APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
CET campus, Thiruvananthapuram - 695 016
Ph: 0471 2598122; Fax: 2598522 www. ktu.edu.in Email: university@ktu.edu.in

KTU/DIRECTOR(ACADEMIC)/1063/2019 24.04.2021

CIRCULAR

The Academic Calendar for B.Tech S6, BHMCT S6, B.Arch S8, B.Arch S6, MCA S4, Integrated MCA S4/S6/S8 is published herewith.

Dr. Sadiq A.
Dean (Academic)

Copy To,

1. Principals of all affiliated Institutions.
2. CoE/KTU Support.
3. AD-IT (for publishing in the website).

* This is a computer system (Digital File) generated letter. Hence there is no need for a physical signature.

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Academic Calendar - March 2021 to July 2021

(B.Tech S6, BHMCT S6, B.Arch S8, B.Arch S6, MCA S4, Int MCA S4/S6/S8)

Mar-21				Apr-21				May-21			
Days	Date	Description	Class	Days	Date	Description	Class	Days	Date	Description	Class
Mon	1			Thu	1	**Maundy Thursday**		Sat	1	**May Day**	
Tue	2			Fri	2	**Good Friday**		Sun	2		
Wed	3			Sat	3		10	Mon	3		31
Thu	4			Sun	4	**Easter**		Tue	4		32
Fri	5			Mon	5		11	Wed	5	**First Series Test to be Completed (B.Arch S6, B.Tech S6, BHMCT S6, B.Arch S8)**	33
Sat	6			Tue	6		12	Thu	6		34
Sun	7			Wed	7	**Commencement of class and registration (MCA S4, Int MCA S4/S6/S8)**	13	Fri	7		35
Mon	8			Thu	8		14	Sat	8		
Tue	9			Fri	9		15	Sun	9		
Wed	10			Sat	10			Mon	10		36
Thu	11	**Maha Sivrathri**		Sun	11			Tue	11		37
Fri	12			Mon	12		16	Wed	12		38
Sat	13			Tue	13		17	Thu	13	**Eid-ul-Fitr(Ramzan)**	
Sun	14			Wed	14	**Vishu**		Fri	14		39
Mon	15			Thu	15		18	Sat	15		
Tue	16			Fri	16		19	Sun	16		
Wed	17			Sat	17		20	Mon	17		40
Thu	18			Sun	18			Tue	18		41
Fri	19			Mon	19		21	Wed	19		42
Sat	20			Tue	20		22	Thu	20		43
Sun	21			Wed	21		23	Fri	21	**First Series Test to be Completed (MCA S4, Int MCA S4/S6/S8)**	44
Mon	22	**Commencement of class and registration (B.Arch S6, B.Tech S6, BHMCT S6, B.Arch S8)**	1	Thu	22		24	Sat	22		
Tue	23		2	Fri	23		25	Sun	23		
Wed	24		3	Sat	24			Mon	24		45
Thu	25		4	Sun	25			Tue	25		46
Fri	26		5	Mon	26	**Course Selection, Reg and Mapping Begins**	26	Wed	26		47
Sat	27		6	Tue	27		27	Thu	27	**Exam Registration Begins**	48
Sun	28			Wed	28		28	Fri	28		49
Mon	29		7	Thu	29		29	Sat	29		
Tue	30		8	Fri	30	**Course Selection, Reg and Mapping Ends**	30	Sun	30		
Wed	31		9					Mon	31		50

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Academic Calendar - March 2021 to July 2021

(B.Tech S6, BHMCT S6, B.Arch S8, B.Arch S6, MCA S4, Int MCA S4/S6/S8)

Jun-21				Jul-21				Aug-21			
Days	Date	Description	Class	Days	Date	Description	Class	Days	Date	Description	Class
Tue	1		51	Thu	1	Second series test to be completed (MCA S4, Int MCA S4/S6/S8)	73	Sun	1		
Wed	2		52	Fri	2		74	Mon	2		
Thu	3	Exam Registration Ends	53	Sat	3			Tue	3		
Fri	4		54	Sun	4			Wed	4		
Sat	5			Mon	5	Class ends, Publish Attendance (B.Tech S6,BHMCT S6.B.Arch S6, B.Arch S8)	75	Thu	5		
Sun	6			Tue	6		76	Fri	6	End Semester Examination (MCA S4, Int MCA S4/S6/S8)	
Mon	7		55	Wed	7		77	Sat	7		
Tue	8		56	Thu	8	Jury Evaluation to be completed(B.Arch S6, B.Arch S8)	78	Sun	8		
Wed	9		57	Fri	9	Publish IA Marks(B.Arch S6,B.Arch S8)	79	Mon	9		
Thu	10		58	Sat	10			Tue	10		
Fri	11		59	Sun	11			Wed	11		
Sat	12			Mon	12		80	Thu	12		
Sun	13			Tue	13		81	Fri	13		
Mon	14		60	Wed	14		82	Sat	14		
Tue	15		61	Thu	15		83	Sun	15	Independance Day	
Wed	16		62	Fri	16	End Semester Examination (B.Tech S6)	84	Mon	16		
Thu	17		63	Sat	17			Tue	17		
Fri	18	Second series test to be completed (B.Arch S6, B.Tech S6, BHMCT S6, B.Arch S8)	64	Sun	18			Wed	18		
Sat	19			Mon	19		85	Thu	19	Muharram	
Sun	20			Tue	20	Bakrid		Fri	20	First Onam	
Mon	21		65	Wed	21		86	Sat	21	Thiruvonam	
Tue	22		66	Thu	22	Publish IA Marks(MCA S4, Int MCA S4/S6/S8) End Semester Examination (B.Arch S6, B.Arch S8)	87	Sun	22	Third Onam	
Wed	23		67	Fri	23	Class ends, Publish Attendance (MCA S4, Int MCA S4/S6/S8) End Semester Examination (BHMCT S6)	88	Mon	23	Fourth Onam	
Thu	24		68	Sat	24			Tue	24		
Fri	25		69	Sun	25			Wed	25		
Sat	26			Mon	26			Thu	26		
Sun	27			Tue	27			Fri	27		
Mon	28		70	Wed	28			Sat	28	Birthday of Ayyankali	
Tue	29		71	Thu	29			Sun	29		
Wed	30	Publish IA Marks(B.Tech S6, BHMCT S6)	72	Fri	30			Mon	30	Sreekrishna Jayanthi	
				Sat	31			Tue	31		

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Academic Calendar: March 2021 to August 2021

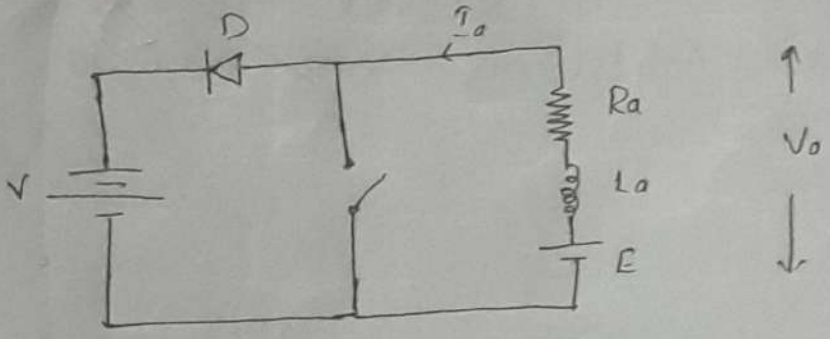
(B.Tech S6, BHMCT S6, B.Arch S8, B.Arch S6, MCA S4, Int MCA S4/S6/S8)

Events

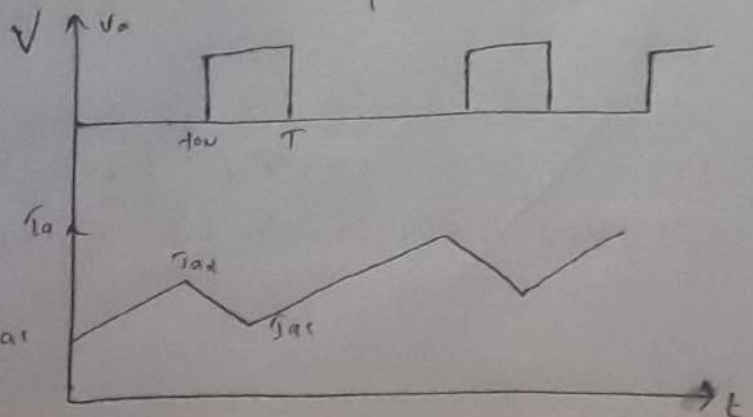
Sl. No.	EVEN SEMESTER (2021)	Important Dates
1	Commencement of classes and registration (B.Tech S6, BHMCT S6, B.Arch S6, B.Arch S8)	**22-Mar**
	Mode of Class(B.Tech S6, BHMCT S6, B.Arch S6, B.Arch S8)	**Online : Mar 22 to Jun 4** **Contact : jun 7 to Jul 5**
2	Commencement of classes and registration (MCA S4, Int MCA S4/S6/S8)	**07-Apr**
	Mode of Class(MCA S4, Int MCA S4/S6/S8)	**Online: Apr 7 to Jun 23** **Contact: Jun 24 to Jul 23**
3	Course selection, reg and mapping	**Apr 26 to Apr 30**
4	CC Meetings	**Apr 28,May 24,Jun 21**
5	First Internal Test to be Completed (B.Tech S6, BHMCT S6, B.Arch S6, B.Arch S8)	**05-May**
6	First Internal Test to be Completed (MCA S4, Int MCA S4/S6/S8)	**21-May**
7	Exam Registration	**May 27 to Jun 3**
8	Second Internal Test to be Completed(B.Tech S6, BHMCT S6, B.Arch S6, B.Arch S8)	**18-Jun**
9	Publish IA Marks (B.Tech S6, BHMCT S6)	**30-Jun**
10	Second Internal Test to be Completed (MCA S4, Int MCA S4/S6/S8)	**01-Jul**
11	Class Ends , Publish Attendance (B.Tech S6, BHMCT S6, B.Arch S6, B.Arch S8	**05-Jul**
12	Jury Evaluation to be completed (B.Arch S6, B.Arch S8)	**08-Jul**
13	Publish IA Marks (B.Arch S6, B.Arch S8)	**09-Jul**
14	End Semester Examination (B.Tech S6)	**16-Jul**
15	End Semester Examination (B.Arch S6, B.Arch S8)	**22-Jul**
16	Publish IA Marks (MCA S4, Int MCA S4/S6/S8)	**22-Jul**
17	End Semester Examination (BHMCT S6)	**23-Jul**
18	Class ends , Publish Attendance (MCA S4, Int MCA S4/S6/S8)	**23-Jul**
19	End Semester Examination (MCA S4, Int MCA S4/S6/S8)	**06-Aug**

ED

1) a) Regenerative braking of a DC Motor Drive



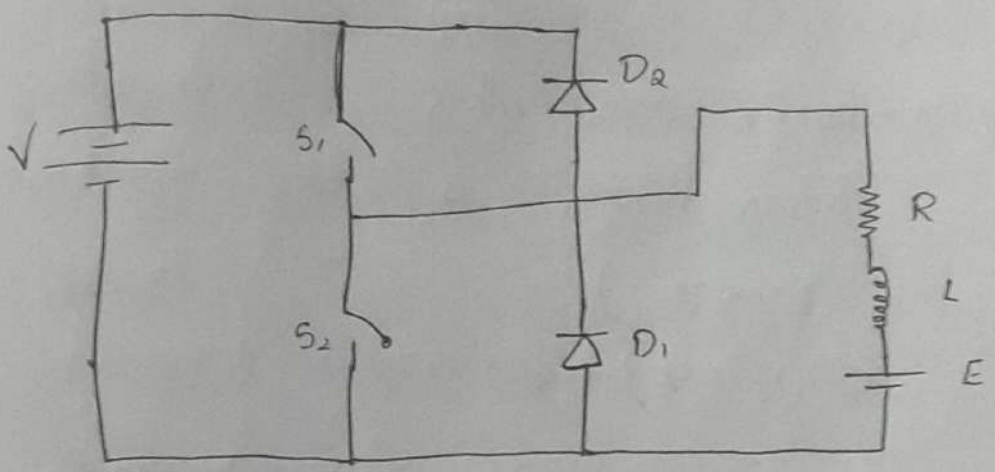
- During ON period of the switch, armature voltage is '0'
- Armature current increases from I_{a1} to I_{a2} and hence DC machine works as a generator
- A part of energy is stored in the armature inductance and remainder is dissipated in the armature resistance
- When the switch is turned OFF, armature current flows through Diode D and source V
- Armature current decreases from I_{a2} to I_{a1}
- The stored energy in the inductance and the energy supplied by the machine is fed to the source
- Duty ratio D: $\frac{T \cdot t_{ON}}{T}$



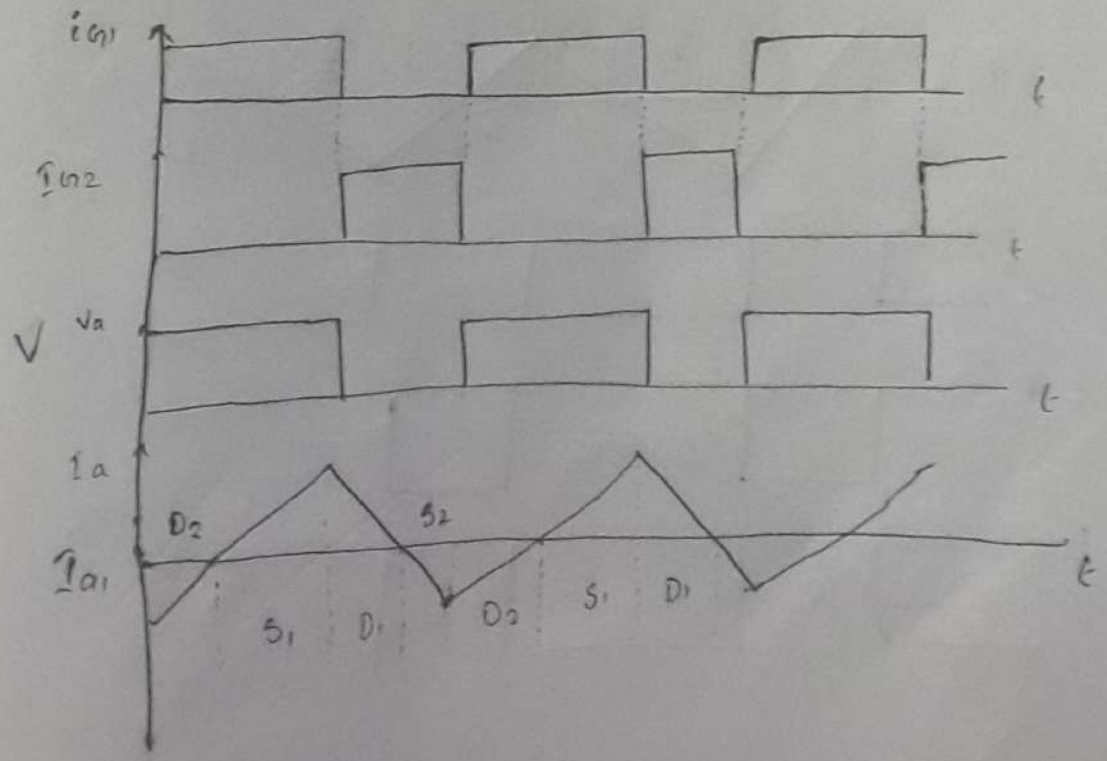
Average Armature Voltage $V_a = \frac{1}{T}\int_{ton}^{T} V_d\,dt$

Speed $\omega_m = \frac{Dv}{k} - \frac{R_a}{k^2}T$

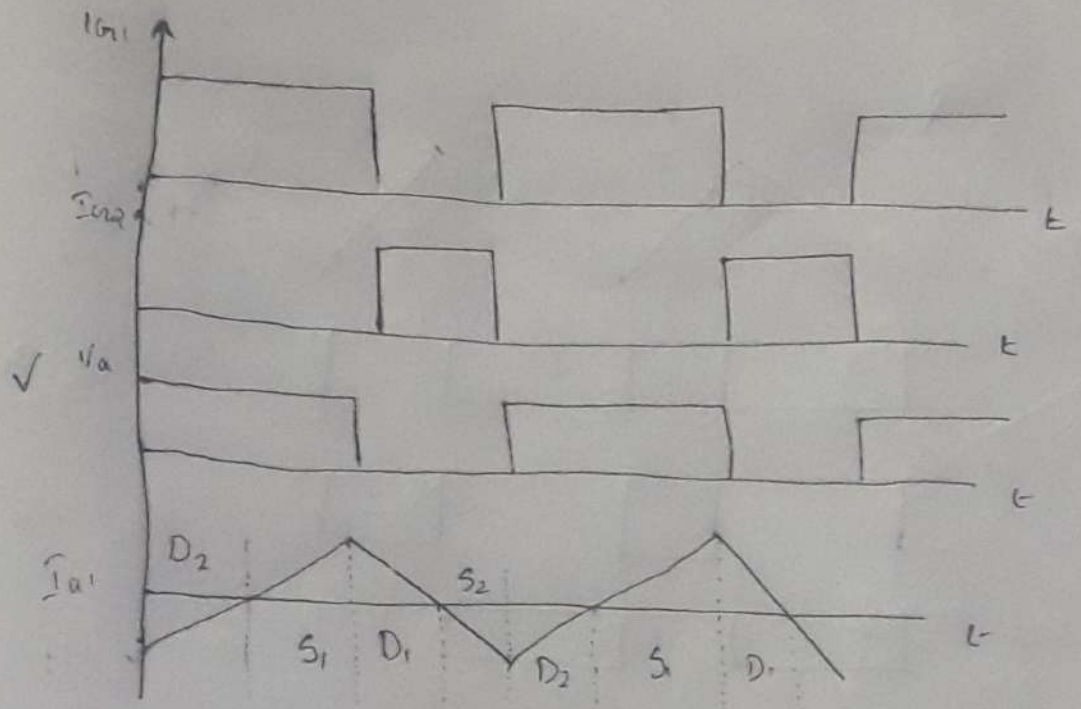
1) b) Class C chopper



VI characteristics for 1st Quadrant operation (S_1 and D_1



for Second Quadrant operation (S_2 D_2



1) c) Types of cyclo converters

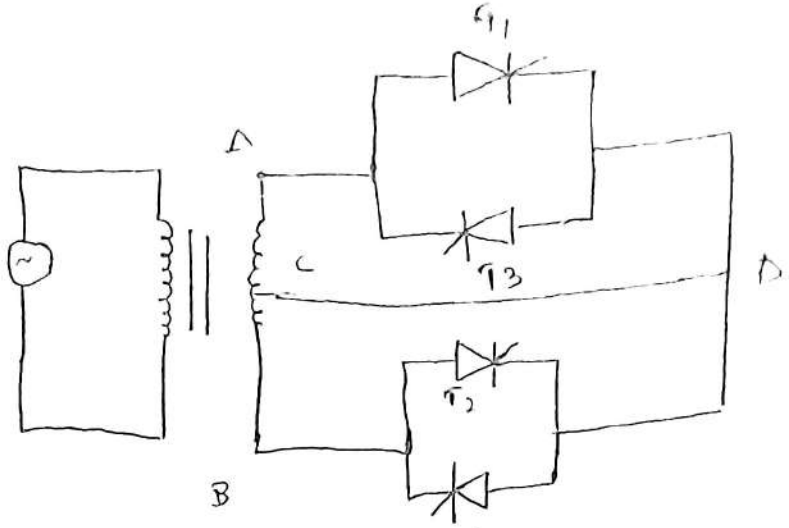
- Step down cycloconverters ($f_o < f_s$)
- Step up " ($f_o > f_s$)

