DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE PLAN – PART I			
Name of the programme and specialization	B.Tech. / Electrical and Electronics Engineering		
Course Title	DC MACHINES AND TRANSFORMERS		
Course Code	EEPC12	No. of Credits	4
Course Code of Pre-requisite subject(s)	NIL		
Session	July 2023	Section (if, applicable)	A
Name of Faculty	Dr. S. Senthil Kumar	Department	EEE
Email	skumar@nitt.edu	Telephone No.	0431-250 3261
Name of Course Coordinator(s) (if, applicable)	NA		
E-mail		Telephone No.	
Course Type	X Core course	☐ Elective course	

Syllabus (approved in BoS)

Principles of Energy conversion – basic magnetic circuit analysis, Faraday's law of electromagnetic induction – singly and doubly excited magnetic field systems – torque production in rotating machines and general analysis of electro mechanical system.

DC Generator – construction, principle of operation – emf equation– types, Characteristics, commutation - armature reaction.

DC motor – principle of operation – torque equation – types – electrical & mechanical characteristics– starting – speed control – various testing – braking.

Transformers – principle of operation – types – basic construction – equivalent circuit - regulation and efficiency – auto transformer.

Three-phase transformer connection-Scott connection – all day efficiency - Sumpner's test - parallel operation of transformers.

Text/Reference Books:

1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.
2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw-Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.
3. A.E. Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw-Hill Education Publications, 6th Edition, 2002.
4. Vincent Del Toro, 'Electrical Engineering Fundamentals', 2nd Edition, Prentice Hall Publications, 2003.
5. Parker Smith, N.N., 'Parker Smith's Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributers, 9 th Edition, 2003.

COURSE OBJECTIVES

This course aims to equip the students with a basic understanding of DC machines and Transformer fundamentals, machine parts and help to gain the skills for operating DC machines and Transformers . The course also equips students with ability to understand and analyze the equivalentcircuits of DC machines and Transformers.

COURSE OUTCOMES (CO)

Course Outcomes

Upon completion of the course the students would be able to

CO1. Understand various properties and applications of magnetic circuits in linear and rotational systems.

CO2. Understand constructional details and principles of DC machines and transformers.

CO3. Analyze the performance parameters/characteristics of the DC machines under various operating conditions through proper testing.

CO4. Evaluate the performance of single-phase transformer using equivalent circuits and phasor diagrams.

CO5. Understand various connection and performance testing of various transformers.

Course articulation matrix (CO-PO mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	-	-	-	1	-	1	1	2
CO2	2	2	1	2	-	-	-	-	-	1	1	2
CO3	3	3	2	3	2	-	2	2	-	2	2	3
CO4	3	3	2	3	2	-	2	2	-	2	2	3
CO5	2	2	2	2	-	-	-	-	-	1	1	3

COURSE PLAN – PART II

COURSE OVERVIEW

An Electrical Machine is an electro-mechanical energy converter. It is a device that converts either mechanical energy to electrical energy - *generator* or electrical energy to mechnaical energy - *motor*. An electrical machine is a dual machine and hence each machine can be used as either generator or a motor. Almost all practical electical machines convert energy from one form to another through the action of a magnetic field. Electrical machines provide green energy production and hence insight into such machines, their design and working principles become inevitable for an electrical engineer. Only machines using magnetic fields as medium of energy conversions are considered in this course.

The *transfomer* is an electrical device that transfoms AC electrical energy at one voltage level to another voltage level, without altering the frequency of operation. Since transformers also operate on the principle of electromagnetic induction, similar to generators and motors, depending on the action of magnetic filed to accomplish the change in voltage level, they are usually studied together with electrical machines. Morevover transformers play a major role in power transfer in large power systems. Hence transformers are also taught along with the electrical machines.

These three types of electric devices are ubiquitous in modern daily life. Electric motors are used widely in the home run refrigerators, freezers, vacuum cleaners, blenders, air conditioners, fans and many similar appliances. In the workplace, motors provide the motive power for all tools. Of course, generators are necessary to supply the power used by all these motors. Hence as an Electrical Engineer, it is essential to know the operating characteristics and relevant performace parameters of above said electrical machines.

