

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: INDUSTRIAL DRIVES AND CONTROL	Course Code : 15EE61T
Semester : VI	Course Group : Core
Teaching Scheme (L:T:P) : 4:0:0 (in Hours)	Credits : 4 Credits
Type of course : Lecture +Assignments	Total Contact Hours : 52
CIE : 25 Marks	SEE : 100 Marks
Programme: Diploma in Electrical and Electronics Engg.	

Pre-requisites : DC and AC Electrical Machines, Power Electronics

Course Objectives : To introduce the concept of selection, Justification and Utilization of Electric drives

COURSE TOPICS:

Unit No	Unit Name	Hours
1	Introduction to Electrical Drives	06
2	Industrial Process & Drives	10
3	Control System	07
4	Development of Control Circuit	09
5	Computer Based Industrial Control	08
6	Electric Traction	12
	Total	52

Course Outcomes:

On successful completion of the course, the student will be able to:

1. Understand the basics of Electric drives
2. Explain industrial processes and selection of drives
3. Differentiate various control systems
4. Develop motor control circuits
5. Illustrate computer based industrial control
6. Describe Electric traction

Composition of Educational Components

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's Taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)	Total Marks (Out of 145)
1	Remembering	10	15
2	Understanding	48	70
3	Application/ Analysis	42	60
Total		100	145

Course Outcome linkage to Cognitive Level

Cognitive Level Legend: R- Remember, U- Understand, A- Application

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the basics of Electric drives	<i>R/U</i>	2, 10	6 Hours
CO2	Explain industrial processes and selection of drives	<i>U/A</i>	2,4, 10	10Hours
CO3	Differentiate various control systems	<i>R/U</i>	2, 10	7 Hours
CO4	Develop motor control circuits	<i>U/A</i>	2,3,10	9 Hours
CO5	Illustrate computer based industrial control	<i>U/A</i>	2, 4 ,10	08Hours
CO6	Describe Electric traction	<i>R/U/A</i>	2, 5,6,10	12 Hours
		Total sessions		52

Course Content and Blue Print of Marks for SEE:

Unit No	Unit Name	Hour	Max. Marks per Unit	Questions to be set for (5marks) PART - A			Questions to be set for (10marks) PART - B			Marks weightage (%)
				R	U	A	R	U	A	
1	Understand the basics of Electric drives	6	20	1	0	0	0.5	1	0	14
2	Explain industrial processes and selection of drives	10	30	0	1	1	0	1	1	21
3	Differentiate various control systems	7	20	1	0	0	0.5	1	0	14
4	Develop motor control circuits	9	25	0	1	1	0	1	0.5	17
5	Illustrate computer based industrial control	8	20	0	1	0	0	1	0.5	14
6	Describe Electric traction	12	30	1	0	1	1	1	0.1	21
Total		52	145	9 (45 Marks)			10 (100Marks)			100

Course-PO Attainment Matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Industrial Drives and Control	-	3	1	2	1	1	0	0	0	3

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If $\geq 40\%$ of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content:

Unit –I

INTRODUCTION TO ELECTRICAL DRIVES (6 Hrs)

Concept of electric drive, Power modulators, Motors used in drives, types of loads choice of drives, classification of drives Multi quadrant operation of Drives.

Unit –II

INDUSTRIAL PROCESS & DRIVES (10 Hrs)

Process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes, centrifugal pumps and compressors, solar powered pump drives, selection of drives for the above processes

Unit –III

CONTROL SYSTEM (7 Hrs)

Open and closed loop systems with examples, Temperature control and water level control, automatic control, speed control of Induction motor, Pilot devices

Unit –IV

DEVELOPMENT OF CONTROL CIRCUIT (9 Hrs)

Develop ladder diagram for control from one place, remote control, interlocking, DOL starter, Forward and reverse motoring, Automatic star delta starter, 3 speed motor Control, Automatic Plugging, Jogging and sequence speed control, Motor control centre, Thyristor controlled DC Motor Drive and Induction motor drive.