Classification based on supply voltage

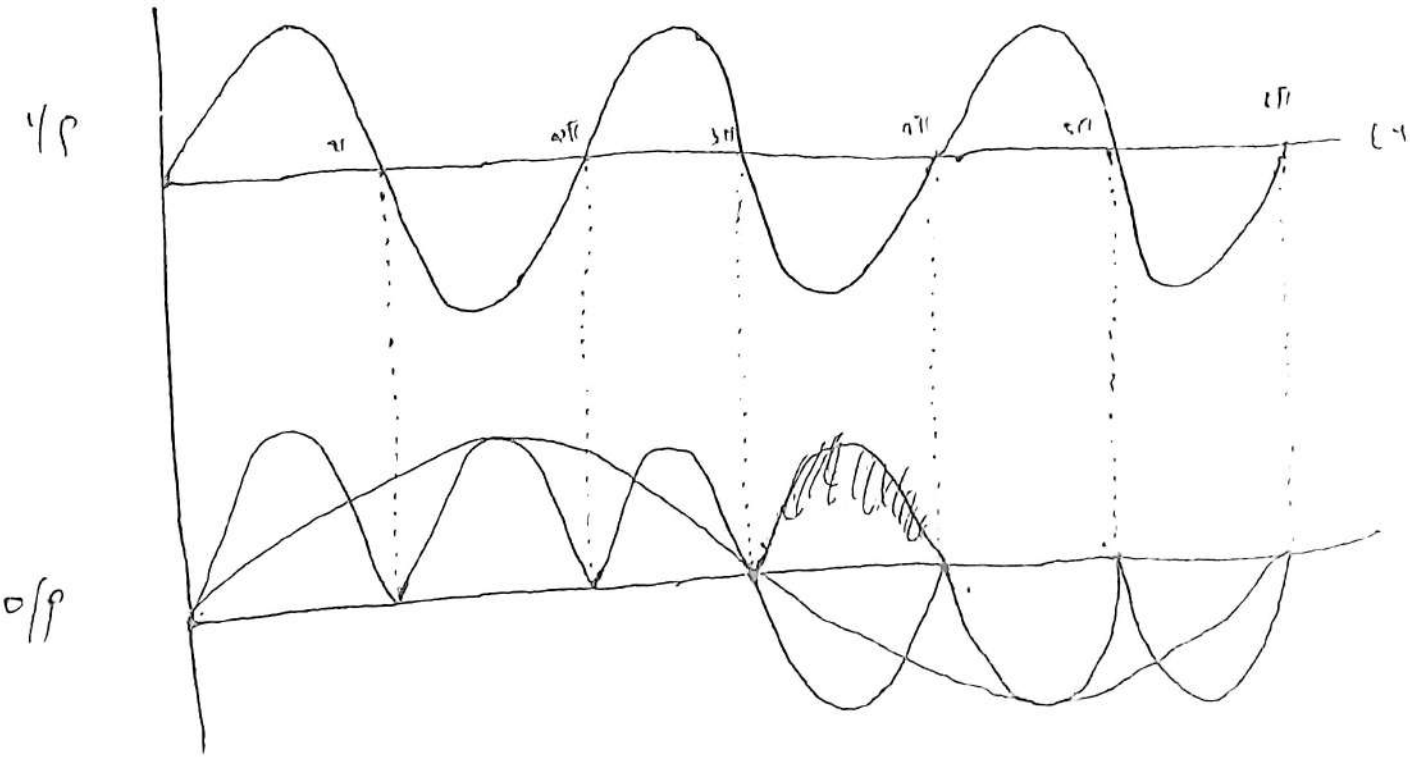
- Single phase to single phase cycloconverters
- Three " Three " "
- " Single "

Step down cycloconverters

- These types requires only line / natural commutation which is provided by AC supply
- Doesn't require force commutation



- During +ve half cycle, T_1 is turned ON and load current flows through load
- In the graph, at a point π, T_1 gets naturally commutated and T_2 is turned ON
- At 2π, T_2 gets naturally commutated and T_1 is turned ON again
- At 3π, T_1 gets naturally commutated and T_3 turned ON
- At 4π T_3 " T_4
- At 5π T_4 " T_3



2) a) Stator frequency control

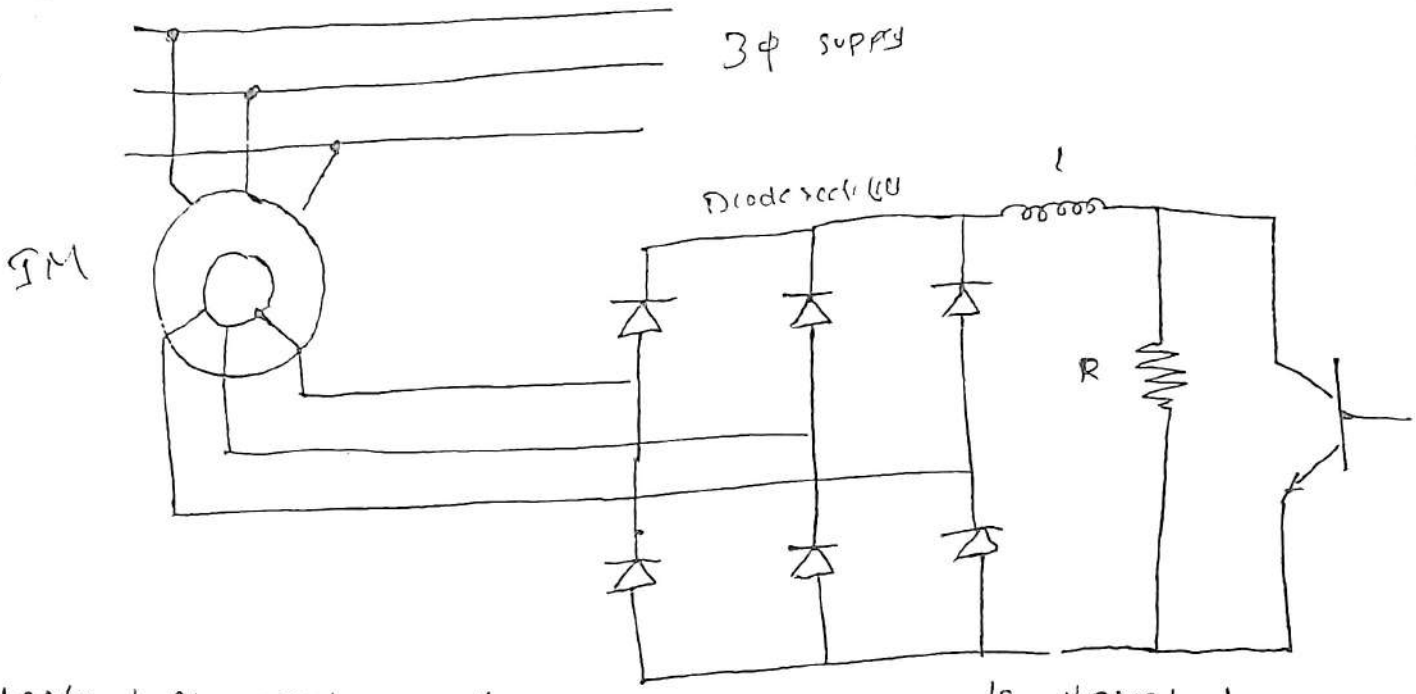
- The speed and torque of an induction motor can be controlled by changing the supply frequency
- The supply frequency is constant so to change frequency we need a frequency changer circuit
- In order to change frequencies we use two types of frequency changer circuit:
  a) cycloconverter
  b) inverter

2) b) [redacted]

Advantages:

- The current required at the starting is reduced
- The motor can more in stable region. Instead of simply running at its base rated speed the motor can be run typically from 5% to the synchronous speed or to the base speed. The torque generated by the motor can be kept constant throughout the region
- Can be done the motor beyond the speed by increasing frequency.
- By changing the supply frequency to the motor with respect to time we can control the acceleration or deceleration of the motor
- Good dynamic performance

2) c) Static Conventional rotor resistance control



- Instead of mechanically varying R, it is varied by the principle of chopper
- AC output voltage of rotor is rectified by a diode bridge rectifier. which is fed to parallel combination of fixed resistance R and self commutated switch T.

* when the switch is ON, resistor is disconnected
* when switch is OFF, resistor is connected
* So by controlling the ON time of switch (duty ratio), the effective total resistance can be varied in an induction motor

1. $V = 200\ V$ $\quad N_2 = 700\ rpm$

$N_1 = 900\ rpm$ $\quad V_m = 210\ V$

$I_a = 100\ A$

$R_a = 0.06\ \Omega$

E at 900 rpm

$$E_1 = V - I_a R_a = 200 - 100 \times 0.06$$
$$= 194\ V$$

E_2 at 700 rpm

$$\frac{E_1}{E_2} = \frac{N_1}{N_2}$$

$$E_2 = \frac{N_2}{N_1} \times E_1 = \frac{700}{900} \times 194 = \underline{151}\ V$$

$$V_a = E + I_a R_a$$
$$= 151 + 100 \times 0.06 = \underline{157}\ V$$

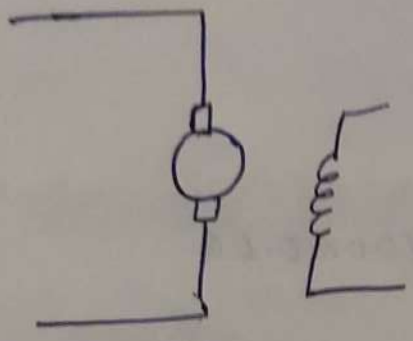
$$V_a = \frac{2V_m}{\pi} \cos\alpha$$

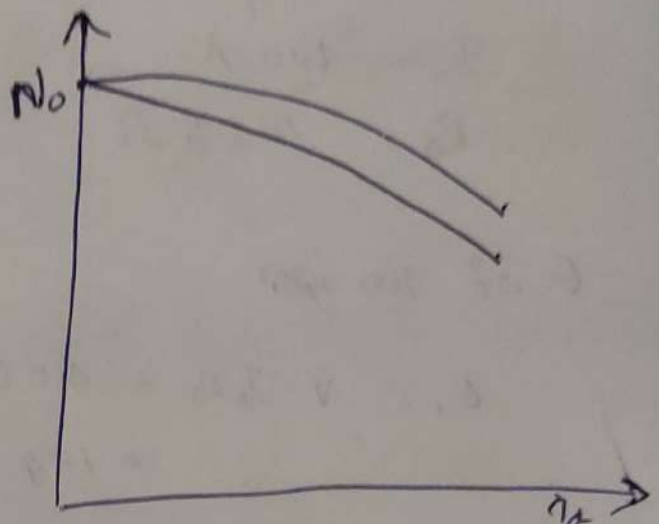
$$157.V = 2 \times \frac{210 \times \sqrt{2}}{\pi} \cos\alpha$$

$$\alpha = \cos^{-1}\left(\frac{157 \times \pi}{2 \times 210 \times \sqrt{2}}\right)$$

$$\alpha = \underline{33.86^\circ}$$

2) Speed Torque Characteristic of Separately Excited DC Motor:





$V_a = E + I_a r_a$ — ①, E is back emf of armature

$$E = \frac{Z\phi N P}{60a}$$

P ; poles
Z no. of conductor
a no. of parallel paths

$$= K_e \phi N = \underline{\underline{K_t \phi \omega}}$$

$\omega = \frac{2\pi N}{60}$ angular velocity.

$E = K\phi\omega$ — ②

② on ① $\Rightarrow$ $V = K\phi\omega + I_a r_a$

$$N = \frac{V_a - I_a r_a}{K_e \phi} \quad — ③$$

Torque developed by motor

$$T_d = \frac{1}{2\pi} 2P\phi \frac{I_a Z}{2a} = \underline{\underline{K_t \phi I_a}} \quad ④$$

from ③ & ④

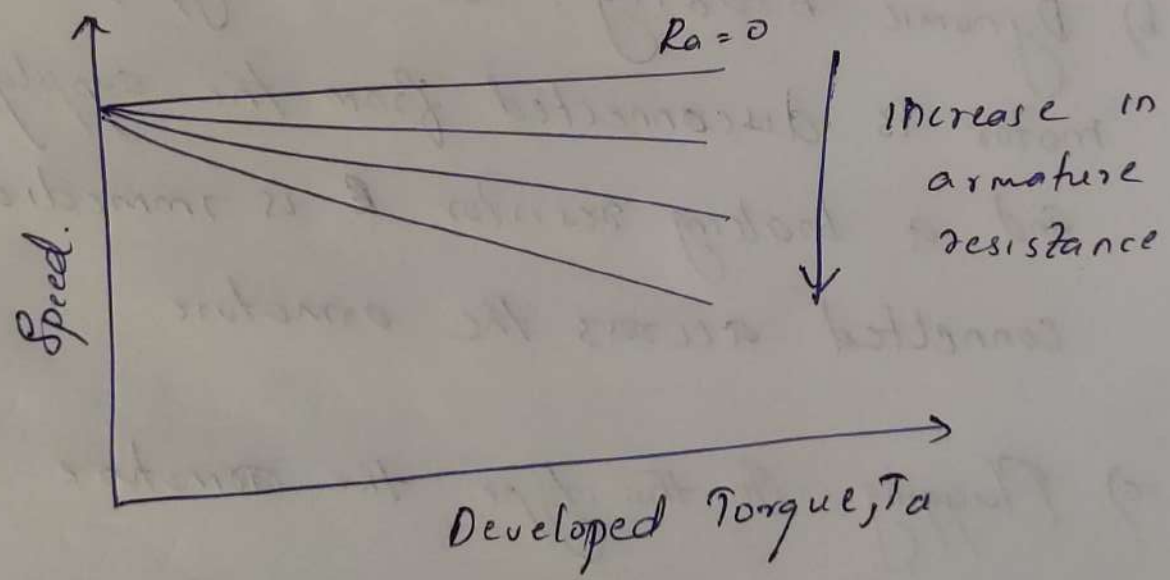
$$N = \frac{V_a}{K_e \phi} - \frac{T_d}{K_t K_e \phi^2} r_a$$

when $T_d = 0$

$$N = \frac{V_a}{K_e \phi}$$ No-load speed

Motor speed decreases as torque developed increases.

With Variable resistance (armature)



with suitable value of R_a, slow speeds are possible

3) Different type of braking in DC motor

a) Regenerative Braking : It is the form of braking in which the kinetic energy of motor is returned to the power supply system.
It cannot be used to stop the motor but to control its speed above the no-load speed.

b) Dynamic braking : In this type, the DC motor is disconnected from the supply and a braking resistor is immediately connected across the armature

c) Plugging : In this type, the armature terminals or supply polarity of DC motor are reversed when runing for braking.

1) Types of Synchronous Machine

a) Rotating armature type - The armature winding is housed in the rotor. The emf generated or current is supplied to load via slip ring and carbon brush assembly. For small rating

b) Rotating field type: Field winding is wound on rotor. DC supply is extended to the field winding by assembly of slip ring and carbon brush. Electrical power is supplied to load using stationary terminals on stator.

2) Types of rotors

a) Round rotor / Cylindrical type : Are used with high-speed turbines. Due to large centrifugal forces, rotor has long, narrow, solid steel cylinder.

The field winding are mounted in slots that are mill-cut into about 2/3 of perimeter.

b) Salient Pole rotor : Are used with low speed hydro turbines. It have multiple pole pairs. Field windings are mounted on the individual poles.

3) Synchronous Motor.

→ A synchronous motor is one in which the rotor normally rotates at same speed as revolving field in the machine.

The stator will be supplyed with a 3 phase 6 windings and rotor will have a dc supply through slip rings.

→ The stator current establishes a rotating magnetic field at $\frac{120f}{p}$ rpm

→ The rotor supplied by dc supply also have a rotating magnetic field.

