO2	CLO4	AEE013.04
5	Define four quadrant operations	The motor operates in two modes: motoring and braking. In motoring, it converts electrical energy into mechanical energy which supports its motion. In braking, it works as a generator, converting mechanical energy into electrical energy and thus opposes the motion. Motor can provide motoring and braking operations for both forward and reverse directions.	Remember	CO2	CLO5	AEE013.05
6	Define positive and negative motor torque	Positive motor torque is defined as the torque which produces acceleration or the positive rate of change of speed in forward direction. Positive load torque is negative if it produces deceleration	Remember	CO2	CLO4	AEE013.04

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7	Explain Time ratio control	In time ratio control, a constant k given by T_{ON}/T is varied. The constant k is called duty ratio. Time ratio control can be achieved in two ways Constant Frequency In this control method, the frequency ($f = 1/T_{ON}$) is kept constant while the ON time T is varied. This is referred to as pulse width modulation (PWM). Variable Frequency In variable frequency technique, the frequency ($f = 1/T$) is varied while the ON time T is kept constant. This is referred to as the frequency modulation control	Understand	CO2	CLO6	AEE013.06
8	Explain Current limit control	In a DC to DC converter, the value of the current varies between the maximum as well as the minimum level for continuous. In this technique, the chopper (switch in a DC to DC converter) is switched ON and then OFF between the upper and lower limits. When the current goes beyond the maximum point, the chopper goes OFF. While the switch is at its OFF state, current freewheels via the diode and drops in an exponential manner. The chopper is switched ON when the current reaches the minimum level. This method can be used either when the ON time T is constant or when the frequency ($f=1/T$)	Understand	CO2	CLO6	AEE013.06
9	Define dual converter	Dual Converter is a Circuit made by the combination of two bridges connected back to back provides four quadrant operations	Remember	CO2	CLO5	AEE013.05
10	Define Braking	A system in which is used to run an electric motor as a generator	Remember	CO2	CLO4	AEE013.04
11	Describe third quadrant operation	When the DC motor voltage and current are negative then the motor will be in third quadrant and operates in reverse motoring	Remember	CO2	CLO4	AEE013.04
12	Define Braking Torque	The torque required to bring a motor down from running speed to a standstill. The term is also used to describe the torque developed by a motor during dynamic braking conditions	Remember	CO2	CLO4	AEE013.04
13	Define Breakaway Torque	The torque required to start a machine from standstill	Remember	CO2	CLO4	AEE013.04
14	Define Break down Torque	The maximum torque which a motor will develop with rated voltage applied at rated frequency, without an abrupt drop in speed	Remember	CO2	CLO4	AEE013.04

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
15	Describe forward braking	When the DC motor voltage is positive and current is negative then the motor will operate in second quadrant	Remember	CO2	CLO6	AEE013.06
UNIT - III						
SPEED CONTROL OF INDUCTION MOTORS THROUGH VARIABLE VOLTAGE AND VARIABLE FREQUENCY						
1	Describe stator voltage control	The speed of the Induction motor can be changed by changing the stator voltage. Because the torque is proportional to the square of the voltage	Remember	CO3	CLO7	AEE013.07
2	Define soft start	The ac voltage controllers show a step less control of supply voltage from zero to rated voltage they are used for soft start formotors	Remember	CO3	CLO7	AEE013.07
3	Define slip	The difference between the synchronous speed (N_s) and actual speed (N)of the rotor is known as slip speed. the % of slip is s given by, %slip $s = [(N_s - N) / N_s] \times 100$	Remember	CO3	CLO7	AEE013.07
4	Define base speed	The synchronous speed corresponding to the rated frequency is called the base speed	Remember	CO3	CLO7	AEE013.07
5	Describe stator current control	The 3 phase Induction motor speed can be controlled by stator current control. The stator current can be varied by using current source inverter	Remember	CO3	CLO9	AEE013.09
6	Define indirect flux control	The method of maintaining the flux constant by providing a voltage boost proportional to slip frequency is a kind of indirect flux control. This method of flux control is not desirable if very good dynamic behavior is required	Remember	CO3	CLO8	AEE013.08
7	Describe voltage source inverter	Voltage source inverter is a kind of D.C. link converter, which is a two stage conversion device with voltage in one direction and current in two directions	Remember	CO3	CLO8	AEE013.08
8	Explain slip controlled drive	Slip is used as a controlled quantity to maintain the flux constant in the motor the drive is called slip controlled drive. By making the slip negative (i.e., decreasing the output frequency of the inverter) The machine may be made to operate as a generator and the energy of the rotating parts fed back to the mains by an additional line side converter or dissipated in a resistance for dynamic braking. By keeping the slip frequency constant, braking at constant torque and current can be achieved. Thus braking is also fast	Understand	CO3	CLO8	AEE013.08