Unit –V

COMPUTER BASED INDUSTRIAL CONTROL (8 Hrs)

Concept of Digital control, CIM, Hierarchical levels Of CIM, Microcontroller based DC Motor speed control, Fuzzy logic, Process control in thermal plant and cement plant

Unit –VI

ELECTRIC TRACTION (12 Hrs)

Introduction to electric traction, systems of Traction, speed time curve, derivation of maximum speed , Tractive effort, nature of traction load , requirements of traction drives , Drives in traction , electric braking, current collection, Train lighting system

Reference Books:

1. Fundamentals of electrical drives by G K DUBEY
2. Computer based Industrial control by Krishnakant
3. Electrical drives by Vedamsubrahmanyam
4. Mechatronics by W B Bolton
5. Electrical estimating and costing K B Raina and S K Bhattacharya
6. Fundamentals of control McIntyre and loose
7. Digital control M Gopal
8. 8051 micro controller and applications- Mazdi&Mazdi
9. Utilization of Electrical Energy - R K Rajput

e-Resources:

www.siemens.com/paper
www.siemens.com/cemet
www.siemens.com/metal
www.siemens.com/sugar
www.abb.com/industries
www.flsmidth.com
www.krupp-polysius.com
www.metso.com
www.voith-paper.com
www.sms-demag.com
www.siemens.com/drives
www.abb.com/drives
www.siemens.com/mobilit
www.bombardier.com
www.gettransportation.com

Course Delivery:

The Course will be delivered through lectures, classroom interaction, animations, group discussion, exercises and student activities, assignments.

Course Assessment and Evaluation:

	What		To Whom	Frequency	Max Marks	Evidence Collected	Course Outcomes
Direct Assessment	CIE (Continuous Internal Evaluation)	I A Tests	Students	Three IA tests for Theory: (Average marks of Three Tests to be computed).	20	Blue Books	1 to 6
		Student Activity		Student Activity	05	Report of 2 pages	1 to 6
		TOTAL		25			
	SEE (Semester End Examination)	End Exam	Students	End Of the Course	100	Answer Scripts at BTE	1 to 6
Indirect Assessment	Student Feedback on course		Students	Middle Of The Course	Feed Back Forms		1 to 6
	End Of Course Survey			End Of The Course	Questionnaires		1 to 6

*CIE – Continuous Internal Evaluation *SEE – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Note to IA verifier: The following documents to be verified by CIE verifier at the end of semester

1. Blue books (20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.

Course Contents with Lecture Schedule:

Lesson No./ Session No.	Contents	Duration
Unit I	Introduction to Electrical drives	6 Hours
1.	Draw the block diagram of an Electric drive and explain the function of each Block List advantages of electric drives Ref:1	01 Hour
2.	List and explain the functions of various power modulators Ref:1	01 Hour
3.	Describe briefly the source employed in electric drives Describe briefly types of motors employed in drives	01 Hour
4.	Analyse the different types of loads Explain classes of Motor duty Ref:3	01 Hour
5.	Choice of electric drives Compare AC drives with DC drives Requirement of variable speed drive Ref1,3	01 Hour
6.	Classify drives and explain a) Group Drive b) Individual Drive c) Multi motor drive Explain Four – quadrant (MULTIQUADRANT) operation of electric drive Ref 2,3	01 Hour
UNIT II	Industrial Process & Drives	10Hours
7.	Draw the process flow diagram of pulp & paper mill & explain various Process Ref 3	
8.	Select a suitable motor and drive in Paper mill and justify the same. Ref 3	01 Hour
9.	Draw the process flow diagram of cement mill and explain various processes Ref 3	01 Hour
10.	Select a suitable motor and drive in cement mill and justify the selection Ref 3	01 Hour
11.	Draw the process flow diagram of sugar mill [sugar cane] and explain various processes involved Ref 3	01 Hour
12.	Select a suitable motor and drive in sugar mill and justify the selection Ref 3	01 Hour
13.	Draw the process flow diagram of steel mill and explain process involved Ref 3	01 Hour
14.	Select a suitable motor and drive in steel mills and justify the selection reverse hot rolling reverse cold rolling, continuous hot	01 Hour