→ The rotor speed is made equal to that of rotating magnetic field of stator, then these two magnetic field will tend to align each other. And runs synchronously with speed of rotating stator mag field.

4) Methods of starting synchronous motor.

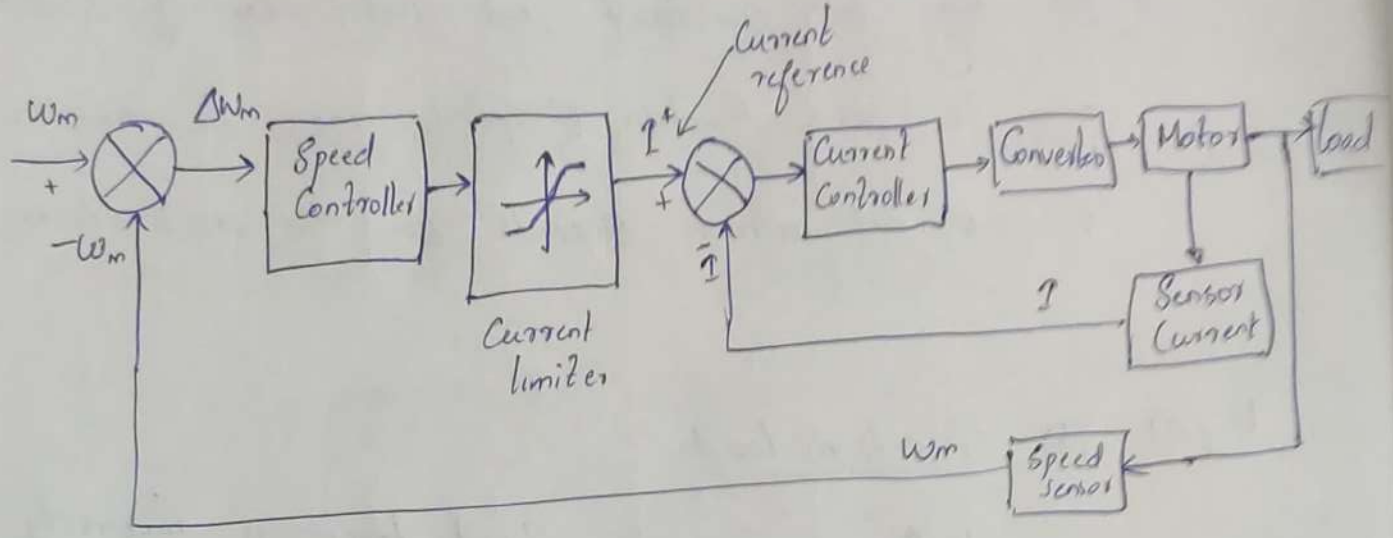
→ Using pony motors. : In this rotor is brought to synchronous speed with small induction motor and when rotor attains synchronous speed the pony motor is removed and dc supply is given to rotor.

→ Using Damper Winding : An additional winding consisting of copper bars short circuited with end rings are placed in slots. acts as squirrel cage rotor winding which will allow the motor to start rotating as an induction motor at sub-synchronous speed and when dc supply is given. motor gets pulled to synchronism

→ Using Small DC machines

→ Usig slip ring as same as damper winding.

1 (a) Closed Loop Speed Control



→ It is used to control or limit the ~~controller current~~ converter current & motor current below a safe limit.

→ When the reference speed increases, a positive error is produced which is passed to current limiter which reduces the current to reduce speed error.

1 (b) Components of Load torque.:

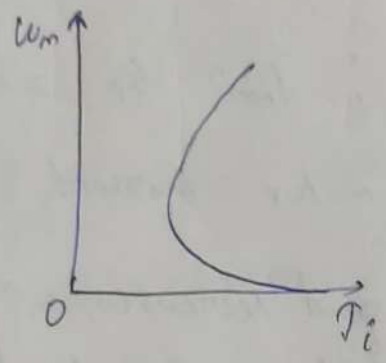
1) Friction torque.: It will be present at the motor shaft and also in various parts of the load. It is due to the frictional forces between moving surface. Denoted by T_f

2) Windage Torque.: It is the torque acquired by the load when the air surrounding the rotating parts moves. Torque produced by wind opposing the motion (T_w)

(3) Torque required to do useful work (T_L)

→ It may be constant and independant of speed, may be some function of speed, may be time variant or invariant which depends on the applications.

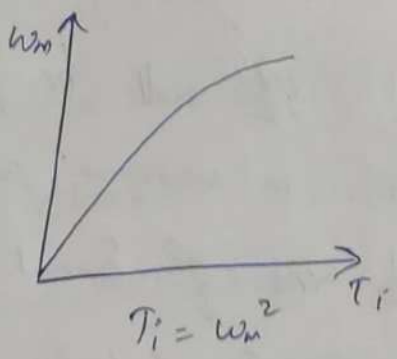
1 (c) (b). Traction load



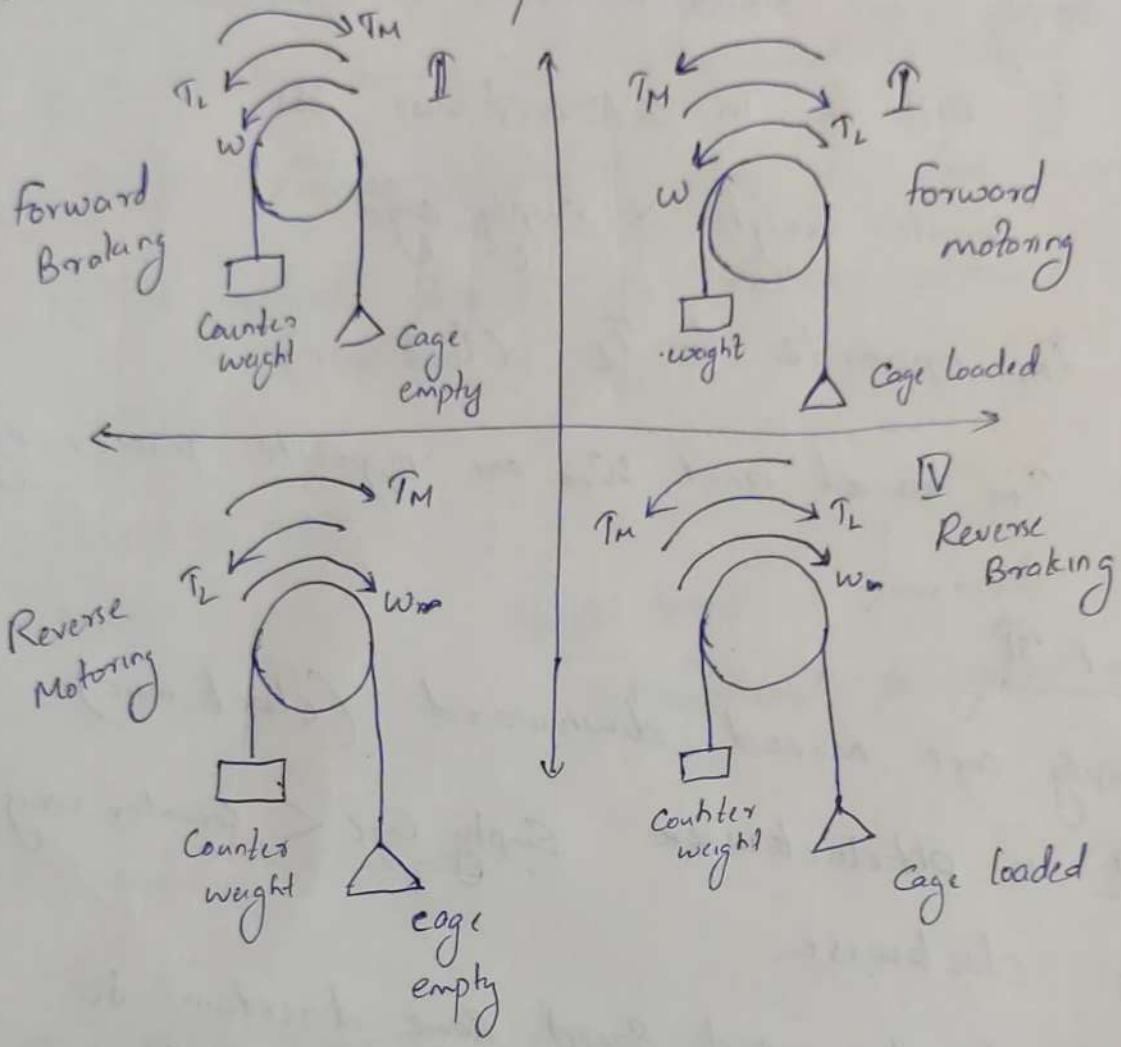
Load torque is inversely proportional to speed

Centrifugal Pump -

It is an example when Load torque is proportional to square of speed of motor.



1 (c) Four Quadrant Operation



Quadrant I Forward motoring.

→ The loaded cage is to be moved upward and the motor is to be rotated in anticlockwise direction.

→ Difference b/w weight of Cage and counter weight is positive so T_L is in clockwise.

→ T_m always opposite to T_L

→ T_M and w in same direction Power is positive.

Quadrant II

→ Empty cage should be moved in upward.

→ T_L will be in anticlockwise as

Counter weigh > Empty cage.

→ T_M opposite to T_L (Clockwise)

→ T_M and W are opposite power negative

Quadrant III

→ Empty cage moved downward (clockwise)

→ T_L is anticlockwise Empty cage < Counter weight

→ T_M clockwise.

→ T_M direction and speed same direction so power is positive

Quadrant IV

→ Loaded cage in downward (clockwise)

→ T_L is clockwise Cage > Counter weight

→ T_M is anticlockwise

→ T_M and W is opposite so power is negative.

2 (b)

$V = 220\ V \quad I_a = 10\ A \quad N_1 = 1500\ rpm$

$N_2 = 600\ rpm \quad R_a = 2\ \Omega \quad V_m = 230\ V$

$E_1 = V - I_a R_a$

$= 200\ V$

$\frac{E_2}{E_1} = \frac{N_2}{N_1}$

$E_2 = \frac{N_2 \times E_1}{N_1} = \frac{600 \times 200}{1500} = 80\ V$

$E_2 = V_2 - I_a R_a$

$V_2 = E_2 + I_a R_a$

$= 80 + 20 = \underline{100\ V}$

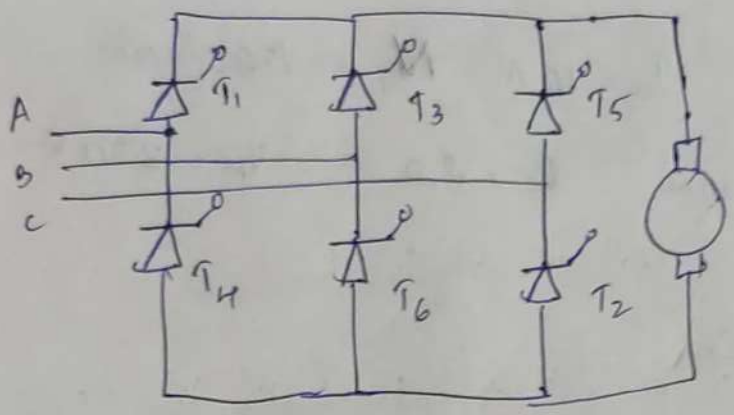
$V_2 = \frac{2 V_m \cos\alpha}{\pi}$

$\frac{V_2 \times \pi}{2 V_m} = \cos\alpha$

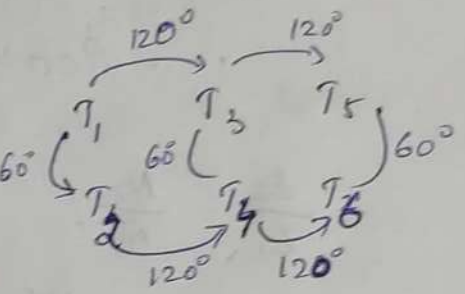
$\alpha = \cos^{-1}\left(\frac{100 \times \pi}{2 \times \sqrt{2} \times 230}\right)$

$= \underline{61.123^\circ}$

2 (c)



Same as RLE load



The thyristor conduction for 120°

For a firing angle of α start conducting at

T_1 - $\alpha + 60°$

T_2 $\alpha + 120°$

T_3 $\alpha + 180°$

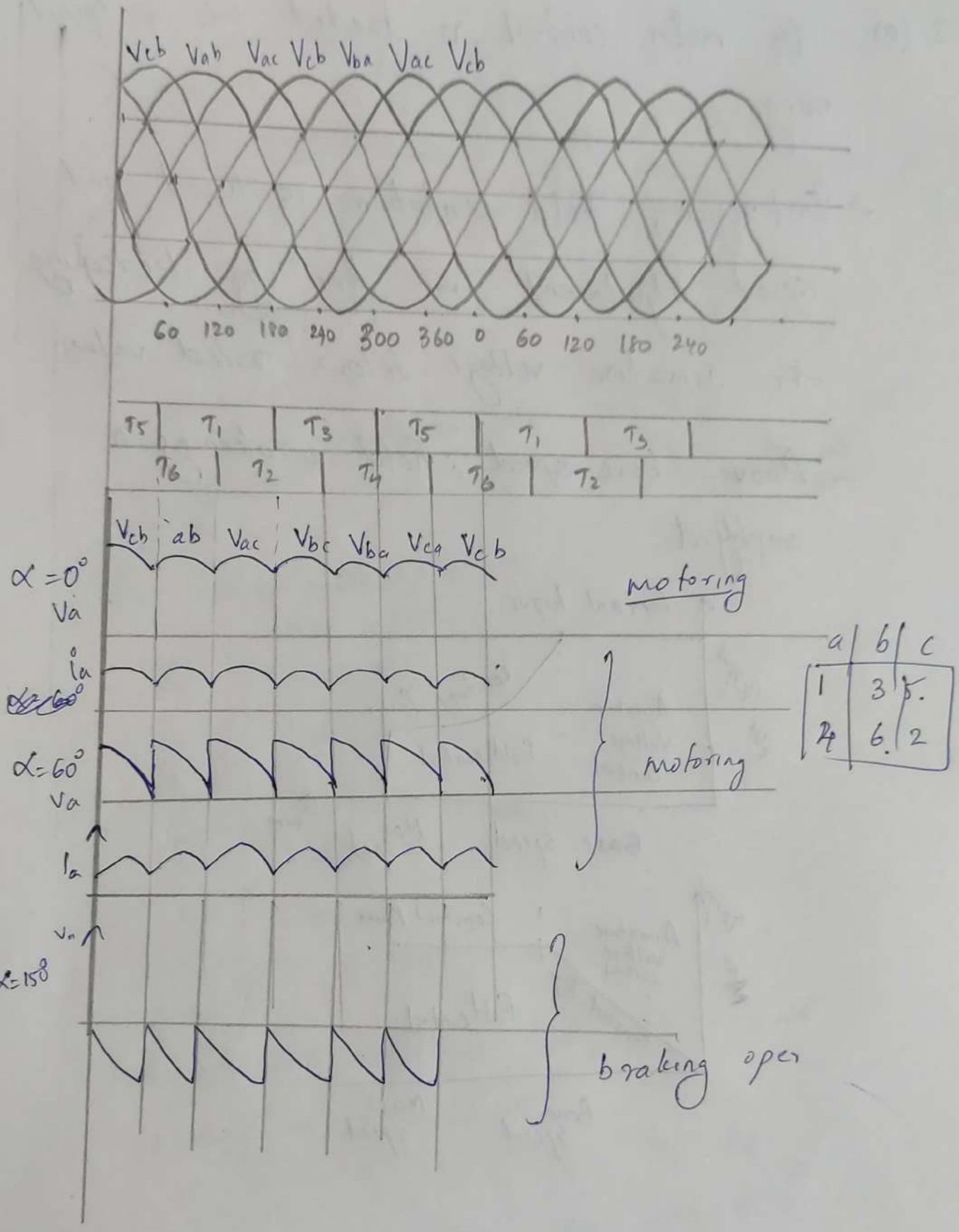
T_4 $\alpha + 240°$

T_5 $\alpha + 300$

T_6 $\alpha + 360°$

Motoring is done at 0, 60, 90 and braking is done at 150°.

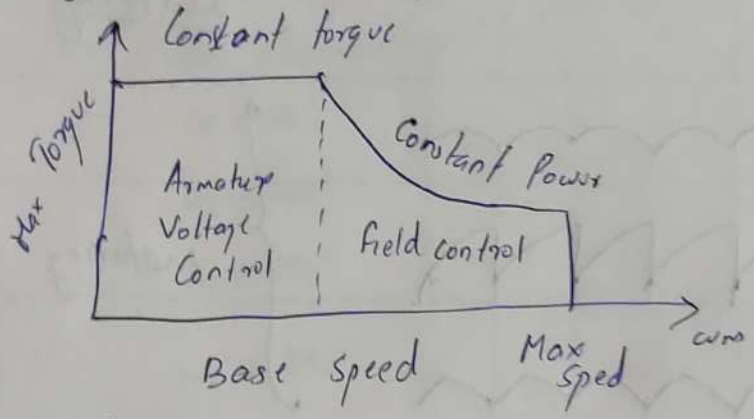
	T_1	T_2	T_3	T_4	T_5	T_6
$\alpha = 0$	60	120	180	240	300	360
$\alpha = 150$	210	270	330	390 ↓ 30°	90°	150

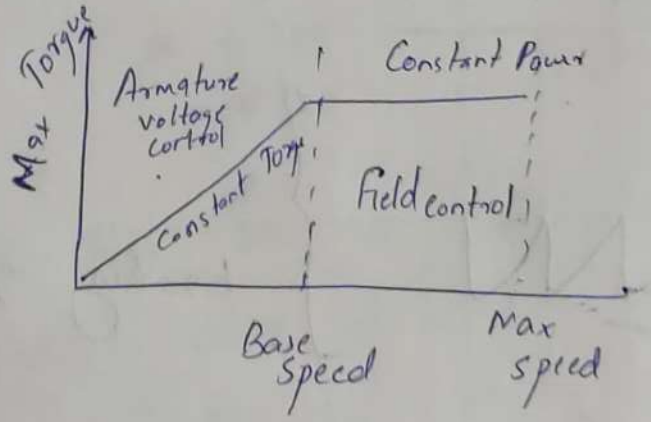

Vcb Vab Vac Vcb Vba Vac Vcb
60 120 180 240 300 360 0 60 120 180 240
T5 T1 T3 T5 T1 T3
T6 T2 T4 T6 T2
Vcb ab Vac Vbc Vba Vca Vcb
α = 0°
Va
ia
α = 60°
Va
Ia
Va
α = 150°
motoring
motoring
braking oper
a b c
1 3 5
4 6 2

2 (a) Dc motor control is divided into 2 speed range.