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
9	Describe current source inverter	In a D.C. link converter, if the D.C. link current is controlled, the inverter is called a current source inverter, The current in the D.C. link is kept constant by a high inductance and the capacitance of the filter is dispensed with a current source inverter is suitable for loads which present a low impedance to harmonic currents and have unity p.f	Remember	CO3	CLO9	AEE013.09
10	Write the importance of Constant Volts Per Hertz	This relationship exists in AC drives where the output voltage is varied directly proportional to frequency. This type of operation is required to allow the motor to produce constant rated torque as speed is varied	Remember	CO3	CLO8	AEE013.08
11	Describe the commutation of the current source inverter	The commutation of the inverter is load dependent. The load parameters form a part of the commutation circuit. A matching is therefore required between the inverter and the motor. Multimotor operation is not possible. The inverter must necessarily be a force commutated one as the induction motor cannot provide the reactive power for the inverter. The motor voltage is almost sinusoidal with superimposed spikes	Remember	CO3	CLO9	AEE013.09
12	Explain plugging in induction motor drives	In plugging, the braking torque is produced by interchange any two supply terminals, so that the direction of rotation of the rotating magnetic field is reversed with respect to the rotation of the motor. The electromagnetic torque developed provides the braking action and brings the rotor to a quick stop	Understand	CO3	CLO8	AEE013.08
13	Describe the harmonics in VSI fed induction motor drive	The harmonics of the stator current cause additional losses and heating. These harmonics are also responsible for torque pulsations. The reaction of the fifth and seventh harmonics with the fundamental gives rise to the seventh harmonic pulsations in the torque developed. For a given induction motor fed from a square wave inverter the harmonic content in the current tends to remain constant independent of input frequency, with the rang of operating frequencies of the inverter	Remember	CO3	CLO8	AEE013.08
14	Define pulse width modulation	Pulse width modulation is “the process in which signal is transmitted by pulses with a special technique”	Understand	CO3	CLO8	AEE013.08
15	Define inversion	Converter which takes power from DC terminals and transfers it to AC mains is called inversion	Remember	CO3	CLO7	AEE013.07

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
UNIT - IV						
SPEED CONTROL OF INDUCTION MOTORS THROUGH ROTOR RESISTANCE AND VECTOR CONTROL						
1	Define slip power recovery	Slip power Recovery is one of the methods of controlling the speed of an Induction motor. The slip power from the rotor circuit can be recovered and fed back to the AC source so as to utilize it outside the motor	Remember	CO4	CLO10	AEE013.10
2	Describe static scherbius drive	Static scherbius drives are capable of bi-directional power flow, with both positive and negative injected voltages possible, in phase with or opposing the rotor current. As a result, a wider set of operating conditions is possible	Remember	CO4	CLO10	AEE013.10
3	Describe static Kramer drive	The static Kramer-drive is the method of controlling the speed of an induction motor by injecting the opposite-phase voltage in the rotor circuit. The static Kramer-drive converts the slip power of an induction motor into AC power and supply back to the line	Remember	CO4	CLO10	AEE013.10
4	Define vector control of induction motor	Vector control, also called field-oriented control (FOC), is a variable-frequency drive (VFD) control method in which the stator currents of a three-phase AC electric motor are identified as two orthogonal components that can be visualized with a vector. FOC is used to control AC synchronous and induction motors	Remember	CO4	CLO11	AEE013.11
5	Describe direct vector control	In direct FOC the rotor angle or control vector is obtained by the terminal voltages and currents directly by using flux estimators. Similar to Indirect Vector Control, various controllers have been implemented on direct vector controlled induction motor drives also to improve the performance of the drive	Remember	CO4	CLO11	AEE013.11
6	Describe indirect vector control	Indirect Field Oriented Control for Induction Motor. Indirect Field Oriented Control (IFOC) is known to produce high performance in induction Motor (IM) drives by decoupling rotor flux and torque producing current components of stator current	Remember	CO4	CLO12	AEE013.12
7	Define rotor resistance control of induction motor	Rotor Resistance Control is also one of the methods by which we can control the speed of the Induction motor. The speed of the wound induction motor can be controlled by connecting an	Remember	CO4	CLO10	AEE013.10