	rolling continuous cold rolling	Ref 3	
15.	Select a suitable motor & drive for electric hoisting crane and justify the selection Select a suitable motor and drive for large centrifugal pump and justify the selection. Select a suitable motor and drive for large high speed compressor and justify the Selection	Ref 3	01 Hour
16.	Describe with a block diagram solar powered pump drives	Ref:1	01 Hour
UNIT III	CONTROL SYSTEM		7 Hours
17.	Define open loop and closed loop system Explain open loop and closed loop system with a block diagram Differentiate open loop and closed loop system	Ref:4	01 Hour
18.	Explain-temperature control, water level control	Ref:4	01 hour
19.	Describe automatic control system with example Describe speed control of induction motor with example	Ref 4	01 Hour
20.	Draw the symbols used in motor control circuit-on and off Pushbutton, contactor, coil, limit switch, time delay relay, &float Switch, flow switch. Ref 5		01 Hour
21.	Describe the operation of Pilot devices with diagram – float switch, pressure switch ,limit switch,	Ref 6	01 Hour
22.	Describe the operation of Pilot devices with diagram –flow switch, thermostat	Ref 6	01 Hour
23.	Draw the diagram and explain electromagnetic contactor, Draw the diagram and explain overload relays	Ref 5	01 Hour
UNIT IV	DEVELOPMENT O F CONTROL CIRCUIT		9 Hours
24.	Describe steps involved in developing ladder diagram	Ref 5,6	01 Hour
25.	Draw schematic and ladder diagram of 3phase motor control circuit	Ref 5	01 Hour
26.	Define two wire and three wire control, describe expanding an existing circuit taking an example	Ref:6	01 Hour
27.	Develop control circuits- 1. Control from one location 2- Control from different location 3-pushbutton interlocking, 4-DOL starter	Ref:5	01 Hour
28.	Develop control circuit of FORWARD and REVERESE motor control, Develop control circuit of Fully automatic star delta starter	Ref 5,6	01 Hour

29.	Develop control circuit of Three speed motor control, Develop control circuit of Automatic plugging control	Ref 6	01 Hour
30.	Develop control circuit of Jogging control Develop control circuit of sequence speed motor control	Ref 6	01 Hour
31.	Define Motor control centre-draw the layout of plant level power distribution and explain	Ref:1	01 Hour
32.	Draw the block diagram of thyristor converter controlled DC motor drive and explain it Draw the block diagram of GTO inverter controlled induction motor drive and explain it	Ref1	01 Hour
V	COMPUTER BASED INDUSTRIAL CONTROL		08Hours
33.	Introduction to digital control Draw and explain Basic structure of computer controlled system	Ref:7	01 Hour
34.	Draw the block diagram and explain computer integrated manufacturing system	Ref:7	01 Hour
35.	Draw the block diagram and explain centralised computer control system Draw the block diagram of and explain Distributed digital control system	Ref:2	01 Hour
36.	Draw the block diagram and explain Hierarchical control system Draw the block diagram of and explain Intelligent control system	Ref:2	01 Hour
37.	Explain with block diagram configuration of digital firing scheme Draw the block diagram of Micro controller based DC motor speed control and explain Explain fuzzy logic architecture with block diagram	Ref:8 Ref:2	01 Hour
38.	Draw and explain application of microprocessors / computers in electrical drives control of Switch reluctance motors Draw and explain application of microprocessors / computers in electrical drives control of permanent magnet brushless dc motors		01 Hour
39.	Draw the block diagram of thermal power plant automation system and explain it	Ref:2	01 Hour
40.	Draw the block diagram of clinker burning control in a cement plant and explain it	Ref:2	01 Hour
UNIT VI	ELECTRIC TRACTION		12 Hours
41.	List the different systems of traction Mention the importance of electric traction List advantages and disadvantages of Electric Traction	Ref:9	01 Hour