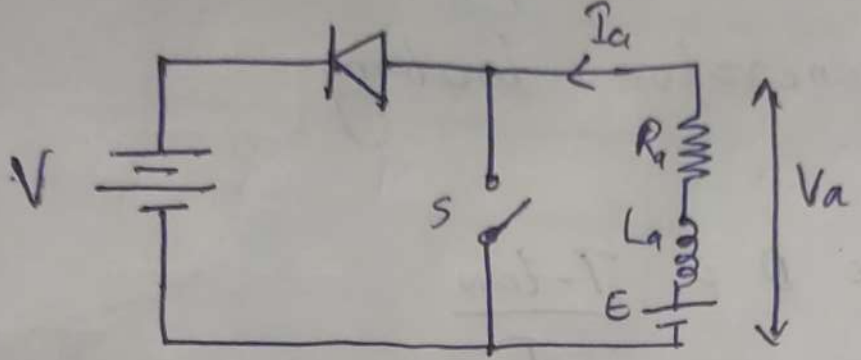
→ First region, field excitation is fixed and speed adjustment are done by decreasing the armature voltage below rated value.

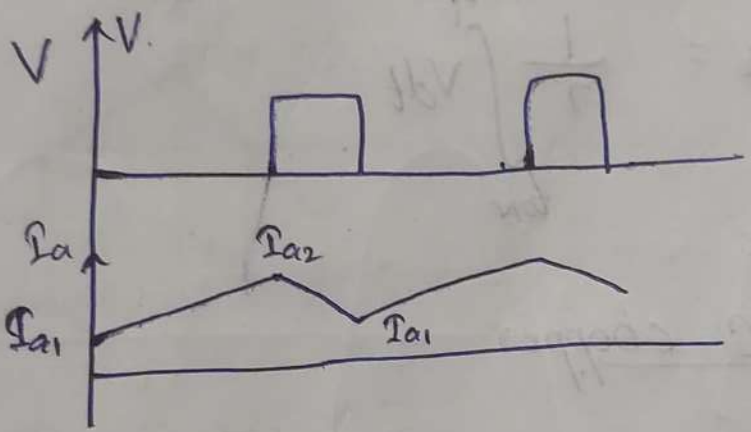
→ Above base speed; field weakening is employed.





10) The chopper circuit which can be used for regenerative braking is class B chopper





when the switch is ON, the armature voltage $V_a = 0$ but armature current changes from I_{a1} to I_{a2} (increases). The machine works as a generator.

→ Inductor stores energy and will be dissipated when switch is turned off.

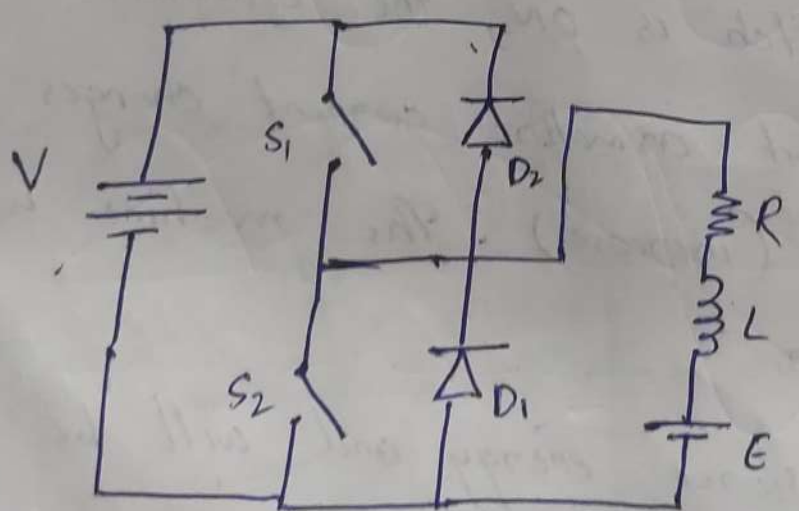
→ When the switch is turned off the current flows back to source through diode

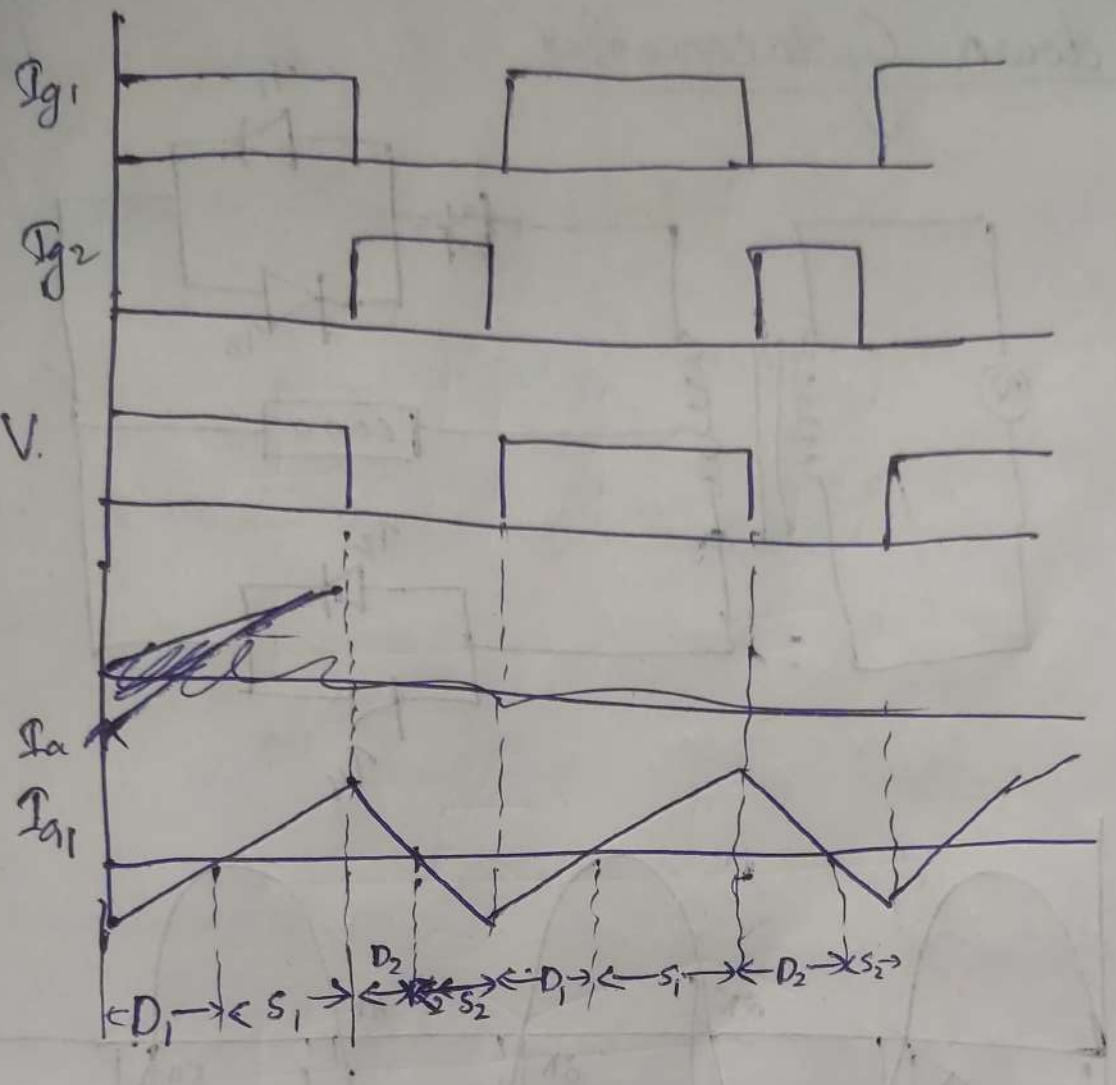
→ This stored energy which is fed back to source is considered the property of regenerative braking or it is used as regenerative braking.

Duty cycle $D = \frac{T - t_{ON}}{T}$

$$\text{Avg } V_a = \frac{1}{T} \int_{t_{ON}}^{T} V dt$$

1 b) Class C chopper





1 c) Types of Cycloconverter.

According to supply voltage

→ Single phase to single phase cycloconverter.

→ 3 phase to 3 phase

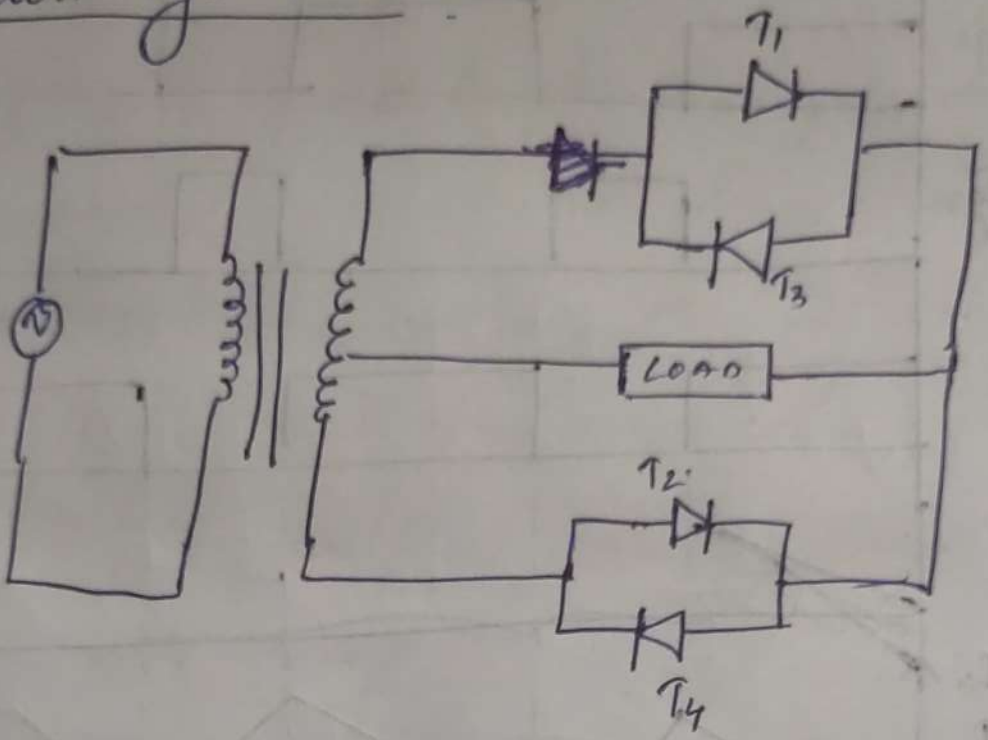
→ 3 phase to single phase.

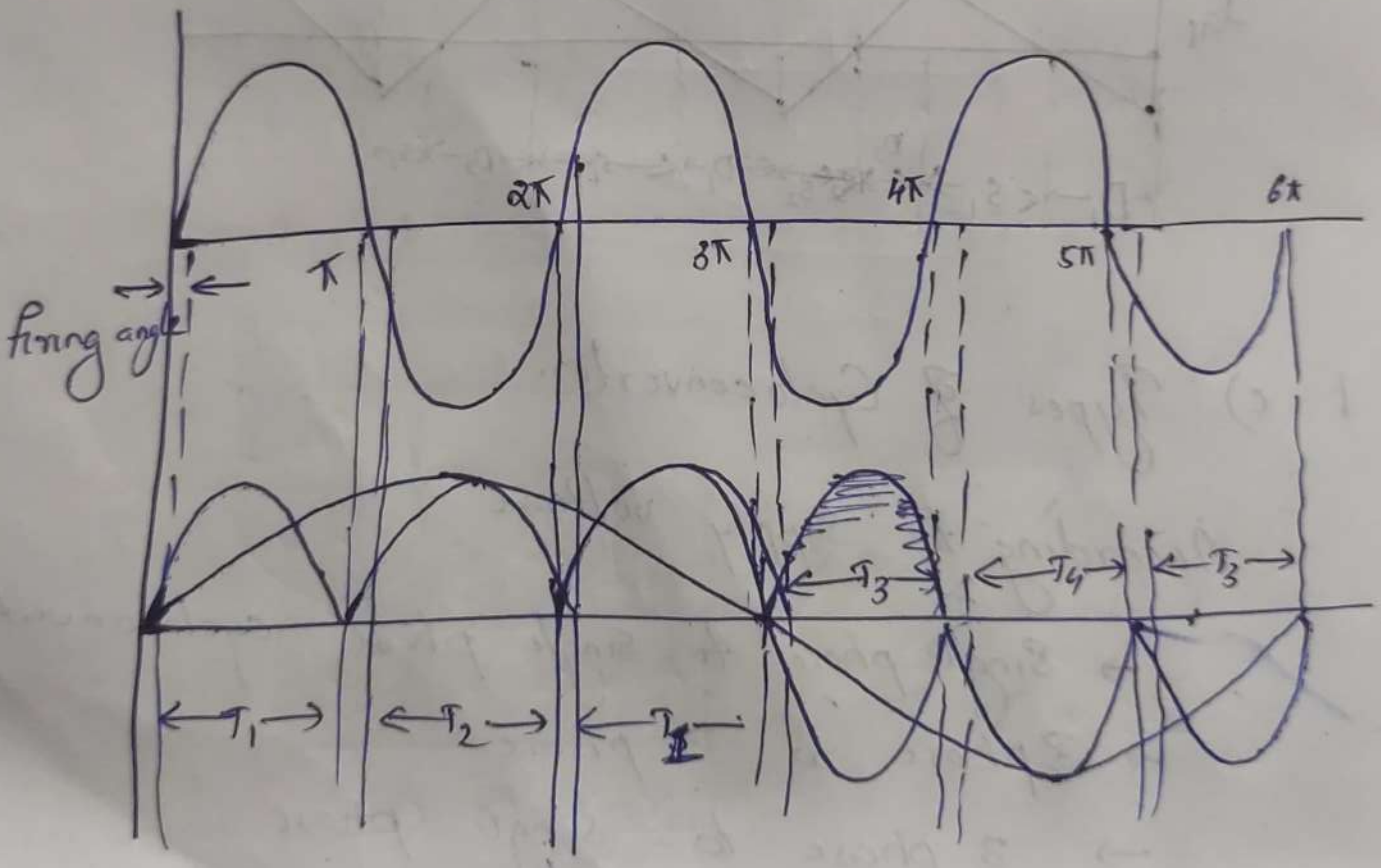
According to Supply frequency & Output frequency

→ Step-down cycloconverter ($f_o < f_s$)

→ Step-up cycloconverter ($f_o > f_s$)

Step - down Cycloconverter





During positive half cycle T_1 is turned on current flows through load at π, T_1 is naturally commutated and T_2 is turned ON current flows through load At 2π, T_2 gets naturally commutated, T_1 is turned ON again

At 3π, T_1 gets naturally commutated T_3 is turned ON, current flows through load,

At 4π, T_3 gets commutated T_4 get ON and current flows through load

At 5π T_4 gets commutated & T_3 turned ON

Here the Output frequency is Frequency is $\left(\frac{1}{3}\right)$ times input frequency.

2a) Stator frequency control

In an Induction motor, the speed torque can be controlled by changing the supply frequency

$$N_s = \frac{120f}{P}$$

$\therefore N_s \propto f$

By changing the stator frequency we could change the speed of the IM but the supply frequency is constant.

So inorder to change the supply frequency certain frequency changer circuits are used.

Commonly used are

(i) Cycloconverters

(ii) Inverters.

By using cycloconverters the AC supply frequency is changed to variable frequency.

Working in low frequencies the cycloconverter can produce small variation which can be used for lower speed large power applications.

→ By inverters we rectification and inversion of AC supplied frequency to change frequency.

2b) V/f Control

We know $E = 4.44 f\phi K T$

$$E \propto f\phi$$

$$\therefore f \propto \frac{1}{\phi}$$

$$\Rightarrow \phi \propto \frac{V}{f}$$

By keeping Voltage constant and reducing frequency, Flux increases

$\therefore N_s \propto f$

Speed decreases

And by increased frequency, flux decrease speed increases

Merits are

→ The current required at the starting is reduced.

