Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electrical and Electronics Engineering
BEE015 & ELECTRICAL SPECIAL MACHINES
Fifth Semester (Odd Semester)

Course (catalog) description

The student gains detailed skills related to the subject of special type of electrical machines.

Compulsory/Elective course: Elective for EEE students

Credit & Contact hours : 3 and 45 hours

Course Coordinator : Mrs. V. Sumathi

Instructors : Mrs. V. Sumathi

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Mrs. V. Sumathi	Third year EEE	KS 302	04422290125	hod.eee@bharathuniv.ac.in	9.00-9.50 AM

Relationship to other courses:

Pre –requisites **:**BEE 302/EM-I & BEE40/EM-II

Assumed knowledge :The student gains detailed skills related to the subject of special type of electrical machines.

Following courses : Electrical machines

Syllabus Contents

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT II STEPPING MOTORS 9

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed
loop control.

UNIT III SWITCHED RELUCTANCE MOTORS 9

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Senseless operation –Closed loop control of SRM - Characteristics.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Constructional features of PMBLDC Motor - Permanent Magnet materials – Magnetic Characteristics – Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power converters – Motor characteristics and control.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sine wave motor with practical windings – Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

Text book(s) and/or required materials

T1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

T2. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

T3. Venkataraman,"Special Electrical machines".

Reference Books:

R1. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.

R2.Stepping Motors – A Guide t. P.P. Aearnley of Motor

Computer usage:

Professional component

General	-	0%
Basic Sciences	-	0%
Engineering sciences & Technical arts	-	0%
Professional subject	-	0%
Major elective	-	100%

Broad area : Circuit theory| **Electrical machines** |Electronic | Power system| Control & Instrumentation

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1st week	Session 1 to 14	2 Periods
2	Cycle Test-2	September 2nd week	Session 15 to 28	2 Periods
3	Model Test	October 2nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

The student gains detailed skills related to the subject of special type of electrical machines.	Correlates to program outcome		
	H	**M**	**L**
1. Construction, principle of operation and performance of synchronous reluctance motors	-	a,e,g,j,l	K
2. Construction, principle of operation, control and performance of stepping motors	-	-	c,l
3. Construction, principle of operation, control and performance of switched reluctance motors	-	a,e,g	d
4. Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.	a	b,j	-
5. Construction, principle of operation and performance of permanent magnet synchronous motors.	-	c,e,k,l	-

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I	**SYNCHRONOUS RELUCTANCE MOTORS**		
1.	Constructional features , Types	NO	[R1]
2.	Axial and Radial flux motors	NO	
3.	Operating principles	NO	
4.	Variable Reluctance and Hybrid Motors	YES	
5.	Voltage and Torque Equations	YES	
6.	Phasor diagram - Characteristics.	NO	
UNIT II	**STEPPING MOTORS**		
7.	Constructional features	NO	[T1]
8.	Principle of operation	NO	
9.	Variable reluctance motor	YES	
10.	Hybrid motor	NO	
11.	Single and multi stack configurations	NO	
12.	Torque equations	YES	
13.	Modes of excitations	NO	
14.	Characteristics – Drive circuits – Microprocessor control of stepping motors	YES	
15.	Closed loop control.	YES	
UNIT III	**SWITCHED RELUCTANCE MOTORS**		
16.	Constructional features	NO	[T1]
17.	Rotary and Linear SRMs	YES	
18.	Principle of operation	YES	
19.	Torque production	NO	
20.	Steady state performance prediction	NO	
21.	Analytical method	YES	
22.	Power Converters and their controllers	YES	
23.	Methods of Rotor position sensing	NO	
24.	Senseless operation	NO	
25.	Closed loop control of SRM - Characteristics.	NO	
UNIT IV	**PERMANENT MAGNET BRUSHLESS D.C. MOTORS**		
26.	Constructional features of PMBLDC Motor	YES	
27.	Permanent Magnet materials	YES	

28.	Magnetic Characteristics	YES	[T2]
29.	Principle of operation	YES	
30.	Types	NO	
31.	Magnetic circuit analysis	YES	
32.	EMF and torque equations	YES	
33.	Commutation - Power converters	YES	
34.	Motor characteristics and control.	NO	
UNIT V	**PERMANENT MAGNET SYNCHRONOUS MOTORS**		
35.	Principle of operation – Ideal PMSM – EMF and Torque equations	YES	[R2]
36.	– Armature reaction MMF	YES	
37.	Synchronous Reactance	NO	
38.	Sine wave motor with practical windings	NO	
39.	Phasor diagram	YES	
40.	Torque/speed characteristics - Power controllers	NO	
45.	Converter Volt-ampere requirements.	YES	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	05%
Cycle Test – II	-	05%
Model Test	-	10%
Attendance	-	5%
SEMINAR& ASSIGNMENT		05%
Final exam	-	70%

Prepared by: Mrs. V. Sumathi **Dated :**

Addendum

ABET Outcomes expected of graduates of B.Tech / EEE / program by the time that they graduate:

a) .An ability to apply knowledge of mathematics, science, and engineering fundamentals.

b) An ability to identify, formulate, and solve engineering problems.

c) An ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d) An ability to design and conduct experiments, as well as to analyze and interpret data.

e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

f) An ability to apply reasoning informed by the knowledge of contemporary issues.

g) An ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

h) An ability to understand professional and ethical responsibility and apply them in engineering practices.

i) An ability to function on multidisciplinary teams.

j) An ability to communicate effectively with the engineering community and with society at large.

k) An ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.

l) An ability to recognize the need for,and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION
Electrical Engineering Graduates are in position with the knowledge of Basic Sciences in general and Electrical Engineering in particular so as to impart the necessary skill to analyze and synthesize electrical circuits, algorithms and complex apparatus.

PEO2: CORE COMPETENCE
Electrical Engineering Graduates have competence to provide technical knowledge, skill and also to identify, comprehend and solve problems in industry, research and academics related to power, information and electronics hardware.

PEO3: PROFESSIONALISM
Electrical Engineering Graduates are successfully work in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to be able to handle critical situations and meet deadlines.

PEO4: SKILL
Electrical Engineering Graduates have better opportunity to become a future researchers/ scientists with good communication skills so that they may be both good team-members and leaders with innovative ideas for a sustainable development.

PEO5: ETHICS
Electrical Engineering Graduates are framed to improve their technical and intellectual capabilities through life-long learning process with ethical feeling so as to become good teachers, either in a class or to juniors in industry.

Course Teacher	Signature
Mrs. V. Sumathi	

Course Coordinator
(Mrs. V. Sumathi)

HOD/EEE

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