42.	Draw the block diagram and Explain a) 25 KV, 50 Hz, AC single phase to 3 phase AC b) 25 KV, 50 Hz, AC single phase to DC c) Diesel electric traction d) DC traction at 750 v and 1500 v DC Ref:2	01 Hour
43.	Define and explain speed time curve Define the terms- max speed, scheduled speed, average speed, acceleration, retardation. Derive an expression for maximum speed Ref:9	01 Hour
44.	Problems on maximum speed Ref:9	01 Hour
45.	Draw and compare speed time curve for a) City: Service or Urban service b) Sub Urban Service c) Main Line Service Ref:9	01 Hour
46.	Define tractive effort Explain Total tractive effort with respect to acceleration, gradient, train resistance. $[FT=FA+FR\pm FG]$ Ref:9	01 Hour
47.	Explain the nature of traction load List the important requirements of traction drives Discuss the various motor used in traction-d.c.series motor, 3phase sq cage-Induction motor, permanent magnet synchronous motor Ref:2	01 Hour
48.	Define electric braking, List the advantages and disadvantages of electric braking, List the types of Electric braking Explain pulgging Ref:9	01 Hour
49.	Describe with diagram how Rheostatic or dynamic braking is obtained with a) DC Series Motor b) 3 Phase squirrel cage /slip ring Induction Motor] Describe with diagram how regenerative braking is obtained with a) DC Series Motor b) 3 Phase Induction Motor [squirrel cage induction motor Ref:9	01 Hour
50.	Describe chopper controlled drive for D.C. motors with composite braking for D.C Traction system Ref:2 Describe PWM voltage source inverter [VSI] induction motor drive for A.C. Traction system. Ref:2	01 Hour
51.	Explain with diagram current collection through single arm pantograph collector. (Faiveley). ref-G.K.Dubey Explain with diagram current collection through 3 rd rail or conductor's rail sys Ref:2	01 Hour
52.	Describe the train lighting –A) auxiliary converter system [electric trains] b) alternator[axle mounted] Ref:2	01 Hour

Student Activity (any one to be submitted with 3 pages self HAND WRITTEN report

- 1) Visit any industry/ process industry and prepare a report on drives used .
- 2) Visit any process industry and prepare a report on control of drives used
- 3) Collect information on Practical train lighting system& current collection system
- 4) Study various power supply transmission systems used in traction
- 5) Collect information on automatic control systems used in industries

MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY (Course Coordinator)

Dimension	Scale					Students score (Group of five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	3				
2	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2				
3	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	5				
4	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	4				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity on any one CO (course outcome) may be given to a group of FIVE students Grand Average/Total						14/4 =3.5 ≈4				

**Example only: MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY-
Task given- Industrial visit and report writing**

Dimension	Scale					Students score (Five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1.Organisation	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed	3				
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles	2				
3.Conclusion	Poor	Less Effective	Partially effective	Summarises but not exact.	Most Effective	5				
4.Conventions	Frequent Error	More Error	Some Error	Occasional Error	No Error	4				
Total marks						14/4=3.5 ≈4				

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th week of sem 10-11 Am	VI SEM	INDUSTRIAL DRIVES AND CONTROL	20			
	Year:					
Name of Course coordinator :						
Units:___ CO's:_____						
Question no	Question	MARKS	CL	C O	PO	
1						
2						
3						
4						

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

MODEL QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks		
1 st Test/ 6 th week, 9 Feb 16, 10-11 AM	VI SEM, E & E Engg	INDUSTRIAL DRIVES AND CONTROL	20		
	Year: 2015-16	Course code:15EE61T			
Name of Course coordinator :					
Units Covered :1 and 2					
Course Outcomes : 1 and 2					
Instruction : (1). Answer all questions (
Question No.	Question	CL	CO	PO	
1	List advantages of electric drives 2 Marks or List the different types of loads	R	CO1		2
2	Explain Group Drive& multi motor drive 4 marks or Explain Four – quadrant operation of electric drives	U	CO1		2
3	Draw the process flow diagram of pulp making & explain various Process 6 marks or Describe with a block diagram solar powered pump drives	U	CO2		2,10
4	Justify selection of motors in Paper mill 8 marks Or Justify the selection of motor for steel mills	A	CO2		4,10

CL: Cognitive Level, R-Remember, U-Understand, A-Application, PO: Program Outcomes

Sl. No	Educational Component	Weightage (%)	Total Marks (Out of 20)
1	Remembering	10	2
2	Understanding	48	10
3	Application	42	8
Total		100	20

Model QUESTION Paper BANK:

Course Title: **INDUSTRIAL DRIVES AND CONTROL**

Course Code: 15EE33T

CO1- Understand the basics of Electric drives

Unit 1 -Introduction to Electrical drives

Cognitive Level: REMEMBER

1. List advantages of electric drives
2. List various power modulators
3. List the different types of loads
4. List the requirement of variable speed drive

