



**NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**  
**DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING**

<b>COURSE PLAN – PART I</b>			
<b>Name of the programme and specialization</b>	<b>M.Tech. INDUSTRIAL AUTOMATION</b>		
<b>Course Title</b>	<b>ELECTRIC DRIVES AND CONTROL</b>		
<b>Course Code</b>	<b>CL 604</b>	<b>No. of Credits</b>	<b>3</b>
<b>Pre-requisites</b>	-		
<b>Session</b>	<b>Jan 2021</b>		
<b>Name of Faculty</b>	<b>Dr. Dhanalakshmi K.</b>	<b>Department</b>	<b>ICE</b>
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<b>Course Type</b>	<b>CORE COURSE</b>		
<b>Syllabus (approved in BoS)</b>			
<p>Components of electrical Drives – electric machines, power converter, controllers – dynamics of electric drive - torque equation - equivalent values of drive parameters - components of load torques - types of load - four quadrant operation of a motor — steady state stability – load equalization – classes of motor duty - determination of motor rating.</p> <p>DC motor drives – dc motors &amp; their performance – braking –Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited &amp; series motor with 1-phase and 3-phase converters –analysis of chopper controlled dc drives – converter ratings and closed loop control – transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive.</p> <p>Induction motor drives – stator voltage control of induction motor – torque-slip characteristics – operation with different types of loads – V/F control- Scalar and vector control of induction motor- Direct torque and flux control of induction motor- controlled current and controlled slip operation – effect of harmonics and control of harmonics-slip power recovery scheme.</p> <p>Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – voltage source inverter drive with open loop control – self-controlled synchronous motor with electronic commutation – self -controlled synchronous motor drive using load commutated thyristor inverter.</p> <p>Hybrid, Variable Reluctance, and PM stepper motors-performance characteristics and time response-full and half step motor drives, micro-stepping- Switched reluctance motor drive, Brushless DC motor drive, PMSM drives, drive controller design.</p> <p>Harmonics – input harmonics study, impact on connected grid, design of input filters; Output harmonics and impact on connected rotating machines (design considerations of driven machines)</p>			
<b>COURSE OBJECTIVES</b>			
<ol style="list-style-type: none"><li>1. To introduce basic concepts of load and drive interaction.</li><li>2. To introduce to the students on the concept of employing power convertors for the design of electric drives.</li><li>3. To impart knowledge on the analysis of electric drive system dynamics.</li><li>4. To impart knowledge on the design and development of control methods for electric drive systems.</li></ol>			
<b>MAPPING OF COs with POs</b>			
<b>Course Outcomes</b>	<b>Programme Outcomes (PO)</b>		
1. The student acquires knowledge to design suitable power electronic circuit for an electric drive system and analyze its steady state stability.	1, 3, 4, 5, 6		



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2. The student understands to select appropriate control method for the electric drives.	1, 3, 4, 5, 6
3. The student comprehends to select a suitable electric drive for a particular industrial application.	1, 3, 4, 5, 6
4. The student learns to design and implement a prototype drive system.	1, 3, 4, 5, 6

### COURSE PLAN – PART II

#### COURSE OVERVIEW

The course aims at giving a broad overview of Electrical Drive Systems and Control. It is assumed that the students have prior exposure to Electrical Machines and Power Electronics. The control principles of various DC and AC motors using solid state converters are discussed. Principles of selection of electric motors for as drives are introduced. Some of the applications of Electrical Drives are highlighted.

#### COURSE TEACHING AND LEARNING ACTIVITIES

	Week	Topic	Mode of Delivery
	1, 2	Introduction to Electrical Drives, Dynamics of Electrical Drives, Review of Torque - Speed Characteristics of Motor Drive parameters - types of load - 4 quadrant operation of a motor.	Online teaching through MS Teams - Power point presentations
	3, 4, 5	Solid-state Control of DC Motor Drives Controlled Rectifier-fed DC Drives, Chopper Controlled DC Drives	- Digital Board and stylus
	6, 7, 8	Induction Motor Drives - Operation of Induction Motor with Unbalanced Source Voltages - Analysis of Induction Motor from Non-sinusoidal Voltage Supply Starting and Braking of Induction Motor	Appropriate tutorials Discussion of case studies
	9, 10, 11	Variable Voltage/ Current, Variable Frequency Control of Induction Motor Fed from VSI and CSI Control of Slip-ring Induction Motor	
	12, 13, 14	Synchronous and Brushless DC Motor Drives, Micro-stepping- Stepper Motor and Switched Reluctance Motor Drives, Brushless DC motor drive- PMSM drives.	
	15, 16	Harmonics – input harmonics study, impact on connected grid, design of input filters; Output harmonics and impact on connected rotating machines	