→ The motor runs mostly in stable region from 5% of synchronous speed to base speed - So torque can be kept constant

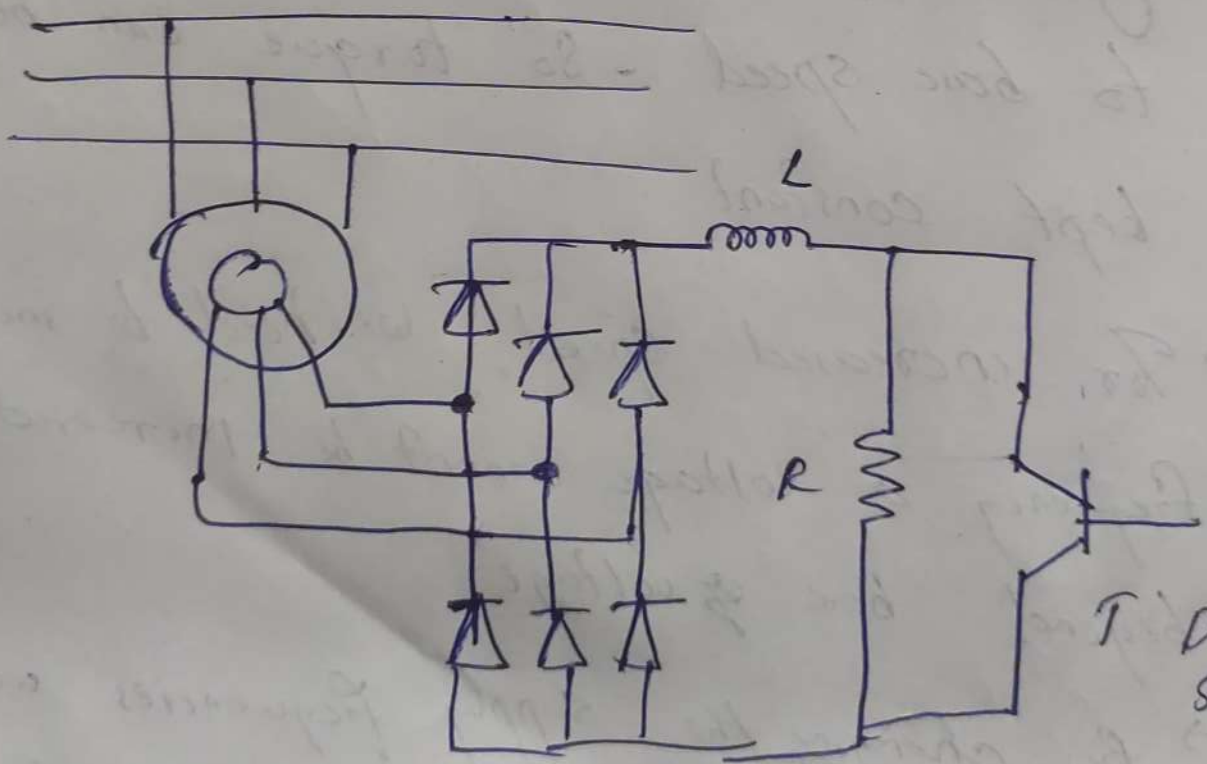
→ For increased speed, we need to increase frequency as voltage cannot be increased beyond base voltage.

→ By changing the supply frequencies we can control acceleration and deceleration of motor.

→ Both speed control and braking are available by changing frequencies.

→ Copper loss and are low and efficiency power factor are high as motor work in synchronous speed and max torque region

2c) Static Rotor Resistance Control.



We know that,

$$T = \frac{S R_2 E_2^2}{R_2^2 + (S X_2)^2}$$

So by changing rotor resistance, we can vary the speed

In Static rotor resistance control, the rotor resistance is varied statically by using chopper circuit.

→ The output voltage of rotor is rectified by diode bridge rectifier.

→ When the switch is turned ON, the resistor is disconnected and when switched is turned off the required resistance connected

→ So by varying the ON-OFF period the the rotor resistance can be varied.

⇒ Disadvantages

→ efficiency is low as additional loss present in resistors connected

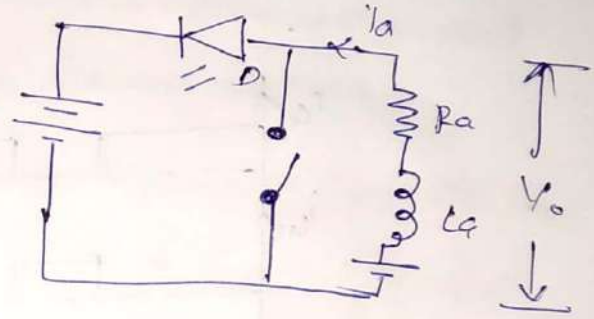
→ efficiency greatly reduced at higher slip

→ If rotor resistance are not equal, unbalance in current & voltages occur.

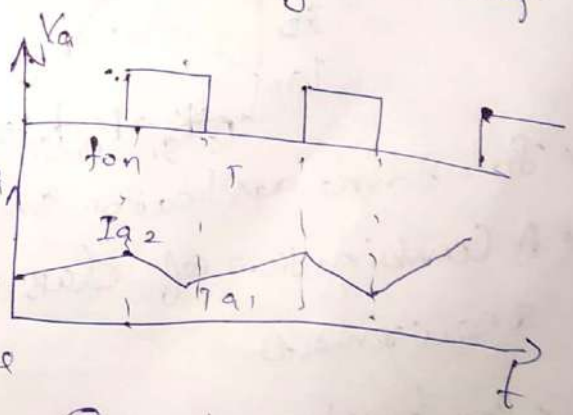
1. A single phase fully controlled converter is used to control a DC separately excited motor of 200V, 900rpm,100A with armature resistance of 0.06Ω. AC source voltage is 210V, 50Hz. Determine firing angle for rated motor torque and 700rpm.
2. Derive the speed torque characteristics of separately excited DC motor and draw its speed torque characteristics for variable armature resistance.
3. What are the different types of braking in DC motors?

1a) Regenerative Breaking - class B Chopper

- During ON period of the switch, armature voltage $V_a = 0$
- Armature Current increases from I_{a1} to I_{a2}
- DC machine works as a generator
- A part of energy is stored in the armature inductance and remainder is dissipated in the armature resistance



- When switch is turned off, armature current flows through diode D and source V
- Armature Current decreases from I_{a2} to I_{a1}
- The stored energy in the inductance and the energy supplied by the machine is fed to the source

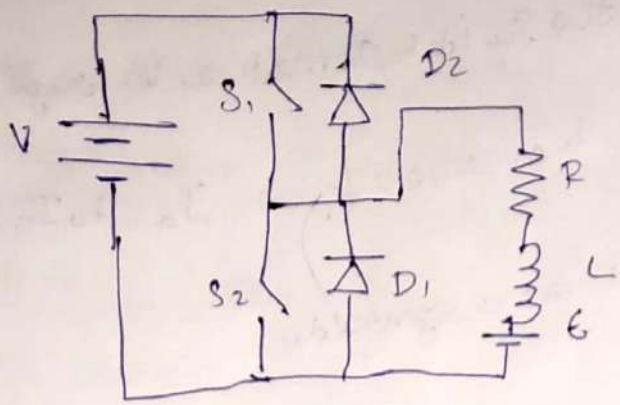


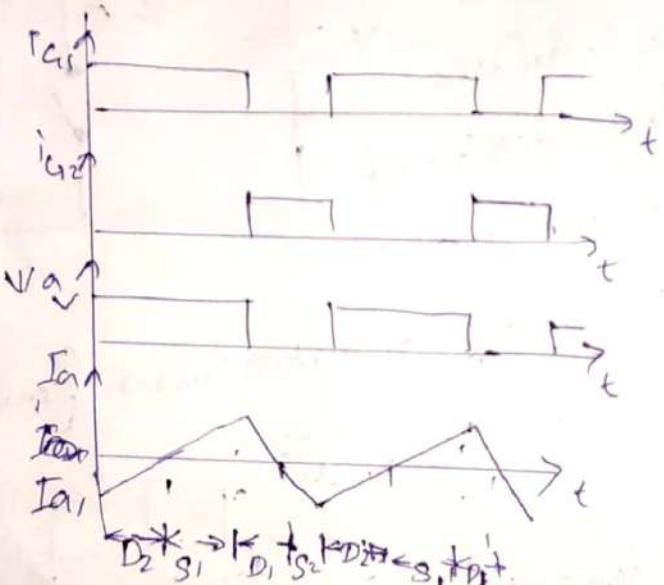
Armature voltage & armature current

- Duty ratio $D = \frac{T - t_{ON}}{T}$
- Average armature voltage, $V_a = \frac{1}{T} \int_{t_{ON}}^{T} V \, dt$
- Speed, $\omega_m = \frac{DV}{K} = \frac{R_a}{K^2} T$

Scanned with CamScanner

1 b) class-C chopper





× for some application smooth transition from motoring to braking is required

× A combination of class A & class B chopper can meet such requirements

× for first quadrant operation S_1 and D_1 will be operated if the average armature current I_a is high enough S_2 and D_2 will not conduct even though S_2 receive gate signal

Scanned with CamScanner

- For second quadrant operation, T_2 and D_2 will be operated
- if the average armature current I_a has sufficient large negative value S_1 and D_2 will not conduct even though S_1 receives gate signal
- The circuit parameters and values of t ON may be such that it would result in discontinuous current in the single quadrant step-down choppers.
- Current in the class C choppers, however cannot be discontinuous because under these condition S_2 and D_2 conduct for period of the cycle.

When the current in D_1 falls to zero, and does negative current through S_2 to store energy in inductance

1c) Cyclo convertors

Types

there are two types of Cyclo Convertors

1. Step down Cyclo Convertors ($f_o < f_i$)
2. Step up cyclo convertors ($f_o > f_s$)

Scanned with CamScanner

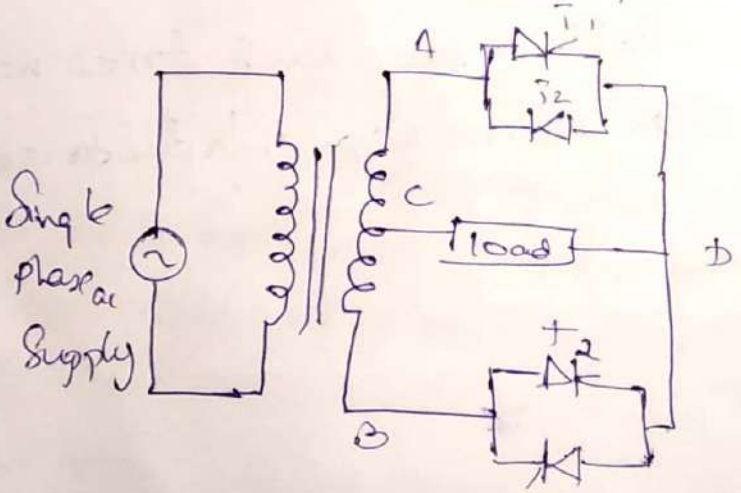
According to Supply Voltage, the classification of Cyclo Converter Include

1. Single phase to Single phase Cyclo Converter
2. Three phase to three phase Cyclo Converter
3. Three phase to Single phase Cyclo Converter

~~The application~~

Single phase Step down Cyclo Converter

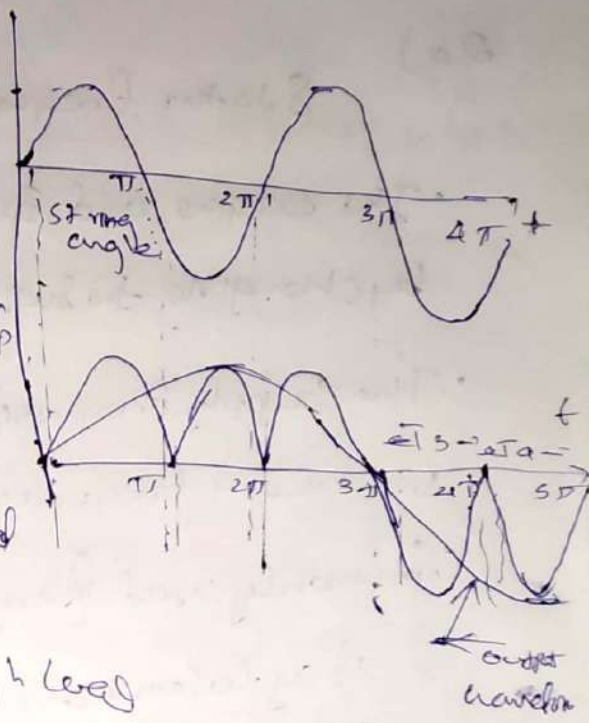
A Step down Cyclo Converter does not require forced Commutation which is provided by Ac Supply



Mid point Cyclo Converter

- During positive half cycle Supply, at $t=0$ SCR T_1 is turned ON

Scanned with CamScanner



- Now load current flows through load
- At π, T1 gets naturally commutated and T2 is turned on
- Now load current flows through load
- At 2π, T2 get naturally commutated i.e T2 is turned on again
- Now load current flows through load

* at 3π, T3 gets Naturally commutated i.e T3 is turned on
* Now load current flows through load

at 4π, T3 get naturally commutated i.e Ta is turned on

- Now load current flows through load

* At 5π, Ta gets naturally commutated i.e T3 is turned on
- Now load current flows through load
- Here the Output frequency is (1/3) times input frequency.

Scanned with CamScanner

2a)

Stator Frequency Control

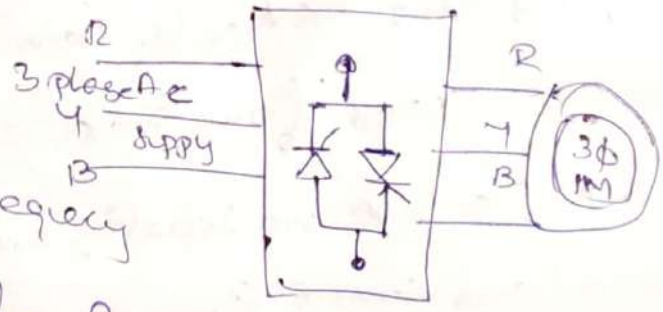
- The torque and speed of an IM can be controlled by changing the supply frequency
- The supply frequency is constant. So to change frequency we need a frequency changer circuit.

Commonly used frequency changer circuit are

1) cyclo converter
2) Inverters

Cyclo Converters

- Converts AC supply frequency to variable frequency

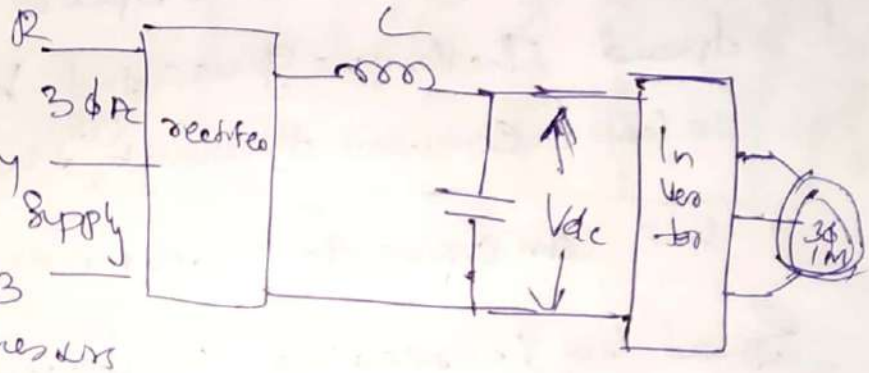


- When Operating at low frequencies, Output has low harmonic content. It increases with frequency making it necessary to limit the Output frequency to 40% of source frequency.
- Maximum Speed is restricted to 40% of synchronous Speed
- ~~Maximum Speed is restricted to 40% of synchronous Speed~~

This will provide a smaller range frequency variation which is suitable for low speed, large power applications like ball mills, cement kiln etc

Inverters

It includes rectification & inversion of supply



- There are two types of inverters
  1) Voltage source inverter (VSI)
  2) Current source inverter (CSI)

The rectifier used can be either a controlled rectifier or uncontrolled rectifier

- The inverter used can be either a PWM inverter or square wave inverter
- Hence output voltage & frequency can be controlled

Scanned with CamScanner

2b) advantages of V/f Speed Control of IM

× The Current required at the Starting is reduced

× The motor runs more in Stable region. Instead of Simple running at its base rated Speed the motor Can be run typically from 5% of the Synchronous Speed up to the base Speed, The torque generated by the motor Can be kept Constant throughout this region.

• We Can drive the motor beyond the base Speed by Increasing the frequency further.

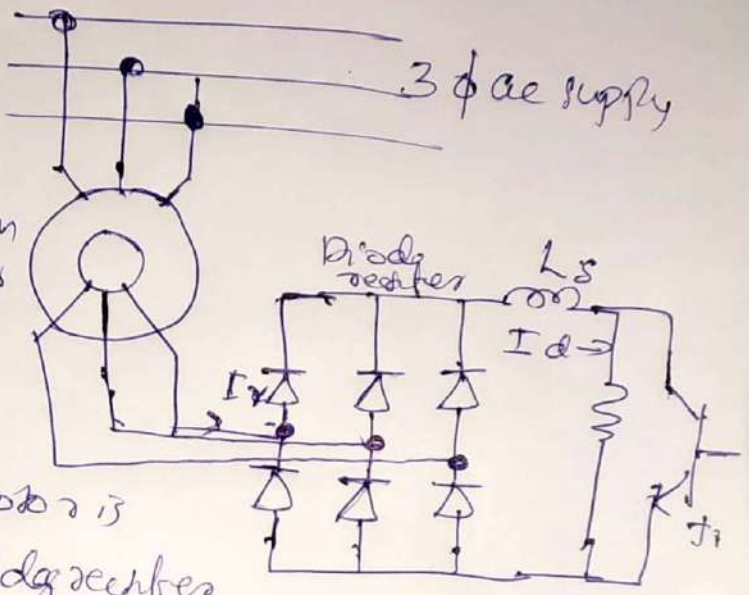
× By changing the Supply frequency to the motor with respect to time we Can Control the Acceleration and deceleration of the motor.

