NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**B.TECH. AND ELECTRICAL AND ELECTRONICS ENGINEERING**		
Course Title	**SOLID STATE DRIVES**		
Course Code	**EEPE33**	**No. of Credits**	**3**
Course Code of Prerequisite subject(s)	**EEPC15, EEPC19**		
Session	**July 2021**	**Section (if, applicable)**	**---**
Name of Faculty	**Dr PINKYMOL K.P.**	**Department**	**ELECTRICAL AND ELECTRONICS ENGINEERING**
Official Email	**pinkymol@nitt.edu**	**Telephone No.**	**9526710598**
Name of Course Coordinator(s) (if, applicable)			
Official E-mail		**Telephone No.**	
Course Type (please tick appropriately)	☐ **Core course**	■ **Elective course**	

Syllabus (approved in BoS)

Introduction to solid state drives, various components – power converters, motors, loads, coupling mechanisms – Stability of drive.

Modeling of DC motor drives – Transfer function and state-space models - Experimental determination of drive parameters – Speed control using AC to DC converters- Input performance parameters, Speed reversal schemes.

Chopper fed DC motor drives – Four quadrant operation, Input filters design – Dynamic braking with DC chopper - Type-C chopper fed regenerative braking - Operation with nonreceptive lines.

Power converters for induction motor speed control - Harmonic behaviour of induction motors harmonic currents and harmonic torques using per phase equivalent circuit – Stator voltage control schemes - Speed control of wound type motors.

State-space modeling of induction motors – Voltage source-Inverter fed operation - Field oriented control schemes – Current source-inverter drives – Principle of vector control.

COURSE OBJECTIVES
1. To understand the basic concept of DC and AC Drives.
2. To understand the various control techniques involved with both DC and AC Drives. 3. To brief about the working principle of Special Electrical Drives.

MAPPING OF COs with POs

Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
1. Learn the fundamental concepts of power electronic converter fed DC and AC machines.	**1, 2, 4, 8, 9, 10**
2. Analyse the converter fed motor under different torque/speed conditions	**1, 2, 4, 7, 8, 9, 10, 12**
3 . Design converter fed drives with existing/new control techniques	**1, 2, 3, 4, 7, 8, 9, 10, 12,13**

COURSE PLAN – PART II

COURSE OVERVIEW

Modern electrical drive systems are used in a large number of industrial and domestic applications like the transportation system, machine tools, fans, pumps, robots, supervised actuation. In these applications, control of drives covers controlling the starting, speed, braking of the electric drive systems. In this course basic components of an electric drive system including mechanical loads, motor, power converters and controllers will be discussed separately first and various components will be combined later to discuss the complete drive system. Students will be able to explain and analyse industrial motors and power electronics converters from drive perspective and understand why a particular motor and /or a converter is selected for a particular drive application.

In this course, Chapter 1 discusses modern electric drive components and dynamic relations applicable to all types of drives. Chapter 2 is on dc machines their operations, modeling and transfer functions and measurement of drive parameters. Chapter 3 deals with the chopper controlled dc motor drives and its modeling. Principle of operation of the four-quadrant chopper and regeneration analysis also introduced. Power converters for induction motor speed control is introduced in chapter 4. Stator voltage control schemes and speed control of wound rotor machines are also presented. Chapter 5 deals with state-space modeling of induction motor. VSI fed and CSI fed operations and various control strategies are explained.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery (On-line) MS TEAMS**
1	**Week 1** 02-08-21 to 06-08-21 **(3 Contact Hours)**	**<u>Unit 1</u>** Introduction to solid state drives, various components – power converters, motors, loads	Online
2	**Week 2** 09-08-21 to 13-08-21 **(3 Contact Hours)**	coupling mechanisms – Stability of drive	Online
3	**Week 3** 16-08-21 to 20-08-21 **(2 Contact Hours)**	**<u>Unit 2</u>** Modeling of DC motor drives – Transfer function and state-space models	Online
4	**Week 4** 23-08-21 to 27-08-21 **(3 Contact Hours)**	Transfer function and state-space models – Experimental determination of drive parameters	Online
5	**Week 5** 30-08-21 to 03-09-21 **(3 Contact Hours)**	Speed control using AC to DC converters- Input performance parameters, Speed reversal schemes.	Online
6	**Week 6** 06-09-21 to 10-09-21 **(3 Contact Hours)**	**<u>Unit 3</u>** Chopper fed DC motor drives – Four quadrant operation **First assessment**	Online
7	**Week 7** 13-09-21 to 17-09-21 **(3 Contact Hours)**	Input filters design -Dynamic braking with DC chopper	Online
8	**Week 8** 20-09-21 to 24-09-21 **(3 Contact Hours)**	Type-C chopper fed regenerative braking - Operation with nonreceptive lines.	Online