Cognitive Level: UNDERSTAND

1. Draw the block diagram of an Electric drive and explain the function of eachBlock
2. Explain the functions of various power modulators
3. Describe briefly the source employed in electric drives
4. Describe briefly types of motoremployed in drives
5. Explain classes of Motor duty
6. Describe AC drives and DC drives
7. **Explain** a) Group Drive b) Individual Drive c) Multi motor drive
8. Explain Four – quadrant operation of electric drives

CO2- Explain industrial processes and selection of drives

Unit II – INDUSTRIAL PROCESS AND DRIVES

Cognitive Level: UNDERSTAND

1. Draw the process flow diagram of **pulp** making & explain various Process
2. Draw the process flow diagram of **paper** mill & explain various Process
3. Draw the process flow diagram of **cement mill** and explain various processes
4. Draw the process flow diagram of **steel mill and explain process involved**
5. Describe with a block diagram solar powered pump drives

Cognitive Level: APPLICATION

1. Justify selection of motors in **Paper** mill .
2. Justify selection of motors in **cement** mill .
3. Justify selection of motors in **sugar** mill
4. Justify the selection of motor for reverse hot rolling
5. Justify the selection of motor for reverse cold rolling,

6. Justify the selection of motor for continuous hot rolling
7. Justify the selection of motor for continuous cold rolling
8. Justify the selection of motor for steel mills
9. Justify the selection of motor for electric hoisting crane
10. Justify the selection of motor for electric centrifugal pump
11. Justify the selection of motor for high speed compressor

CO3- Differentiate various control systems

Unit III -CONTROL SYSTEM

Cognitive Level: REMEMBER

1. Define open loop and closed loop system
2. Draw the symbols used in motor control circuit-on and off Pushbutton, contactor, coil, limit switch, time delay relay, & float switch, flow switch.

Cognitive Level: UNDERSTAND

1. Explain open loop control system with a block diagram
2. Explain closed loop control system with a block diagram
3. List differences between open loop and closed loop system
4. Explain temperature control with a neat diagram
5. Explain water level control
6. Describe automatic control system with example
7. Describe speed control of induction motor with example
8. Describe the operation of float switch with diagram
9. Describe the operation of pressure switch with diagram
10. Describe the operation of limit switch with diagram
11. Describe the operation of thermostat with diagram
12. Draw the diagram and explain electromagnetic contactor
13. Draw the diagram and explain overload relays

CO4- Develop motor control circuits

Unit IV - DEVELOPMENT OF CONTROL CIRCUIT

Cognitive Level: UNDERSTAND

1. Draw schematic and ladder diagram of 3phase motor control circuit
2. Describe steps involved in developing ladder diagram
3. Define two wire and three wire control
4. Describe expanding an existing circuit taking an example
5. Define Motor control centre-draw the layout of plant level power distribution and explain
6. Draw the block diagram of thyristor converter controlled DC motor drive and explain it.
7. Draw the block diagram of GTO inverter controlled induction motor drive and explain it

Cognitive Level: APPLICATION

1. Develop control circuits for Control of motor from one location
2. Develop control circuits for Control of motor from different location
3. Control of motor with pushbutton interlocking
4. Develop control circuits for DOL starter
5. Develop control circuit of FORWARD and REVERSE motor control,
6. Develop control circuit of Fully automatic star delta starter
7. Develop control circuit of Three speed motor control,
8. Develop control circuit of Automatic plugging control
9. Develop control circuit of Jogging control
10. Develop control circuit of sequence speed motor control

CO5- Illustrate computer based industrial control

Unit V - COMPUTER BASED INDUSTRIAL CONTROL

Cognitive Level: UNDERSTAND

1. Draw the Basic structure of computer based system and explain
2. Draw the block diagram and explain computer integrated manufacturing
3. Draw the block diagram and explain centralised computer control system
4. Draw the block diagram of and explain Distributed digital control system
5. Draw the block diagram and explain Hierarchical control system
6. Draw the block diagram of and explain Intelligent control system
7. Explain with block diagram configuration of digital control scheme
8. Draw the block diagram of Micro controller based DC motor speed control and explain
9. Explain fuzzy logic architecture with block diagram

Cognitive Level: APPLICATION

1. Draw and explain application of microprocessors / computers in electrical drives control, of Switch reluctance motors
2. Draw and explain application of microprocessors / computers in electrical drives control, of permanent magnet brushless dc motors
3. Draw the block diagram of thermal power plant automation system and explain it