2c) The Speed of the Wound Induction motor Can be Controlled by Connecting an external resistance in the rotor Circuit through Sliprings.

if the resistance of the motor is Increased, then the Pull-Out Speed of the motor decreases. But the maximum torque remains Constant

Scanned with CamScanner

Static Rotor Resistance Control



- Here instead of mechanically varying the rotor resistance, it is varied statically by using the principle of a chopper
- The AC output voltage of rotor is rectified by a diode bridge rectifier
- it is fed to a parallel combination of fixed resistance R and a self commutated switch Tr
- When the switch operates, the resistance R periodically connects & disconnects to DC supply.
- When switch is ON, resistor is disconnected.
- When switch is OFF, resistor is connected.
- So by controlling the ON time of switch (duty ratio), the effective rotor resistance can be varied

Disadvantage

The efficiency is low because of the additional loss present in the resistor connected within the rotor.

The efficiency is greatly reduced at low speed because of the higher value of the slip.

Scanned with CamScanner

Department of Electrical & Electronics Engineering

Course File Index – Theory Course

Sub. Code & Name: EE 308 ELECTRIC DRIVES Class: III/EEE

Name of the Faculty with Designation: Veenaa Raj, AP/EEE

Contents

1. **Course Log Book (Theory)**
   - Details of the subject
   - Time table
   - Year Calendar
   - Details of compensations made for holidays
   - Students' attendance
   - Students' performance in internal tests and assignments.
   - Internal Marks
2. **Students name list**
3. **Syllabus**
4. **Course objectives and outcomes**
5. **Mapping of course outcome and program outcome & program specific outcomes**
6. **Industrial relevance of course / online courses details (NPTEL, MOOC etc)**
7. **Lesson plan & Review**
8. **Question bank**
9. **Previous university question papers & scheme of evaluation (if any)**
10. **Details of Assignment question papers & Sample copy of assignments submitted by the students**
11. **Details of Tutorial questions & Sample copy of tutorials submitted by the students**
12. **Internal exam**
    - Question papers
    - Scheme of evaluation
    - Sample answer sheets
13. **List of students categorized as slow and fast learners**
14. **Details of remedial / honor classes**
15. **Performance evaluation of remedial / honor classes conducted**
16. **End-Semester University Question Paper.**
17. **End-semester university question paper feedback form.**
18. **CO attainment sheet (if applicable)**

KtuQbank

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(S), DECEMBER 2019

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1		What are the functions of power modulator in an electric drive?	(5)
2		A single phase fully controlled converter is used to control a DC separately excited motor of 200V, 900rpm,100A with armature resistance of 0.06Ω. AC source voltage is 210V, 50Hz. Determine firing angle for rated motor torque and 700rpm.	(5)
3		With detailed analysis explain how chopper helps to control a separately excited DC motor drive in motoring mode	(5)
4		How speed of the induction motor can be controlled using stator frequency control.	(5)
5		Differentiate VSI fed induction motor drive with CSI fed induction motor drive	(5)
6		Explain field orientation control of induction motors.	(5)
7		Explain in detail about the different types of PM synchronous motor?	(5)
8		Explain how speed control can be done in a set of multiple synchronous motors	(5)

PART B

Answer any two full questions, each carries10 marks.

9	a)	Illustrate four quadrant operation of drive considering hoist as an example	(6)
	b)	Draw the Torque – Speed characteristics of the following loads (i) Centrifugal pump (ii) Traction load	(4)
10	a)	With the help of block diagram explain in detail about the closed loop speed control of DC motor	(5)
	b)	Draw the armature voltage and armature current waveforms of 3 phase semi-converter-fed DC motor drive for $\alpha=60^{o}$.	(5)
11	a)	Give one application of dual converter for speed control of DC motor.	(5)
	b)	A 220V, 1500rpm, 50A separately exited motor with armature resistance of 0.5Ω is fed from a circulating current mode dual converter with a source voltage	(5)

For More Visit : KtuQbank.com

KtuQbank

KtuQbank

of 165V (line). Determine converter firing angle for the following operating points.

(i) Motoring operation at rated motor torque and 1000rpm

(ii) Braking operation at rated motor torque and 1000rpm.

PART C

Answer any two full questions, each carries10 marks.

12 List different types of cycloconverters. Explain single phase step down cycloconverter with circuit diagram and waveforms. (10)

13 a) Describe dynamic braking operation of chopper fed separately excited DC motor drive. Draw speed-torque curves in motoring and braking mode (5)

b) Describe speed control of induction motors using three phase ac voltage controller. (5)

14 What are the slip power recovery control schemes of induction motors. Explain how static Kramer drive is used to control the speed of induction motors. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 Discuss the operation of CSI fed induction motor drive. Explain its regenerative braking and multi-quadrant operation. (10)

16 a) Give the concept of basic transformation in reference frame theory applied to induction motors. (5)

b) Explain in detail about self-control mode of operation of synchronous motor (5)

17 With block diagram, explain the operation of microcontroller based permanent magnet synchronous motor drives. (10)

***

For More Visit : KtuQbank.com

KtuQbank

COURSE INFORMATION SHEET

PROGRAMME: S6 EEE	DEGREE: B.Tech
COURSE: ELECTRIC DRIVES	SEMESTER: VI CREDITS: 3
COURSE CODE: EE308 REGULATION:2016	COURSE TYPE: CORE / Electrical Engineering
COURSE AREA/DOMAIN: Electrical Engineering	CONTACT HOURS-3 (Tutorial) hours/Week-0

COURSE OBJECTIVES:

1	To provide fundamental knowledge in dynamics and control of Electric Drives.
2	To justify the selection of Drives for various applications.
3	To familiarize the various semiconductor controlled drives employing various motors.

PROGRAM OUTCOMES (PO):

SL. NO	DESCRIPTION
1.	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and

	norms of the engineering practice.
9.	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

COURSE OUTCOMES:

SNO	DESCRIPTION	PO MAPPING
1	Students will be able to analyze a drive being applied in 4 different quadrants.	PO1,PO2,PO6,
2	Students will be able to apply drives being used in real applications	PO1,PO3,PO4,PO12
3	Students will be able to understand the various speed control techniques used in the control of the machine.	PO1,PO2,PO4,PO5,PO10,PO12
4	Students will be able to understand the concept for DC drive	PO1,PO4,PO10
5	Students will be able to understand the concept of speed control for AC drives	PO1,PO4, PO10,PO12
6	Students will be able to select a drive for a particular application and familiarize various control techniques.	PO1, PO2,PO3, PO4,PO6,PO10,PO12

GAPS IN THE SYLLABUS - TO MEET INDUSTRY/PROFESSION REQUIREMENTS:

SNO	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
1	Students are not informed about the simulation of electrical drives using software tools	Bridge Course on MATLAB	PO5

PROPOSED ACTIONS: TOPICS BEYOND SYLLABUS/ASSIGNMENT/INDUSTRY VISIT/GUEST LECTURER/NPTEL ETC

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

SNO	DESCRIPTION	PO MAPPING
1	Students shall be given basic briefing to actual drives at Drives Lab	PO3,PO11
2	Students can be introduced to the simulation using MATLAB	PO5

WEB SOURCE REFERENCES:

1	Video Lectures on Electric Drives and their Applications by Dr. S. Chatterji [Online] Available https://www.youtube.com/watch?v=SUCwqwBUOKM&t=6s
2	NPTEL Lectures [Online Available] http://nptel.ac.in/courses/108102046/
3	NPTEL video Lecture By Prof. K. Gopakumar , on Industrial Drives- Power Electronics [Online] Available http://nptel.ac.in/courses/108108077/

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓ CHALK & TALK	✓ STUD. ASSIGNMENT	☐ WEB RESOURCES	
☐ LCD/SMART BOARDS	☐ STUD. SEMINARS	☐ ADD-ON COURSES	

ASSESSMENT METHODOLOGIES-DIRECT

✓ ASSIGNMENTS	☐ STUD. SEMINARS	✓ TESTS/MODEL EXAMS	✓ UNIV. EXAMINATION
☐ STUD. LAB PRACTICES	☐ STUD. VIVA	☐ MINI/MAJOR PROJECTS	☐ CERTIFICATIONS
☐ ADD-ON COURSES	☐ OTHERS		

ASSESSMENT METHODOLOGIES-INDIRECT

☐ ASSESSMENT OF COURSE OUTCOMES (BY FEEDBACK, ONCE)	✓ STUDENT FEEDBACK ON FACULTY (TWICE)
☐ ASSESSMENT OF MINI/MAJOR PROJECTS BY EXT. EXPERTS	☐ OTHERS

CORRELATION BETWEEN COURSE OUTCOMES AND PROGRAM OUTCOMES

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				2						
CO2	3		2	2							2	
CO3	3	2		2						2	2	

CO4	3			1								
CO5	3			2							2	
CO6	3	2	2	2		2				2	2	
AVG	**3**	**2**	**2**	**1.8**		**2**				**2**	**2**	

Correlation Levels 1, 2 or 3 are defined below

1: Slight (Low) **2: Moderate (Medium)** **3: Substantial (High)**

Prepared by
Veenaa Raj

Approved by
(HOD)

AHALIA SCHOOL OF ENGINEERING & TECHNOLOGY
(ISO 9001:2015 Certified Institution)
Approved by AICTE & Affiliated to A. P. J. Abdul Kalam Technological University
Ahalia Health, Heritage & Knowledge Village, Palakkad - 678557. Ph: 04923-226666, www.ahalia.ac.in

First Internal Test, May 2021			
Dept.:	Electrical & Electronics Engineering	Semester:	S6
Course. Code:	EE 308	Course Name:	Electric Drives
Duration:	90 minutes	Maximum Marks:	40 Marks
Date:			
(Special Instructions, if any)			

			Marks	CO	PO	PSO	BL
PART - A							
Answer all questions							
1	a.	Draw the block diagram of a closed loop speed control of an electric drive.	5	1	1	1	K1
	b.	What are the different components of a load torque? Explain each component in detail.	5	1	1	1	K1
	c.	a. Illustrate four quadrant operation of drive considering hoist as an example. b. Draw the torque-speed characteristics of the following loads 1. Centrifugal Pump 2. Traction load	10	1	1,2, 6	1	K1, K2, K3
PART – B							
Answer all questions							
2.	a.	Explain the armature voltage control and field weakening mode control of DC separately excited motor drive system.	5	2	1	2	K2
	b.	A 220 V, 1500 rpm, 10 A separately excited motor has an armature resistance of 2Ω. The motor is driven from a single-phase fully-controlled rectifier operating in continuous conduction mode. The input is rated at 230V, 50Hz. Calculate firing angle of the controlled rectifier if the motor runs at 600 rpm developing rated torque.	5	2	1,2, 3	1	K3
	c.	With a neat sketch, explain the motoring and braking operation of three phase fully controlled rectifier control of separately exited DC motor.	10	2	1,2, 3	2	K2

AHALIA SCHOOL OF ENGINEERING & TECHNOLOGY
(ISO 9001:2015 Certified Institution)
Approved by AICTE & Affiliated to A. P. J. Abdul Kalam Technological University
Ahalia Health, Heritage & Knowledge Village, Palakkad - 678557. Ph: 04923-226666, www.ahalia.ac.in

First Internal Test, May 2021			
Dept.:	Electrical & Electronics Engineering	Semester:	S6
Course. Code:	EE 308	Course Name:	Electric Drives
Duration:	90 minutes	Maximum Marks:	40 Marks
Date:			
(Special Instructions, if any)			

			Marks	CO	PO	PSO	BL
PART - A							
Answer all questions							
1	a.	. With a chopper circuit and waveforms explain the regenerative braking of a DC motor drive.	5	2	1	1	K1, K2
	b.	Draw the circuit diagram of a class-C chopper fed DC motor. Draw its V/I characteristics.	5	2	1	1	K1, K2
	c.	List different types of cycloconverters. Explain single phase step down cycloconverter with circuit diagram and waveforms.	10	2,5	1,3	1	K1, K2, K3
PART – B							
Answer all questions							
2.	a.	How speed of the induction motor can be controlled using stator frequency control.	5	2	1	2	K1, K2
	b.	List and explain the merits of constant V/f control of Induction Motor.	5	2	1,2, 3	1	K1, K2
	c.	Explain the closed loop static rotor resistance control method for the speed control of a slip ring induction motor. What are the disadvantages of this method?	10	2	1,2, 3	1	K1, K2

Module: 6

Q. Explain the classification of synchronous m/cs?

Q. Explain types of motors used in synchronous m/cs?

Q. Explain principle of operation of synchronous motors?

Q. Explain methods of starting synchronous motors?

AHALIA SCHOOL OF ENGINE

(ISO 9001:2015 Certified Institution)
Approved by AICTE & Affiliated to A. P. J. Abdul Kalam Tec
Ahalia Health, Heritage & Knowledge Village, Palakkad - 678557. Ph: (

Details of Students Internals

Department of Electrical & Electronics Engineering

Semester:S6 **Academic year: 2020-2021** **Subject: EE 30**

Sl.No	Reg.No.	Student Name	T1	T2	Avg (40)
1	ATP18EE001	A KAREEM ARSHAD	27	31	29
2	ATP18EE002	AMARNATH S	28	31	29.5
3	ATP18EE003	ANAGHA K B	29	31	30
4	ATP18EE004	ANUJITH S	32	34	33
5	ATP18EE005	ARJUN K	37	37	37
6	ATP18EE006	HRITHIK H	29	34	31.5
7	ATP18EE007	JAMSHEER J	29	36	32.5
8	ATP18EE008	RAHUL R	29	31	30
9	ATP18EE009	RASHIK S A	26	29	27.5
10	ATP18EE010	SREEJITH A	32	34	33
11	LATP18EE011	ASUN K S	31	37	34
12	LATP18EE012	RAHUL B	25	24	24.5

8 Electric Drives

A1	A2	Avg (10)	Internals	Final	Attendance %
7	0	7	36	39	75%
9	8	8.5	38	41	83%
9	9	9	39	42	98%
9	9	9	42	45	91%
9	9	9	46	49	98%
8	9	8.5	40	43	85%
9	8	8.5	41	44	94%
9	8	8.5	38.5	42	85%
9	8	8.5	36	39	81%
9	9	9	42	45	85%
9	9	9	43	46	89%
9	9	9	33.5	37	85%

*Generated on: 2021-08-09,19:39:19

APJ Abdul Kalam Technological University
CET Campus, Thiruvananthapuram
Kerala -695016
India

AHALIA SCHOOL OF ENGINEERING AND TECHNOLOGY

Students Examination Eligibility Details

Academic Year : 2020 - 2021 **Degree Type : Regular**

Program : B.Tech(Full Time) **Branch : ELECTRICAL AND ELECTRONICS ENGINEERING** **Semester : S3**

Course Name ANALOG ELECTRONICS LAB-EEL203 **Batch : 1**

Student	Internal Marks / Attendance %	Availed Leaves	Disc. Action	Eligible for Written Exam	Status	In-eligibility Type
BASIL SHAJI Register No : ATP19EE001	Internal Marks : 69.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	
GAUTHAM M Register No : ATP19EE002	Internal Marks : 74.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	
Jijith V Register No : ATP19EE003	Internal Marks : 70.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	
J UNNIKRISHNAN Register No : ATP19EE004	Internal Marks : 73.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	
PRAMOD KRISHNA P Register No : ATP19EE005	Internal Marks : 75.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	

VAISHNAVI V Register No : ATP19EE006	Internal Marks : 74.0/75 Attendance : 100.0	Long Leave : Duty Leave :		Yes	Submitted by college	

EE 308- ELECTRIC DRIVES

Series 2- Valuation Scheme

PART-A

1. a) Chopper circuit diagram – 1 mark
   Waveforms – 2 marks
   Explanation of regenerative braking – 2 marks

   b) Circuit diagram of chopper – 1 mark
   Waveforms – 2 marks
   Explanation of class C chopper – 2 marks

   c) Types of cycloconverters – 3 marks
   Circuit diagram of 1ϕ step down cycloconverter } – 2 marks
   Waveform – 2 marks
   Explanation of working – 3 marks.

PART-B

2. a) Explanation of stator frequency control with the help of equation } – 3 marks
   Methods of speed control – 2 marks

b. List any five merits of V/f control – 5 marks

c. Schematic of closed loop static rotor resistance control } – 3 marks

Explanation – 3 marks

Disadvantages – 3 marks.

RE 308 - ELECTRIC DRIVES

Series 1 - Valuation Scheme

PART - A

1. a) Block diagram of closed loop speed control - 3 marks
   Explanation of block diagram - 2 marks

   b) Different components of load torque - 1 mark
   Explanation of each component - 3 mark

   c) a. Diagram - 2 marks
   Explanation with reference to figure - 4 marks

   b. 1) Torque - speed characteristics of centrifugal pump } - 2 marks

   2) Torque - speed characteristics of traction load } - 2 marks

PART - B

2. a) Graphical representation - 1 mark
   Armature voltage control - 2 mark
   Field weakening mode - 2 mark

b Finding rated R.M.F - 1 mark
(200 V)

Finding V_2 using eqn - 2 mark
(100 V)

Finding firing angle $\alpha = 61.12^\circ$ - 2 marks

c. Schematic of 3 ϕ fully controlled rectifier - 2 marks
Motoring action explanation - 1 mark
Braking action explanation - 1 mark
Firing angle table - 2 mark
Graph for both motoring & braking - 4 marks

Course code	Course Name	L-T-P-Credits	Year of Introduction
EE308	Electric Drives	3-0-0-3	2016

Prerequisite: EE202 & EE205

Course Objectives

- To provide fundamental knowledge in dynamics and control of Electric Drives.
- To justify the selection of Drives for various applications.
- To familiarize the various semiconductor controlled drives employing various motors.

Syllabus

Fundamentals of dynamics and control of electric drives– separately excited dc motor drives using controlled rectifiers — chopper controlled dc drives – ac voltage controllers – three phase induction motor speed control – VSI and CSI fed induction motor drives – synchronous motor drives

Expected outcome.

The students will be able to select a drive for a particular application. They will familiarize with the various control techniques employed for controlling drives with ac and dc motors.