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		external resistance in the rotor circuit through slip rings				
8	Define harmonics	A harmonic is a signal or wave whose frequency is an integral (whole-number) multiple of the frequency of some reference signal or wave. Signals occurring at frequencies of 2f, 4f, 6f, etc. are called even harmonics. The signals at frequencies of 3f, 5f, 7f, etc. are called odd harmonics.	Remember	CO4	CLO10	AEE013.10
9	Describe regenerative braking in induction motors	Regenerative braking occurs when the motor speed exceeds the synchronous speed. In this case the IM runs as the induction m/c is converting the mechanical power into electrical power which is delivered back to the electrical system. This method of braking is known as regenerative braking	Remember	CO4	CLO10	AEE013.10
10	Define wound rotor induction motor	A wound-rotor motor is a type of induction motor where the rotor windings are connected through slip rings to external resistance. Adjusting the resistance allows control of the speed / torque characteristic of the motor	Remember	CO4	CLO10	AEE013.10
11	Define Variable Frequency Drive	A Variable Frequency Drive (VFD) is a type of motor controller that drives an electric motor by varying the frequency and voltage supplied to the electric motor	Remember	CO4	CLO10	AEE013.10
12	Define braking resistance	The property of resistors to dissipate heat can be used to slow down a mechanical system. This process is called dynamic braking and such a resistor is called a dynamic braking resistor. To decelerate an electric motor, kinetic energy is transformed back into electrical energy	Remember	CO4	CLO10	AEE013.10
13	Describe how the super synchronous speed achieved	Super synchronous speed can be achieved if the power is fed to the rotor from A.C. mains. This can be made possible by replacing the converter cascade by a cycloconverter. A cycloconverter allows power flow in either direction making the static scherbius drive operate at both sub and supper synchronous speeds	Remember	CO4	CLO10	AEE013.12
14	Describe the purpose of inductance and capacitance in the D.C. link circuit	The inductance in the D.C. link circuit provides smoothing whereas the capacitance maintains the constancy of link voltage. The link voltage is a controlled quality	Remember	CO4	CLO10	AEE013.10

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
15	Define AC voltage regulator	The converter which converts fixed AC to Variable AC with change in Magnitude of source	Remember	CO4	CLO10	AEE013.10
UNIT – V SPEED CONTROL OF SYNCHRONOUS MOTORS						
1	Define load commutation	Commutation of thyristors by induced voltages pf load is known as load commutation	Remember	CO5	CLO13	AEE013.13
2	Describe synchronous motor	A synchronous electric motor is an AC motor in which, at steady state, the rotation of the shaft is synchronized with the frequency of the supply current; the rotation period is exactly equal to an integral number of AC cycles	Remember	CO5	CLO13	AEE013.13
3	Define self control of synchronous motor	Control of synchronous motors is performed using field oriented control for the operation of synchronous motor as a dc motor. The stator windings of the motor are fed by an inverter that generates a variable frequency variable voltage	Remember	CO5	CLO13	AEE013.13
4	Define separate control of synchronous motor	Synchronous machine is a constant speed Machine and independent on load. In some industrial applications speed control is necessary. The synchronous machine speed is controlled by varying the frequency. Scalar control and vector control. A scalar control synchronous machine consists of two different modes of operation	Remember	CO5	CLO13	AEE013.13
5	Describe margin angle of commutation	The difference between the lead angle of firing and the overlap angle is called the margin angle of commutation. If this angle of the thyristor, commutation failure occurs. Safe commutation is assured if this angle has a minimum value equal to the turn off angle of the thyristor	Remember	CO5	CLO13	AEE013.13
6	Define pull in torque	The maximum constant torque under which a motor will accelerate from rest to approximate normal speed	Remember	CO5	CLO13	AEE013.13
7	Define cycloconverter	Cycloconverter is a single stage conversion device which provides a Variable voltage, variable frequency supply	Remember	CO5	CLO14	AEE013.14
8	Define auxiliary motor	Sometimes when the power is small an auxiliary motor can be used to run up the synchronous motor to the desired speed	Remember	CO5	CLO14	AEE013.14
9	Describe sub synchronous speed operation	The sub synchronous speed operation means the SRIM speed can be controlled below the synchronous speed. i.e) the slip power is fed back to the supply	Remember	CO5	CLO13	AEE013.13

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
10	Define super synchronous speed operation	The super synchronous speed operation means the SRIM speed can be controlled above the synchronous speed. The supply is fed back to the rotor side	Remember	CO5	CLO13	AEE013.13
11	Describe brushless D.C. motor	The brushless D.C. motor is an inverter-fed self controlled permanent synchronous motor drive	Remember	CO5	CLO13	AEE013.13
12	Define commutation	The turn OFF process of an SCR is called commutation. The term commutation means the transfer of currents from one path to another. So the commutation circuit does this job by reducing the forward current to zero so as to turn OFF the SCR or Thyristor	Remember	CO5	CLO13	AEE013.13
13	Define controller	The purpose of a controller is to produce a signal that is suitable as input to the controlled plant or process	Remember	CO5	CLO15	AEE013.15
14	Define natural commutation	When a reverse voltage will appear across the device which will turn off the thyristor immediately. This process is called as natural commutation	Remember	CO5	CLO15	AEE013.15
15	Define pull out torque	Pull-out or breakdown torque is the maximum torque the motor can produce at full rated voltage and frequency. If the motor is running and is loaded beyond the pull-out torque, it will pull out or stall	Remember	CO5	CLO14	AEE013.14

Signature of the Faculty

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