CO6- Describe Electric traction

Unit VI -ELECTRIC TRACTION

Cognitive Level: REMEMBER

- 1) List the different systems of traction
- 2) Mention the importance of electric traction
- 3) List advantages and disadvantages of Electric Traction
- 4) Define the terms- max speed, scheduled speed, average speed acceleration ,retardation .
- 5) Define tractive effort

- 6) List the important requirements of traction drives
- 7) Define electric braking,
- 8) List the advantages and disadvantages of electric braking,
- 9) List the types of Electric braking

Cognitive Level: UNDERSTAND

- 1) Draw the block diagram and Explain 25 KV, 50 Hz, AC single phase to 3 phase AC
- 2) Draw the block diagram and Explain 25 KV, 50 Hz, AC single phase to DC
- 3) Draw the block diagram and Explain Diesel electric traction
- 4) Draw the block diagram and Explain DC traction at 750 vand1500 v DC
- 5) Define and explain speed time curve
- 6) Derive an expression for maximum speed
- 7) Draw and compare speed time curve for a) City: Service or Urban service b) Sub Urban Service c) Main Line Service
- 8) Explain Total tractive effort with respect to acceleration, gradient, train resistance. $[FT=FA+FR\pm FG]$
- 9) Explain the nature of traction load
- 10) Explain pulgging
- 11) Describe with diagram how Rheostatic or dynamic braking is obtained with a) DC Series Motor
- 12) b) 3 Phase squirrel cage /slip ring Induction Motor]
- 13) Describe with diagram how regenerative braking is obtained with
 - a) DC Series Motor
 - b) 3 Phase Induction Motor [squirrel cage induction motor
- 14) Describe chopper controlled drive for D.C. motors with composite braking for D.C Traction system
- 15) Describe pwm voltage source inverter [VSI] induction motor drive for A.C.Traction system
- 16) Explain with diagram current collection through single arm pantograph(Faively)
- 17) Explain with diagram current collection through 3rd rail or conductor's rail sys
- 18) Describe the train lighting –A) auxiliary converter system [electric trains]
- 19) b) alternator[axle mounted]

20) Problems on Maximum speed .

Cognitive Level: APPLICATION

- 1) **Enumerate** the various motor used in traction

Model Question Paper:

Code:15EE61T

VI Semester Examination
Diploma in Electrical and Electronics Engg.

Time: 3 Hours

Max Marks: 100

- Note:** i) Answer any SIX questions from PART - A. Each question carries 5 marks.
ii) Answer any SEVEN Questions from PART - B. Each question carries 10 marks.

PART – A

1. List the requirement of variable speed drive
2. Draw the process flow diagram of **cement mill**
3. Justify the selection of motor for high speed compressor
4. Draw the symbols used in motor control circuit-on and off Pushbutton, contactor coil, limit switch, time delay relay
5. Define Motor control centre-draw the layout of plant level power distribution and explain
6. Develop control circuit of Jogging control
7. Draw the Basic structure of computer based system and explain
8. List advantages and disadvantages of Electric Traction
9. Enumerate the various motor used in traction.

PART – B

- 10 a) Describe AC drives and DC drives 5 marks
- b) Define open loop and closed loop system 5 marks
- 11) Explain the functions of various power modulators
- 12) Draw the process flow diagram of **paper mill** & explain various Process 10 marks
- 13 a) Justify the selection of motor for reverse hot rolling 5 marks
- b) Justify the selection of motor for reverse cold rolling 5 marks
- 14 a) Draw the diagram and explain electromagnetic contactor 5 marks
- b) Draw the diagram and explain overload relays 5 marks
- 15 Describe expanding an existing circuit taking an example 10 marks
- 16 a) Develop control circuits for DOL starter 5 marks
- b) Draw the block diagram of thermal power plant automation system 5 marks
- 17 Explain with block diagram configuration of digital control scheme 10 marks
- 18 Describe pwm voltage source inverter [VSI] induction motor drive for A.C.Traction system 10 marks

- 19 A train has a schedule speed of 60 KMPH between stops 6kms apart . Find the Maximum speed when acceleration is 2 KMPHPS retardation is 3 KMPHPS . stop time is 60 seconds . Assume Trapezoidal speed time curve

---- **XXX** -----