Text books

1. Bimal K. Bose "Modern power electronics and AC drives" Pearson Education, Asia 2003
2. Dubey G. K. "Power semiconductor control drives" Prentice Hall, Englewood Cliffs, New Jersey, 1989

References:

1. Dewan S.B. , G. R. Slemon, A. Strauvhen, "Power semiconductor drives", John Wiley and sons
2. Dr. P. S. Bimbra "Power electronics", Khanna publishers
3. J. M. D. Murphy "Thyristor control of AC drives"
4. N. K. De, P. K. Sen "Electric drives" Prentice Hall of India 2002
5. Ned Mohan, Tore m Undeland, William P Robbins, "Power electronics converters applications and design", John Wiley and Sons.
6. Pillai S. K. "A first course on electric drives", Wieley Eastern Ltd, New Delhi
7. Vedam Subrahmanyam, "Electric Drives", MC Graw Hill Education, New Delhi
8. W. Shepherd, L. N. Hulley and D. T. Liang, "Power Electronocs and motor control", Second Edition, Cambridge University Press, 1995.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to electric drives – Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives.	7	15%
II	DC motor drives- constant torque and constant power operation, separately excited dc motor drives using controlled rectifiers, single phase semi converter and single phase fully controlled converter drives. Three phase semi converter and fully controlled converter drives. Dual converters, applications of dual converter for speed control of DC motor. Closed loop control of separately excited dc motor drive. DC series motor drive for traction application.	7	15%
FIRST INTERNAL EXAMINATION			

KTUNOTES.IN

III	Chopper controlled DC drives. Analysis of single quadrant chopper drives. Regenerative braking control. Two quadrant chopper drives. Four quadrant chopper drives. Cycloconverters for drive applications – different types – basic principle.	7	15%
IV	Three phase induction motor speed control. Using semiconductor devices. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f). Rotor chopper speed control - slip power recovery control schemes – sub synchronous and super synchronous speed variations.	7	15%
SECOND INTERNAL EXAMINATION			
V	Voltage source inverter fed induction motor drives, Current source inverter fed induction motor drives. Concept of space vector – Basic transformation in reference frame theory – field orientation principle.	7	20%
VI	Synchronous motor drives – introduction to v/f control. Permanent Magnet synchronous motor drives – different types – control requirements, converter circuits, modes of operation. Microcontroller based permanent magnet synchronous motor drives (schematic only).	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

KTUNOTES.IN

ED

① Types of synchronous machine.

a Rotating armature type - The armature winding is housed in the ~~cooled~~ rotor. The emf generated or current is supplied to load via slip ring and carbon brush assemply. for small rating.

b Rotating field type - field winding is wound on rotor. DC supply is extended to the field winding by assembly of slip ring and carbon brush. Electrical power is supplied to load using stationary terminals on stator.

② Types of rotor.

a Round rotor / cylindrical type : Are used with high-speed turbines Due to large centrifugal forces, rotor has long, narrow, solid steel cylinder. The field winding are mounted in slots that are mill-cut into about 2/3 of perimeter.

b. Salient pole rotor : Are used with low speed hydro turbines. It have multiple pole pairs. field windings are mounted on the individual poles.

③ Synchronous motor.

- A synchronous motor is one in which the rotor normally rotates at same speed at revolving field in the machine

ED

The stator will be supplyed with a 3phase winding and rotor will have a dc supply through slip rings.

- The stator current establishes a rotating magnetic field at $\frac{120f}{P}$ rpm.
- The rotor supplied by dc supply also have a rotating magnetic field.
- The rotor speed is made equal to that of rotating magnetic field of stator, then ~~thos~~ these two magnetic field will tent to align each other. And runs synchronously with speed of rotating stator magnetic field

(4) Methods of starting synchronous motor

- using pony motors: in this rotor is bought to synchronous speed with small induction motor and when rotor attains synchronous speed the pony motor is removed and dc supply is given to rotor.
- using Damper winding: An additional winding consisting of copper bars short circuited with end rings are placed in slots acts on squirrel cage rotor winding which will allow the motor to start rotating as an induction motor of sub-synchronous speed and when dc supply is given motor gets pulled to synchronous
- using small DC machines
- using slip rings as same as damper winding.

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Dr. G. Murugananth (Prof.& Head/EEE)

Academic Year: 2020-21 **Sem : EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday	**EMA**				
Tuesday		**EMA**			
Wednesday		**EMA**			
Thursday		**EMA**			
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday					
Saturday					

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
EMA	EE 474	Energy Management and Auditing	Dr. G Murugananth Professor & Head EEE	3	0	0	4
Total No. of Sessions							**4**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Mr. A MANICKAVASAGAM(AP EEE)

Academic Year: 2020-21 **Sem: EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday			**SEM**		**PSA**
Tuesday	**SEM**		**PSA**		
Wednesday	**SEM**		**PSA**		
Thursday	**PSA**				
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday		**SEM**			
Saturday			**PSA**		

Abbreviation	**Subject Code**	**Subject**	**Class**	**No. of Sessions/ week**			**No. of Sessions**
				L	**T**	**P**	
SEM	EE 402	Special Electrical Machines	S8 EEE	3	0	0	4
PSA	EE306	Power System Analysis	S6 EEE	5	0	0	5
PP	EE 492	Project	S8 EEE	0	0	6	
Total No. of Sessions							**9**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Lakshmy Suresh (AP EEE)

Academic Year: 2020-21 **Sem: EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday			**DCMT**		
Tuesday			**DCMT**		
Wednesday	**BMI**				**BMI**
Thursday	**DCMT**			**BMI**	
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday			**DCMT**		**BMI**
Saturday			**DCMT**		

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
BMI	EE372	Biomedical Instrumentation	S6 EEE	4	0	0	4
DCMT	EET202	DC Machines and Transformers	S4 EEE	2	2	0	5
Total No. of Sessions							**9**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: **Sowmya S(AP EEE)**

Academic Year:2020-21 **Sem:EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday	**ACT**		**BEE**		
Tuesday				**ACT**	
Wednesday		**ACT**			
Thursday	**BEE**		**ACT**		
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday		**ACT**			
Saturday	**BEE**				

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
ACT	EE304	Advanced Control Theory	S6 EEE	4	1	0	5
BEE	EST 130	Basics of Electrical Engineering	S2 CSE/EE/EC	2	1	0	3
						Total No. of Sessions	**8**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Swathy M V(AP EEE)

Academic Year: 2020-21 **Sem: EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday		**EM**		**ET**	
Tuesday		**ET**			**EM**
Wednesday	**ET**			**EM**	
Thursday		**EM**		**ET**	
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday		**ET**			
Saturday	**EM**				

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
EM	EE302	Electromagnetics	S6 EEE	3	1	0	5
ET	EET 204	Electromagnetic Theory	S4 EEE	3	1	0	5
Total No. of Sessions							**10**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Veenaa Raj (AP EEE)

Academic Year: 2020-21 **Sem: EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday		**DE**		**ED**	
Tuesday	**ED**				**DE**
Wednesday			**DE**		
Thursday		**DE**			
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday			**ED**		**DE**
Saturday		**ED**			

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
ED	EE308	Electric Drives	S6 EEE	4	0	0	4
DE	EET206	Digital Electronics	S4 EEE	3	1	0	5
Total No. of Sessions							**9**

Timetable Co-ordinator **HoD** **Principal**

Form No: ASET-EE/AC02/FM03

Faculty Individual Timetable

Department of Electrical And Electronics Engineering

Name of the Faculty with Designation: Subin Chacko (AP EEE)

Academic Year: 2020-21 **Sem: EVEN**

Session / Time/Day	1	2	3	4	5
	08.30 am – 09.15 am	09.45 am – 10.30 am	10.45 am – 11.30 am	11.45 am – 12.30 am	12.45 am – 01.30 pm
Monday	**PE**			**IIM**	
Tuesday					
Wednesday				**IIM**	
Thursday			**IIM**		**PE**
(Friday timings)	08.00 am – 08.45 am	09.15am – 10.00 am	10.15am – 11.00 am	11.15 am – 12.00 am	12.15 pm – 01.00 pm
Friday				**IIM**	
Saturday		**PE**			

Abbreviation	Subject Code	Subject	Class	No. of Sessions/ week			No. of Sessions
				L	T	P	
IIM	EE 404	Industrial Instrumentation & Automation	S8 EEE	3	0	0	4
PE	HUT 200	Professional Ethics	S4 EEE	2	0	0	3
Total No. of Sessions							**7**

Timetable Co-ordinator **HoD** **Principal**

1. $V = 200V$

$N_1 = 900$ rpm

$N_2 = 700$ rpm

$V_m = 210V$

$I_a = \cancel{+00A}\ 100A$

$R_a = 0.06\ \Omega$

E at 900 rpm

$$E_1 = V - I_a R_a = 200 - 100 \times 0.06$$

$$= 194V$$

E_2 at 700 rpm

$$\frac{E_1}{E_2} = \frac{N_1}{N_2}$$

$$E_2 = \frac{N_2}{N_1} \times E_1 = \frac{700}{900} \times 194 = \underline{151V}$$

$$V_a = E + I_a R_a$$

$$= 151 + 100 \times 0.06 = \underline{157V}$$

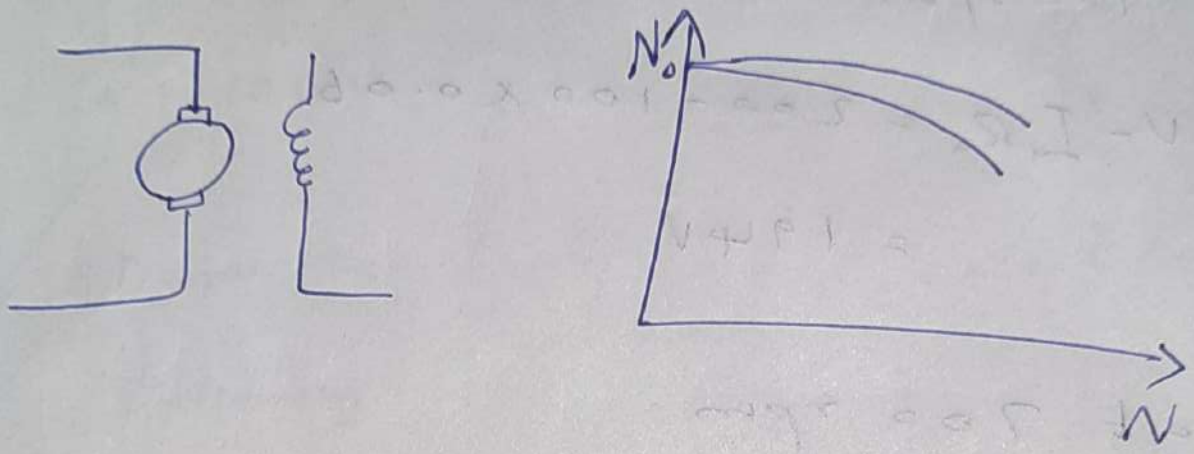
$$V_a = \frac{2V_m}{\pi} \cos\alpha$$

$$157V = \frac{2 \times 210 \times \sqrt{2}}{\pi} \cos\alpha$$

$$\alpha = \cos^{-1}\left(\frac{157 \times \pi}{2 \times 210 \times \sqrt{2}}\right)$$

$\alpha = 33.86^\circ$

2) Speed Torque characteristic of separately Excited DC motor.



$V_a = E + I_a r_a$ — ① E is back emf of armature

$E = \frac{2\phi NP}{60a}$ P; Poles
Z no of conductor
a no of parallel paths

$= K_c \phi N = \underline{K_t \phi \omega}$ $\omega = \frac{2\pi N}{60}$ angular velocity

~~$E = K\phi\omega$ — ②~~ $E = K\phi\omega$ — ②

② on ① $\Rightarrow V = K\phi\omega + I_a r_a$

$N = V_a - I_a r_a / K_c \phi$ — ③

Torque developed by motor.

$$T_d = \frac{1}{2\pi} 2p\phi \frac{I_a 2}{2a} = K_t \phi I_a \quad \text{---} (4)$$

From (2) & (4)

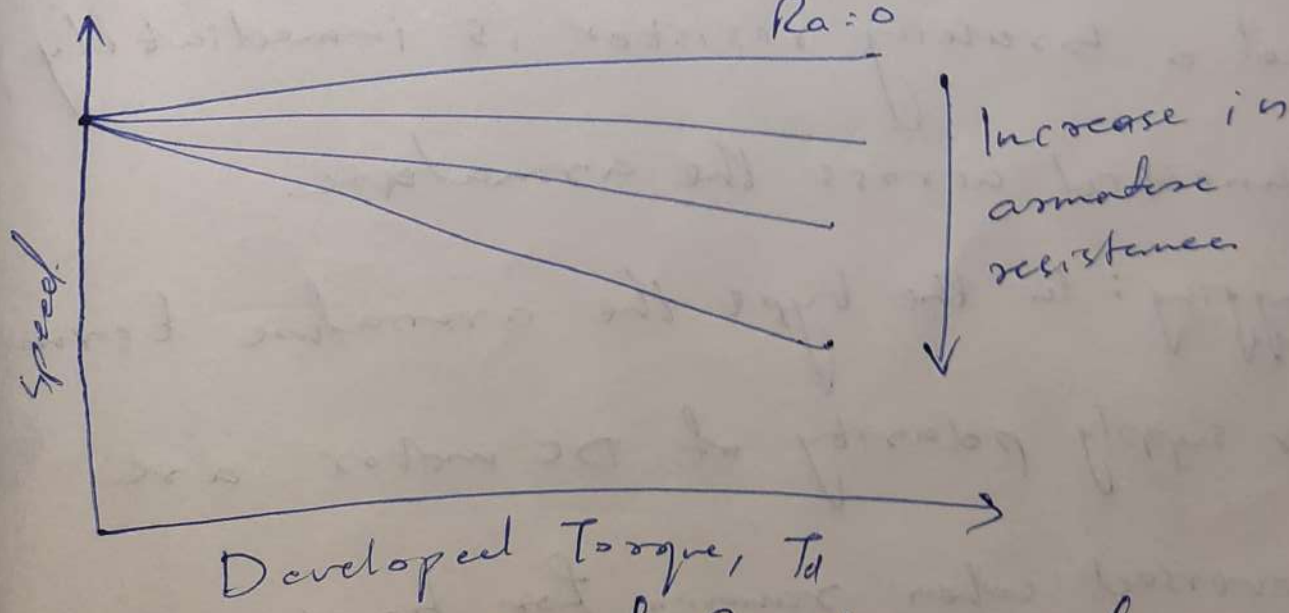
$$N = \frac{V_a}{K_e \phi} - \frac{T_d}{K_t K_e \phi^2}$$

when $T_d = 0$

$$N = \frac{V_a}{K_e \phi}$$ No load speed

Motor speed decreases as torque developed increases.

with variable resistance. (armature)



with suitable value of Ra, slow speed are possible

3, Different type of braking in DC motor

a, Regenerative Braking: It is the form of braking in which the kinetic energy of motor is returned to the power supply system.

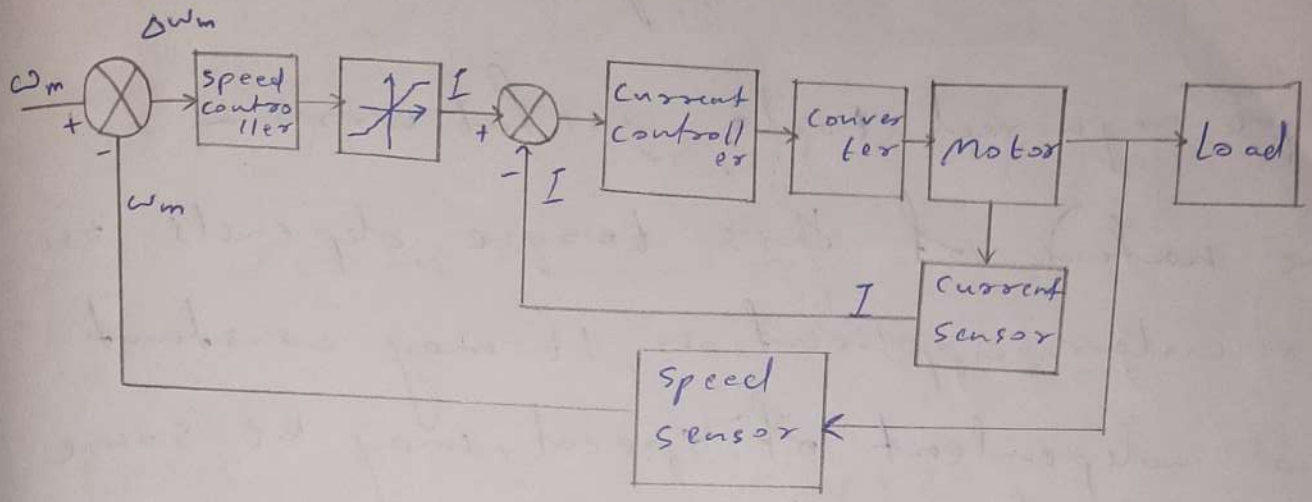
It cannot be used to stop the motor but to stop the motor but to control its speed above the no-load speed.

b, Dynamic braking: In this type, the DC motor is disconnected from the supply and a braking resistor is immediately connected across the armature

c, plugging: In the type the armature terminals or supply polarity of DC motor are reversed when running for braking

1/

a) Block diagram - closed loop speed control



1/

b) the different components are Fricton torque, winage torque, and Torque needed for useful work.

Friction torque - its the torque present in the motor shaft and other parts of the load.

- This torque is equivalent to the various friction torques reflected to the motor shaft.

Windage torque -

- while motor is running, the wind will generates an opposing torque to the motor it is called windage torque.

Torque required to do useful work. -

- The nature of this torque depends on particular application. It may constant and independent of speed, may be some function of speed, may be time variant or time invariant etc.

