GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29)

INDUSTRIAL DRIVES

SUBJECT CODE: 2722911

SEMESTER: II

Type of course: Core

Prerequisite: Electrical Machine & Power Electronics

Rationale: This course offers an overview and fundamentals of various DC and AC electrical drives which includes its modelling and different speed control strategies. Also, it covers advanced concepts of industrial drives.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamental of Electric Drives Modelling of Electrical Machines :** Concepts of Electric Drives, Classification, Control Scheme, Speed torque characteristics of motors, Mathematical modelling of Electrical Machines, Reference frame Theory, Analysis of AC, DC machines, Linear equations of AC and DC machines, Duty cycles & ratings.	5	12%
2.	**Converter Control of DC motor:** Principal of phase angle control, steady state analysis, performance parameters, performance characteristics, two quadrant DC motor drive, Four quadrant DC motor drive, Harmonics and associated problems, closed loop operation, Modelling of DC machines.	5	12%
3.	**Chopper Control of DC motor:** Principal of operation, Four quadrant operation of chopper circuit, steady state analysis of Chopper controlled DC motor drive, closed loop operation.	5	13%
4.	**Induction Motor Control:** Scalar controls of induction motor drive, stator voltage control, rotor resistance control, frequency control, V/f control, current control, Analysis of CSI and VSI fed AC drive, Generalized operation of induction motor with impressed voltages of non sinusoidal waveform. Analysis using equivalent circuit, harmonics losses, derating.	7	16%

5.	**Field Oriented Control:** Principle of Field control of induction machines, direct vector control, indirect vector control scheme, Flux vector estimation, Space vector modulation control.	7	16%
6.	**Direct torque Control:** Direct torque control of induction machine, Torque expression with stator and rotor flux, DTC control strategy, reduction of torque ripple methods.	6	15%
7.	**Variable Frequency Synchronous Motor Drive :** Open loop inverter fed synchronous motor drive, self synchronous operation, operating characteristics and control.	7	16%

Reference Books:

1 Vedam Subrahmanyam, "Electric drives: concepts and applications", McGraw Hill, 1996
2 Ramu Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control", Prentice Hall, 2001
3 Gopal K. Dubey, "Fundamentals of Electrical Drives", Alpha Science-2001
4 Bimal K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall PTR, 2002
5 Ion Boldea, Syed A. Nasar, "Electric Drives, Second Edition", CRC Press, Taylor & Francis-2006

Course Outcome:

After learning the course the students should be able to

1. Understand modelling of various electric motors.
2. Understand characteristics of various electric motors.
3. Understand different speed control techniques for DC motor, induction motor and synchronous motor.
4. Understand various advanced control technique like MARS.
5. Understand speed control techniques of advanced electric motors like BLDC, SRM and stepper motor.

List of Experiments:

1. To model DC shunt machine.
2. To model DC series machine.
3. To model induction machine.
4. To model synchronous machine.
5. To simulate V/f control technique for induction machine.
6. To simulate vector control technique for induction machine.
7. To simulate DTC technique for induction machine.
8. To simulate rotor resistance control of wound rotor for induction machine.
9. To simulate vector control technique for induction machine.
10. To study BLDC motor drive.
11. To study SRM drive.
12. To study stepper motor control techniques.

Open Ended Problem: Solution of the open ended problem(s) in guidance of course Instructor is mandatory. Few of the problems are specified as under.

(1) To develop model of DC machine, Induction machine and synchronous machine
(2) To develop model of flux observers for Sensor less control techniques. Check effect of various parameters on its performance.
(3) To check effectiveness of model reference adaptive systems (MARS) over other estimation techniques.
(4) Compare various induction motors control techniques like scalar control, direct torque control and vector control techniques.
(5) Compare performance of special electrical machines like BLDC, SRM and stepper motor for various applications area.

List of Open Source Software/learning website:

1. Scilab
2. www.nptel.ac.in/

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website