9	**Week 9** 27-09-21 to 01-10-21 **(1 Contact Hour)**	**<u>Unit 4</u>** Power converters for induction motor speed control **Break for Online Class**	Online
10	**Week 10** 04-10-21 to 08-10-21 **(3 Contact Hours)**	Harmonic behavior of induction motors-harmonic currents and harmonic torques using per phase equivalent circuit **Second assessment**	Online
11	**Week 11** 11-10-21 to 15-10-21 **(3 Contact Hours)**	Stator voltage control schemes	Online
12	**Week 12** 18-10-21 to 22-10-21 **(2 Contact Hours)**	Speed control of wound type motors.	Online
13	**Week 13** 25-10-21 to 29-10-21 **(3 Contact Hours)**	**<u>Unit 5</u>** State-space modeling of induction motors – Voltage source-Inverter fed operation	Online
14	**Week 14** 01-11-21 to 05-11-21 **(2 Contact Hours)**	State-space modeling of induction motors – Voltage source-Inverter fed operation	Online
15	**Week 15** 08-11-21 to 12-11-21 **(3 Contact Hours)**	Voltage source-Inverter fed operation- Field oriented control schemes	Online
16	**Week 16** 15-11-21 to 19-11-21 **(3 Contact Hours)**	Current source-inverter drives – Principle of vector control.	Online
17	**Week 17** 22-11-21 to 25-11-21 **(3 Contact Hours)**	Left out Topics **Compensation Test**	Online
**If any contact hour is NOT handled on the particular day due to unseen reasons, an extra class will be scheduled on the same week based on the time available.*			

COURSE ASSESSMENT METHODS (shall range from 4 to 6**) - Online**				
S.No.	**Mode of Assessment**	**Week/Date**	**Duration**	**% Weightage**
1	First assessment – First class test	Week – 6	60 minutes	20
2	Second assessment – Second class test	Week – 10	60 minutes	20
3	Third Assessment- Assignment +Surprise Tests	-------		30
CPA	Compensation Assessment* (Written test for 1st and 2nd Assessments)	Week -17	60 minutes	20
4	Final Assessment *	02-13 Dec. 2021	One and half hour	30

ESSENTIAL READINGS: Textbooks, Refernce books, website address, journals,etc Text Books:

1. *P.C.Sen, 'Thyristor DC Drives' John Wiley & Sons Publishers, New York, 2008.*
2. *.R .Krishnan, 'Electric Motor Drives - Modeling, Analysis, and Control', Pearson Education Publishers, 1 st Edition, 2011.*
3. *B.K.Bose, 'Modern Power Electronics and AC Drives', Pearson Education Publications, 2nd Edition, 2005.*

Reference Books:

1. *G.K. Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, 2nd Edition, 2008.*
2. *T. Wildi, 'Electrical Machines Drives and Power Systems', Pearson Education Publications, 6th Edition, 2013.*
3. *Mohamed A. El-Sharkawi, 'Fundamentals of Electric Drives', Brooks/Cole, 2000*.

Useful web links:

1. https://nptel.ac.in/courses/108/104/108104140/

COURSE EXIT SURVEY
1. Feedback from the students during class committee meetings 2. Anonymous feedback through questionnaire (Mid of the semester & End of the semester) 3. End semester feedback on course outcomes
COURSE POLICY

1. Attending all the assessments mandatory for every student
2. One compensation assessment will be conducted for those students who are being physically absent for the assessment 1 and/or 2, only for the valid reason.
3. At any case CPA will not be considered as an improvement test.
4. Absolute/Relative grading will be adopted for the course.

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

FOR APPROVAL

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

Vivek Mohan

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.