2,

b) $V = 220$

$I_a = 10 \quad Ra = 2$

$E = 220 - 10 \times 2 = 200V$

we know

$$\frac{E_1}{E_2} = \frac{N_1}{N_2}$$

$$E_2 = \frac{E_1 \times N_2}{N_1}$$

$$= \frac{220 \times 600}{1500} = \underline{\underline{80V}}$$

$V_a = \not{E} + I_a R_a$

$= 8 + 10 \times 2$

$= 100V$

$V_m = 230 \times \sqrt{2}$

$\not{2}V$

$\frac{2V_m \cos\alpha}{\pi} = V_a$

$\cos\alpha = \frac{V_a \times \pi}{2V_m}$

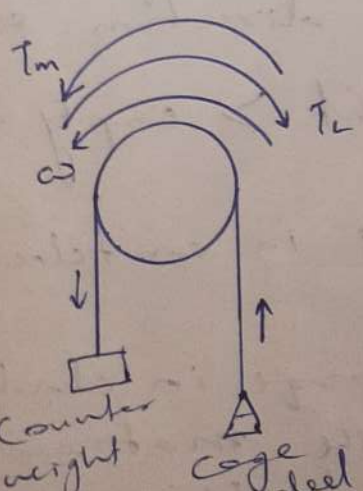
$\cos\alpha = \frac{100 \times \pi}{2 \times 230 \times \sqrt{2}} = 0.4829$

$\alpha = \cos^{-1}(0.4829) = 61.1235^\circ$

2,

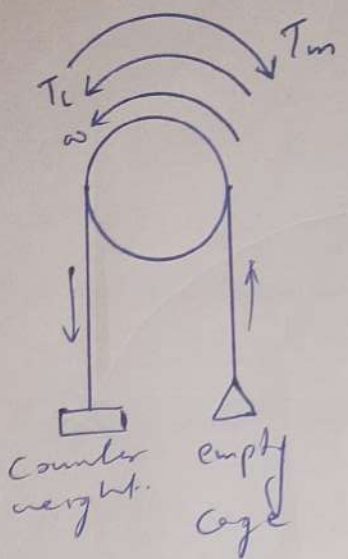
C, (a)

i. Forward motoring Quadrant I



- The loaded cage moves upwards.
- The direction of rotation is anticlockwise
- The Load torque is clockwise
- Motor torque is anticlockwise which will be opposite to Load torque.
- movement and motor rotation is in same direction so Power is positive.

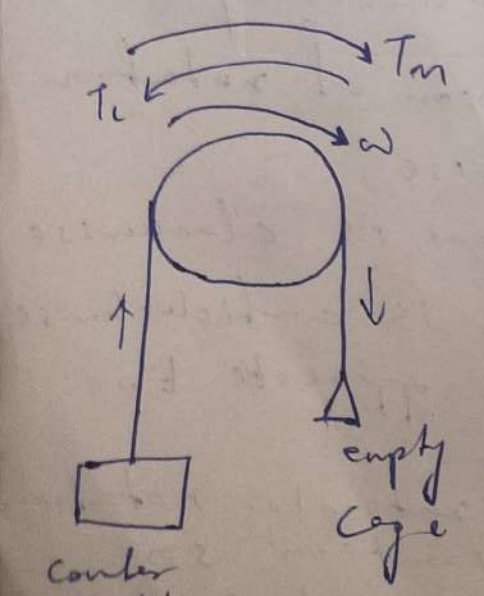
ii. Forward Braking, Quadrant 2.



. The empty cage moves upward.
. weight of counter ~~weight of cage~~ weight is greater than empty cage. so rotation will be anticlockwise.
. Load torque rotates in anticlockwise
. Motor torque opposes the Load torque so the Tm is clockwise direction.

. here the movement is opposite to motor torque direction so its negative power.

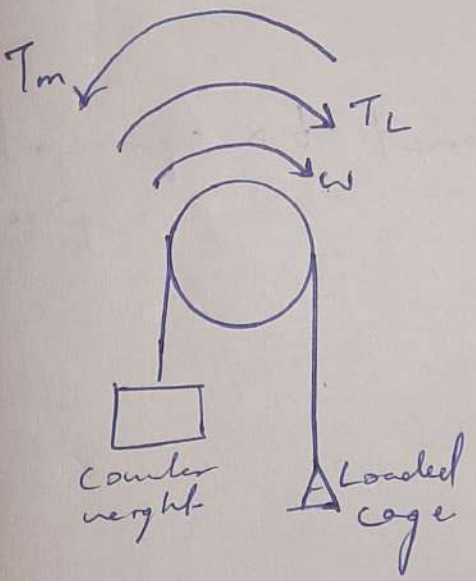
③ Reverse motoring, Quadrant 3.



. The empty cage have to go downward direction ~~so~~
∴ Counter weight > empty cage
. Load torque in anticlockwise direction
. so motor torque in clockwise direction. so the motion will be clockwise.

- So the cage goes downwards.
- The ∓ Motor torque and direction of movement is in same direction so its positive power.

④ Reverse braking Quadrant 4

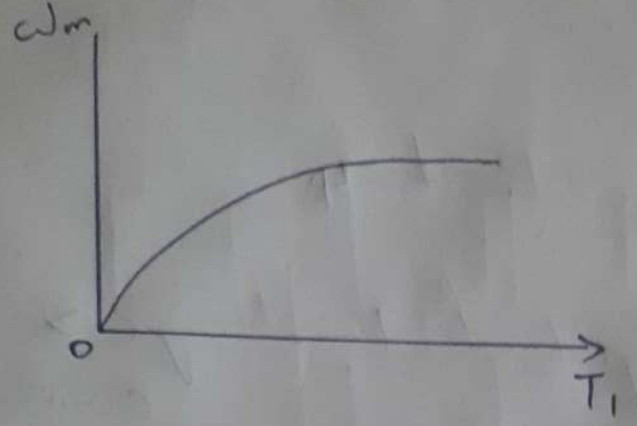


- weight of load cage > Counter weight
- So Load torque in clock wise rotation.
- motor torque opposes so its anticlockwise rotation
- movement of cage is downward direction

here motoring direction and movement direction is opposite so its negative power.

1)
c) b)

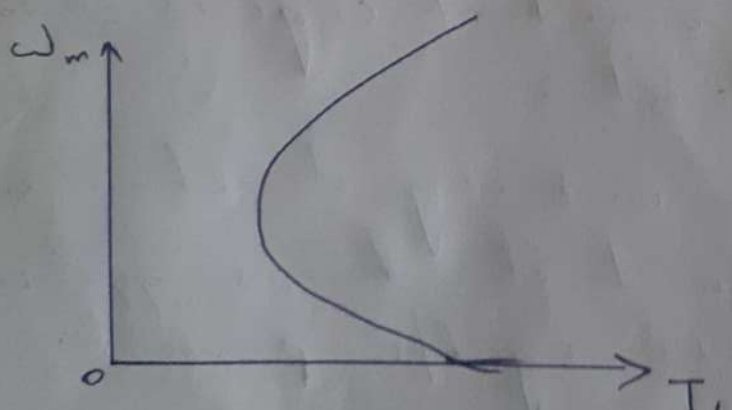
① centrifugal pump



load torque directly proportional to square of speed

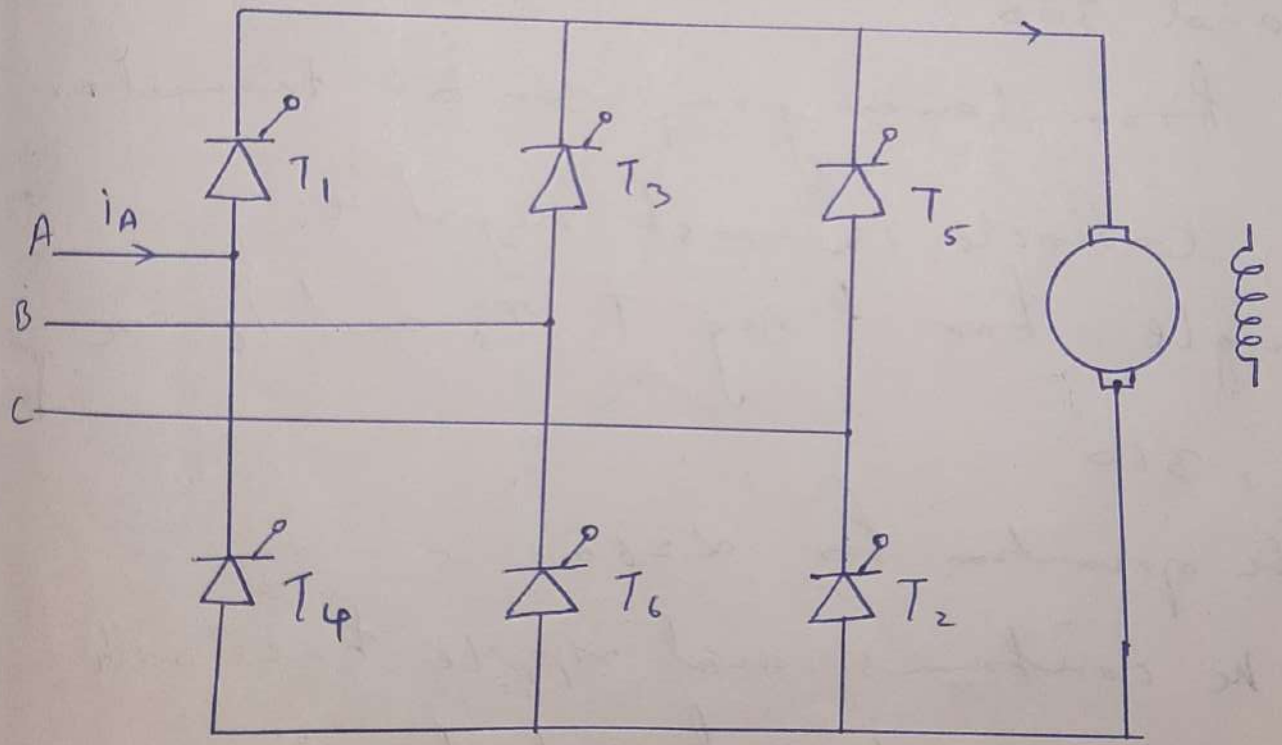
$T \propto \omega_m^2$

②, Traction Load.



2.

4. 3 phase fully controlled rectifier.



- Here each thyristor conducts for 120°
- At any instant, two thyristor will conduct one thyristor from upper group and other From lower group.

- Thyristors are fired in the sequence of their numbers with a phase difference of 60°

A Thyristor from upper group can be turned on when its anode voltage is greater than the other two phase voltages

- Firing angle of T_1 is measured from 60° of phase voltage V_A
- Reference angle for firing T_1, T_3, and T_5 are 60°, 180° and 300°
- A Thyristor from lower group can be turned on when its cathode is most negative
- Reference angle for firing T_2, T_4 and T_6 are 120, 240, 360

consider the operation for $\alpha = 60°$

Assume that the continuous and ripple free with sufficiently large value of inductance in armature circuit

Firing angle	T_1	T_2	T_3	T_4	T_5	T_6
$\alpha = 0$	60°	120°	180°	240°	300°	360°
$\alpha = 60$	120°	180°	240°	300°	360°	420°
$\alpha = 90$	150°	210°	270°	330°	390°	450°
$\alpha = 150$	210°	270°	330°	390°	450°	510°

$$V_o = \frac{3}{\pi} \int_{\frac{\pi}{3}+\alpha}^{\frac{2\pi}{3}+\alpha} V_m \sin\omega t \, d\omega t$$

Form No: ASET-EE/AC 04/FM01

LESSON PLAN

Department of Electrical and Electronics Engineering

Name of the Faculty: Veenaa Raj Designation: Assistant Professor Student Batch: 2018-2022

Academic Year: 2020-21 Semester : EVEN Branch : EEE

Subject Code: EE 308 Subject : Electric Drives Credit : 3

S. No.	Module No.	Portions to be Covered	Planned No. of Hours	Teaching Methodology (L/A/S/SS/T)	Actual	
					No. of Hours	Date(s) of Coverage
1	I	Introduction to Electric Drives and Block Diagram	1	L	1	22-03-21
2		Dynamics of electric drive and Torque equation	1	L	1	23-03-21
3		Four quadrant operation of electric drives	1	L	1	25-03-21
4		Steady state stability	1	L	1	27-03-21
5		Components of load torque	1	L	1	29-03-21

6		Nature and classification of load torques	**1**	**L**	**1**	**30-03-21**
7		Introduction to closed loop control of drives	**1**	**L**	**1**	**03-04-21**
8	**II**	Constant torque and constant power operation of separately excited dc motor	**1**	**L**	**1**	**09-04-21**
9		Single phase fully controlled rectifier fed separately excited DC motor	**1**	**L**	**1**	**12-04-21**
10		Single phase half controlled rectifier fed separately excited DC motor	**1**	**L**	**1**	**13-04-21**
11		Three phase fully controlled converter fed separately excited DC motor	**1**	**L**	**2**	**17-04-21**
12		Three phase half controlled converter fed separately excited DC motor	**1**	**L**	**2**	**20-04-21**
13		Dual Converters and its application for speed control	**1**	**L**	**1**	**23-04-21**
14		Closed loop control of separately excited dc motor drive and DC series motor drive for traction application	**1**	**L**	**1**	**24-04-21**
15	**III**	Introduction to choppers	**1**	**L**	**1**	**26-04-21**
16		Analysis of single quadrant chopper	**1**	**L**	**1**	**27-04-21**

18		Regenerative braking control	**1**	**L**	**1**	**30-04-21**
19		Two quadrant chopper drives	**1**	**L**	**1**	**04-05-21**
20		Four quadrant chopper drives	**1**	**L**	**1**	**10-05-21**
21		Introduction to cycloconverters-basic principles	**1**	**L**	**1**	**21-05-21**
22		Cycloconverters-different types	**1**	**L**	**3**	**25-05-21**
23	**IV**	Speed control of three phase Induction motor-Stator voltage control, Stator frequency control	**1**	**L**	**3**	**31-05-21**
24		Stator voltage and frequency control	**1**	**L**	**1**	**01-06-21**
25		Rotor chopper speed control	**1**	**L**	**1**	**04-06-21**
26		Static Scherbius drive	**2**	**L**	**1**	**07-06-21**
27		Static Kramer drive	**2**	**L**	**1**	**11-06-21**
29	**V**	VSI fed induction motor drives	**1**	**L**	**2**	**15-06-21**
30		CSI fed induction motor drives– operation under fixed frequency	**1**	**L**	**1**	**18-06-21**

31		CSI fed induction motor drives-operation under variable frequency	**1**	**L**	**1**	**21-06-21**
32		Concept of space vector	**2**	**L**	**2**	**25-06-21**
33		Transformation in reference frame-field orienation principle	**2**	**L**	**2**	**29-06-21**
34	**VI**	Different types of synchronous motor drive	**1**	**L**	**1**	**05-07-21**
35		Controller requirements	**1**	**L**	**1**	**07-07-21**
36		Converter circuits	**1**	**L**	**1**	**09-07-21**
37		Modes of operation	**2**	**L**	**2**	**13-07-21**
38		Microcontroller based PMSM drives	**2**	**L**	**1**	**16-07-21**
		Total No. of Hours	**42**		**45**	

L-Lecture, A-Assignment, S-Seminar, SS-Self Study, T-Tutorial

Prepared by

Signature of Faculty:

Name & Designation: Veenaa Raj

Approved by

Signature:

Name & Designation:

KtuQbank

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EE308

Course Name: Electric Drives

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks. Marks

1 What is an Electric Drive? Explain the function of each blocks with the help of a neat block diagram. (5)

2 Explain the armature voltage control and field weakening mode control of DC separately excited motor drive system. (5)

3 With a chopper circuit and waveforms explain the regenerative braking of a DC motor drive. (5)

4 Explain the speed control method of induction motor with stator voltage and also state the disadvantages of this method. (5)

5 Compare CSI fed IM drive with VSI fed IM drive (5)

6 Explain the Park's transformation. (5)

7 With a block diagram explain the variable frequency control of SM drive in self-control mode. (5)

8 Explain the V/F control characteristics in torque-speed plane of a SM drive (5)

PART B

Answer any two full questions, each carries10 marks.

9 a) What are the different components of a load torque? Explain each component in detail. (5)

b) Derive the mathematical condition to obtain the steady state stability of equilibrium point. (5)

10 With a neat sketch, explain the motoring and braking operation of three phase fully controlled rectifier control of separately excited DC motor. (10)

11 A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06Ω. It is fed from a single phase fully controlled rectifier with an ac voltage of 220 V,50Hz. Assuming continuous conduction, calculate (10)

For More Visit : KtuQbank.com KtuQbank

KtuQbank

(i) Firing angle for rated motor torque and 750 rpm

(ii) Firing angle for rated motor torque and -500 rpm

(iii) Motor speed for firing angle $\alpha=160^{o}$ and rated torque

PART C

Answer any two full questions, each carries10 marks.

12 Explain the operation of four quadrant chopper fed separately excited DC motor drive with necessary diagrams. (10)

13 Explain the closed loop static rotor resistance control method for the speed control of a slip ring induction motor. What are the disadvantages of this method? (10)

14 Explain the static Kramer scheme for the speed control of a slip ring IM. Explain the firing angle control of thyristor bridge with constant motor field. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 a) With a neat circuit and waveform explain a thyristor based CSI fed IM drive. (5)

b) Explain how CSI fed IM drive can be used for regenerative braking and multiquadrant operation. (5)

16 a) Explain in detail about the classification of PM synchronous motor? (5)

b) Explain the field oriented control (FOC) of an AC motor with a block diagram (5)

17 With a block diagram explain the Micro controller based PMSM drive. (10)

****

For More Visit : KtuQbank.com

KtuQbank