NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF INSTRUMENTATION AND CONTROL

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech / Instrumentation and Control Engineering		
Course Title	Industrial Electric Drives		
Course Code	ICPE35	No. of Credits	3
Course Code of Pre-requisite subject(s)	ICPE33		
Session	July 2023	Section (if, applicable)	
Name of Faculty	Dr Shiraz Sohail	Department	ICE
Official Email	ssohail@nitt.edu	Telephone No.	04312504965
Name of Course Coordinator(s) (if, applicable)	Not applicable		
Official E-mail		Telephone No.	
Course Type	Programme Elective		

Syllabus (approved in BoS)

Electric Drive System - Dynamics and steady state stability.
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.
DC motor drives – dc motors and their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging –Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited and series motor with 1-phase and 3-phase converters – dual converter –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.
Induction motor drives – stator voltage control of induction motor – torque-slip characteristics – operation with different types of loads – operation with unbalanced source voltages and single phasing – analysis of induction motor fed from non-sinusoidal voltage supply – stator frequency control – variable frequency operation – V/F control, controlled current and controlled slip operation – effect of harmonics and control of harmonics.
PWM inverter drives for Induction Motors – multi quadrant drives – rotor resistance control – slip torque characteristic – torque equations, constant torque operation – slip power

recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation.

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.

COURSE OBJECTIVES

1. To introduce to the students on the concept of employing power convertors for the design of electric drives.
2. To impart knowledge on the analysis of electric drive system dynamics.
3. To apply the knowledge of drives to choose the right solid-state drive for a given application.
4. To impart knowledge on the design and development of control methods for electric drive systems.

MAPPING OF COs with POs

Course Outcomes	Programme Outcomes (PO) (Enter Numbers only)
1. Design suitable power electronic circuit for an electric drive system	**1-5, 9-12**
2. Analyze the dynamics and steady state stability of motors	**1-5, 9-12**
3. Select appropriate control method for the electric drives.	**1-5, 9-12**
4. Select a suitable electric drive for a particular industrial application.	**1-12**

COURSE PLAN – PART II

COURSE OVERVIEW: TEACHING AND LEARNING ACTIVITIES

S.No.	Contact Hours	Topic	Mode of Delivery
1.	Lecture 1	Introduction to Electric Drive System	Chalk and black-board
2.	Lecture 2	Dynamics and steady state stability	Chalk and black-board
3.	Lecture 3	Components of electrical Drives - electric machines, power converter, controllers	Chalk and black-board
4.	Lecture 4	dynamics of electric drive - torque equation	Chalk and black-board
5.	Lecture 5	equivalent values of drive parameters	Chalk and black-board
6.	Lecture 6	components of load torque types of loads	Chalk and black-board
7.	Lecture 7	four quadrant operation of a motor	Chalk and black-board

8.	Lecture 8	steady state stability – load equalization	Chalk and black-board
9.	Lecture 9	classes of motor duty - determination of motor rating	Chalk and black-board
10.	Lecture 10	Introduction to DC motor drives	Chalk and black-board
11.	Lecture 11	dc motors and their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor)	Chalk and black-board
12.	Lecture 12	braking – regenerative, dynamic braking, plugging	Chalk and black-board
13.	Lecture 13	Transient analysis of separately excited motor – converter control of dc motors	Chalk and black-board
14.	Lecture 14	analysis of separately excited and series motor with 1-phase and 3-phase converters	Chalk and black-board
15.	Lecture 15	dual converter – analysis of chopper-controlled dc drives	Chalk and black-board
16.	Lecture 16	converter ratings and closed loop control – transfer function of self, separately excited DC motors	Chalk and black-board
17.	Lecture 17	linear transfer function model of power converters	Chalk and black-board
18.	Lecture 18	sensing and feeds back elements – current and speed loops, P, PI and PID controllers	Chalk and black-board
19.	Lecture 19	response comparison – simulation of converter and chopper fed DC drive.	Chalk and black-board
20.	Lecture 20	Introduction to Induction motor drives	Chalk and black-board
21.	Lecture 21	stator voltage control of induction motor	Chalk and black-board
22.	Lecture 22	torque-slip characteristics	Chalk and black-board
23.	Lecture 23	operation with different types of loads	Chalk and black-board
24.	Lecture 24	operation with unbalanced source voltages and single phasing	Chalk and black-board
25.	Lecture 25	analysis of induction motor fed from non-sinusoidal voltage supply	Chalk and black-board
26.	Lecture 26	stator frequency control – variable frequency operation	Chalk and black-board
27.	Lecture 27	V/F control, controlled current and controlled slip operation	Chalk and black-board
28.	Lecture 28	effect of harmonics and control of harmonics	Chalk and black-board
29.	Lecture 29	PWM inverter drives for Induction Motors	Chalk and black-board
30.	Lecture 30	multi quadrant drives – rotor resistance control	Chalk and black-board
31.	Lecture 31	slip torque characteristic – torque equations, constant torque operation	Chalk and black-board
32.	Lecture 32	slip power recovery scheme – torque equation	Chalk and black-