#### COURSE ASSESSMENT METHODS

S. No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment 1	After the first month of commencement of classes	1.5 hours	20



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		<b>Units 1 and portion of Unit 2</b>		
2	Assessment 2	At the third month <b>Portion of Unit 2 and Unit 3</b>	1.5 hours	20
3	Assessment 3	Any time during the semester <b>Assignment, Presentation, viva,quiz, attentiveness in class</b>	1 hour	30
CPA	Compensation Assessment* Allowed only for any of Assessment 1 and 2	<b>Units 1 to 3</b>		20
4	Final Assessment *	At the end of the semester <b>All 5 units</b>	3 hour	30

**\*mandatory; refer to guidelines on page 4**

### **COURSE EXIT SURVEY**

Feedback may be provided during the Class Committee Meeting.  
Descriptive feedback shall be collected by the faculty during the mid of the semester.  
A formal online feedback will be collected by the institute at the end of the semester.

### **COURSE POLICY**

Every student is required to appear for each assessment and is expected to obtain above 50 % of the weightage to expect a pass grade in the course.

**Prior permission** should be obtained from the faculty member or at least kept informed (only in case of emergency) **through email**, if a student would be unable to appear for any assessment. If this is not adhered to, request of any kind will not be accepted for a student to be permitted to appear for the Compensatory Assessment.

A student who misses any or both of the assessments 1 and 2 will get an opportunity to compensate for only 20 % weightage.

Compensatory assessment will be conducted 1 week prior to Assessment 4 (the end semester examination).

**Grading policy**– Relative grading based on normalized curve will be followed.

**Withdrawal from the end semester examination**– A student may for any valid reason, on production of valid proof/certificate and with the approval of the HoD be permitted to withdraw from appearing for the end semester examination (assessment 4), only if the application is made before the commencement of the examination. The student can then, appear for the Re assessment.

**Re assessment**– The Re assessment will be conducted during the initial phase of the consecutive semester.

Eligibility to appear for the Re assessment are:

1. Students who were absent (only with proper official permission) for Assessment 4 OR withdrawn from the Assessment 4  
weightage will be 30 % (internal marks will be used)
2. Students who failed in the subject AND who were absent (without permission) for Assessment 4  
weightage will be 100 %



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Students who fail in the Re Assessment have to register for the Formative Assessment.

### **ATTENDANCE POLICY** (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.
- Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

### **ACADEMIC DISHONESTY & PLAGIARISM**

- Copying from other students or other sources during an assessment will be treated as punishable dishonesty. For assignment and presentation, the content which has plagiarism above 50 % would be given zero mark.
- The departmental disciplinary committee including the faculty member of the course, PAC chairperson and the HoD, as members shall verify the facts of the malpractice if the student is found guilty; the report shall be submitted to the Academic office for award of the punishment.

### **ADDITIONAL INFORMATION, IF ANY**

**Essential Reading** Students can learn the course from any standard book or opensource material.

Books prescribed in the syllabus are:

Text Books:

1. Richard Crowder, "Electric Drives and Electromechanical Systems", 2nd Edition, Elsevier, 2019
2. Ion Boldea, S. A. Nasar, "Electrical Drives", 3rd Edition, CRC Press - 2016.
3. R. Krishnan, "Electrical Motor Drives", PHI - 2001.
4. G. K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosa - 2009.
5. M. A. El-Sharkawi, "Fundamentals of Electrical Drives", Cengage Learning, 2nd edition, 2000.

Reference Books:

1. Vedam Subrahmaniam, "Electric Drives", 2nd Edition, TMH - 2017.
2. Ramu Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press, 2017.
3. W. Leohnard, "Control of Electric Drives", 3rd Edition, Springer - 2001.
4. Bimal K Bose, "Modern Power Electronics and AC Drives", Prentice Hall, 1st edition, 2002.

### **FOR APPROVAL**

**Course Faculty**

**CC- Chairperson**

  
10-02-2021

**HoD**

**Date: 25 Jan. 2021**



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### Guidelines

- a) The number of assessments for any theory course shall range from 4 to 6.
- b) Every theory course shall have a final assessment on the entire syllabus with at least 30% weightage.
- c) One compensation assessment for absentees in assessments (other than final assessment) is mandatory. Only genuine cases of absence shall be considered.
- d) The passing minimum shall be as per the regulations.

B.Tech. Admitted in				P.G.
2018	2017	2016	2015	
35% or (Class average/2) whichever is greater.		(Peak/3) or (Class Average/2) whichever is lower		40%

- e) Attendance policy and the policy on academic dishonesty & plagiarism by students are uniform for all the courses.
- f) Absolute grading policy shall be incorporated if the number of students per course is less than 10.
- g) Necessary care shall be taken to ensure that the course plan is reasonable and is objective.