In this course, the discussion is limited to Direct Current operated electrical machines(motors and generators) as well as transformers. Prior to studying about various electro-mechanical systems, it is indispensable to understand about the basics of magnetic circuits and its relevant parameters.			
COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1.	**Week 1** 31-07-23 to 04-08-23 **(3 Contact Hours)**	Course plan details & General introduction Principles of energy conversion Magnetic circuit analysis	Lecture PPT Chalk & Board
2.	**Week 2** 07-08-23 to 11-08-23 **(4 Contact Hours)**	Basic magnetic circuit analysis Faradays Law of electro magnetic induction	Lecture Chalk & Board
3.	**Week 3** 14-08-23 to 18-08-23 **(3 Contact Hours)**	singly and doubly Excited magnetic field systems Torque production in rotating machines	Lecture Chalk & Board
4.	**Week 4** 21-08-23 to 25-08-23 **(4 Contact Hours)**	Introduction to DC machine DC Generator-Construction, the principle of operation	Lecture Chalk & Board
5.	**Week 5** 28-08-23 to 01-09-23 **(4 Contact Hours)**	emf equation Characteristics of DC generators **Assessment – 1**	Lecture Chalk & Board **Written test**
6.	**Week 6** 04-09-23 to 08-09-23 **(4 Contact Hours)**	Process of commutation Armature reaction	Lecture Chalk & Board
7.	**Week 7** 11-09-23 to 15-09-23 **(4 Contact Hours)**	DC motor – operation, Types of DC motors	Lecture Chalk & Board
8.	**Week 8** 18-09-23 to 22-09-23 **(3 Contact Hours)**	Types and torque equation Characteristics Performance analysis	Lecture Chalk & Board
9.	**Week 9** 25-09-23 to 29-09-23 **(3 Contact Hours)**	Electrical and mechanical Characteristics	Lecture Chalk & Board
10.	**Week 10** 02-10-23 to 06-10-23 **(3 Contact Hours)**	**Assessment – 2**	**Written test**
11.	**Week 11** 09-10-23 to 13-10-23 **(4 Contact Hours)**	Starting, Speed control methods, Braking Various testing on DC motors	Lecture Chalk & Board
12.	**Week 12** 16-10-23 to 20-10-23 **(4 Contact Hours)**	Introduction to Transformer Operation of transformer Types and construction	Lecture Chalk & Board
13.	**Week 13** 23-10-23 to 27-10-23 **(2 Contact Hours)**	Transformer – equivalent circuit Testing of transformers	Lecture Chalk & Board

14.	**Week 14** 30-10-23 to 03-11-23 **(4 Contact Hours)**	Performance analysis Three-phase transformer connection,	Lecture Chalk & Board
15.	**Week 15** 06-11-23 to 10-11-23 **(4 Contact Hours)**	Scott connection All day efficiency	Lecture Chalk & Board
16.	Week 16 13-11-23 to 17-11-23 **(4 Contact Hours)**	Sumner's test and parallel operation of transformers **Assessment – 3**	Lecture Chalk & Board Group Activity
17.	Week - 17 20th – 24th November 2023, **(2 Contact Hours)**	Compensation Test	Written test/Quiz (Objective NOT MCQ)
18.	Week - 18 27th November – 1st December 2023 **(3 Contact Hours)**	**Assessment - 4**	End semester exam - Descriptive type

**Mostly 4th contact hour of every week would be a tutorial class*
**If any contact hours are NOT handled as per the 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)

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	Assessment -1	Week 5	60 minutes	20
2	Assessment - 2	Week 10	60 minutes	20
3	Assessment – 3 Group Activity	Week 16		10
CPA	Compensation Assessment ***Written test/Quiz (Objective NOT MCQ)***	Week -17	60 minutes	Maximum of 20
4	Assessment – 4 Descriptive Type Examination	Week 18	180 Minutes	50

COURSE EXIT SURVEY

- Feedback from the students during class committee meetings
- Anonymous feedback through questionnaire (Mid of the semester & End of the semester)
- End semester feedback on Course Outcomes

COURSE POLICY

MODE OF CORRESPONDENCE

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail only.
2. Queries (if required) to the course teacher shall only be emailed to skumar@nitt.edu

COMPENSATION ASSESSMENT POLICY

- CPA will be offered only for the students who could not appear due to genuine reasons with prior permission for Assessment-1 & Assessment-2.

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

- **At least 75% attendance on 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 to 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.

ADDITIONAL INFORMATION

The faculty will be available for consultation as per the intimation given by the faculty. Queries may also be sent to WhatsApp for quick response.

FOR APPROVAL

Course Faculty	CC-Chairperson	HoD / EEE
[Dr. S. SENTHIL KUMAR]	[Dr. C. NAGAMANI]	14/08/23