			board
33.	Lecture 33	torque slip characteristics – power factor	Chalk and black-board
34.	Lecture 34	methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation.	Chalk and black-board
35.	Lecture 35	Synchronous motor drives	Chalk and black-board
36.	Lecture 36	speed control of synchronous motors – adjustable frequency operation of synchronous motors	Chalk and black-board
37.	Lecture 37	principles of synchronous motor control – voltage source inverter drive with open loop control	Chalk and black-board
38.	Lecture 38	self-controlled synchronous motor with electronic commutation	Chalk and black-board
39.	Lecture 39	self -controlled synchronous motor drive using load commutated thyristor inverter.	Chalk and black-board

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	First Assessment	As per academic calendar	1 hour	20 %
2	Second Assessment	As per academic calendar	1 hour	20 %
3	Third Assessment (Assignment)	As per academic calendar	Shall be informed in the class	10 %
4	Compensation Assessment (CPA)	As per academic calendar	1 hour	20 %
5	Fourth Assessment (Semester Examination)	As per academic calendar	3 hour	50 %

ESSENTIAL READINGS (Textbooks, reference books, website addresses, journals, etc.)

Text Books

1. R. Krishnan, Electrical Motor Drives, PHI-2003.
2. G.K. Dubey, Power semiconductor-controlled drives, Prentice Hall- 1989.
3. G.K. Dubey, Fundamentals of Electrical Drives, Narosa- 1995.
4. S.A. Nasar, Boldea, Electrical Drives, Second Edition, CRC Press – 2006.

5. M. A. ElSharkawi, Fundamentals of Electrical Drives, Thomson Learning.2nd edition 2019.

COURSE EXIT SURVEY
(mention the ways in which the feedback about the course shall be assessed)

1. Anonymous feedback through minute card.
2. Direct feedback from the students by meeting individually /as the class as a whole.
3. Feedback from the students during the class committee meetings.
4. Students performance in the class test.

COURSE POLICY (including compensation assessment to be specified)

Mode of correspondence (email/ phone etc.): Email and Phone

Grading

The passing minimum should be 35% or (Class average/2) whichever is greater.

Compensation Assessment

1. Students who have missed the first-class test or second-class test can register with the consent faculty for appearing in the re-test by submitting proper valid justification in written form.
2. No Re-Test for End semester Exam.

Re-Assessment

- A student may, for valid reasons on production of valid medical certificate and with the approval of HOD be permitted to withdraw from appearing for the End Semester Examination. Withdrawal application shall be valid only if it is made before the commencement of the examination.
- Those who failed in the subject may register for re-assessment examination which will be conducted for 100% mark (Absolute grading where passing minimum is 35).
- Grades for the students who have withdrawn from writing the End Semester Exam will be same as the regular assessment grades. For those who are failed or absent and appearing for re-assessment, the maximum grade is restricted to 'E'.
- Re-assessment exam will be conducted as per in the first week of the next semester or earlier during the vacation.

Formative Assessment (FA)

Students who have failed after Re-Assessment Exam of the course will have to register and pass the course by Formative Assessment (FA) only.

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

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.
- The above policy against academic dishonesty shall be applicable for all the programmes.

ADDITIONAL INFORMATION, IF ANY

- Student can meet anytime depends on the mutual availability. Course faculty will be available in the Room No. 321, Lyceum Building.
- The students can email their queries to the course faculty directly at ssohail@nitt.edu

FOR APPROVAL

Course Faculty _____ **CC- Chairperson** _____ **HOD :** _____

(Dr. Shiraz Sohail) (Dr. Geetha C) **Dr. K.**

Dhanalakshmi

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.