Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electrical and Electronics Engineering
BEE012 & SOLID STATE RELAYS
FifthSemester (Odd Semester)

Course (catalog) description

- To educate the basic concepts and new developments in solid state relays and power system protection
- To educate the theory and applications of the main components used in power system protection for electric machines, transformers, bus bars, overhead and underground feeders.

Compulsory/Elective course:Elective for EEE students

Credit hours : 3 & 45

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@gmail.com	12.00 to 12.30 pm

Relationship to other courses:

Pre –requisites : BEE101 –Basic Electrical and Electronics Engineering

Assumed knowledge : The students will have basic knowledge in power electronic devices and also Machines I and II which is helpful for solid state relays

Syllabus Contents

UNIT I INTRODUCTION OF RELAYS 9

Comparators: phase and amplitude comparators-types-Direct and integrating rectifier bridge, circulating current, opposed voltage coincident type phase comparator-Direct or block spike phase comparator, phase splitting technique, integrating type phase comparator with transistor AND gate, hybrid comparator with transistor AND gate. Hybrid comparator- Hall effect type and magneto resistivity type, vector product type - zener diode phase comparators-Multi input-Three input coincidence comparators

UNIT II RELAY CIRCUIT 9

Static relay circuit (using analog and digital ic's) for over current, inverse time characteristics, differential relay.

UNIT III RELAY CIRCUIT 9

Static relay circuits fort generator loss of field, under frequency, distance relay, impedance, reactance, reverse power relays.

UNIT IV TRANSIENT BEHAVIOR OF RELAYS 9

Static relay circuits for carrier current protection-steady state and transient behavior of static relay-testing and maintenance - tripping circuits using thyristors.

UNIT V MICROPROCESSOR BASED RELAYS 9

Microprocessor based relays: hardware and software for the measurement of voltage, current, frequency, phase angle-microprocessor implementation of over current relays-inverse time characteristics-impedance relay-directional relay-mho relay

Text book(s) and/or required materials

T1. Badri Ram, D. N. Vishwakarma 'power system protection and switchgear',22nd Edition, Tata Mcgraw Hill, 2001.

T2. Rao, T.S.M. Power System Protection And Switch Gear, 2nd Edition, Wiley Eastern Ltd,1979

Reference Books:

R1. Van. C.Wamngton. 'Protective Relays- their theory and practice', 2nd Edition, Chapman and hall

R2Russel c. Mason, "The art and science of protective relays" 1st Edition. John Wiley and Sons Ltd

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| Electronics | 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

• To educate the basic concepts and new developments in solid state relays and power system protection • To educate the theory and applications of the main components used in power system protection for electric machines, transformers, bus bars, overhead and underground feeders.	Correlates to program outcome		
	H	**M**	**L**
1. Gain Knowledge On Different Protective Equipment's Or Power Relays, Know About Various Protective Systems- How It Works And Where It Works?	a,b,c,d,e	g,l,j	f,h
2. Different Applications Of The Relays, Circuit Breakers, Grounding For Different Elements Of Power System Is Also Discussed In The Subject.	c,e,h,l,j,k,l	a,b,d,f	g
3. Ability To Understand Various Power, Frequency And Impedance Relays	b,c,e,l	a,f,g,h,i	d,j,k
4. Ability To Understand Protective Schemes ,Transient Behavior ,Testing And Tripping Schemes	c,d,	e,h,l,j,k,l	a,b,f,g
5. Ability To Understand Relays Using Microprocessor	a,b	e,f,g,h,l,j,k,l	c, d

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

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I	**INTRODUCTION OF RELAYS**		
1.	Comparators: phase and amplitude comparators bridge	**No**	[T_1]
2.	Types-Direct and integrating rectifiercirculating current	**No**	
3.	Voltage phase splitting technique,	**No**	
4.	Integrating type phase comparator with transistor AND gate	**No**	
5.	hybrid comparator with transistor AND gate	**No**	
6.	Hybrid comparator- Hall effect type	**No**	

7.	Magneto resistivity type	**No**	
8.	Vector product type - zener diode phase comparators	**No**	
9.	Multi input-Three input coincidence comparators	**No**	
UNIT II	**RELAY CIRCUIT**		
10.	Static relay circuit using analog ic's for over current	**No**	[T_1]
11.	Static relay circuit using digitalic's for over current	**No**	
12.	inverse time characteristics	**No**	
13.	differential relay	**No**	
14.	Quiz		
15.	Review of Unit II		
16.	Surprise Test		
UNIT III	**RELAY CIRCUIT**		
17.	Static relay circuits for generator loss of field	**No**	[T_1] & [R_1]
18.	Static relay circuits for generator loss of field under frequency	**No**	
19.	Static relay circuits for generator loss of field under distance relay	**No**	
20.	Static relay circuits for generator loss of field under impedance	**No**	
21.	Static relay circuits for generator loss of field under reactance	**No**	
22.	Static relay circuits for generator loss of field under reverse power relays.	**No**	
23.	Quiz	**No**	
24.	Review of Unit III	**No**	
25.	Surprise Test	**No**	
UNIT IV	**TRANSIENT BEHAVIOR OF RELAYS**		
26.	Static relay circuits for carrier current protection	**No**	[T_1] & [R_1]
27.	Steady statebehavior	**No**	
28.	Transient behavior of static relay-testing	**No**	
29.	Tripping circuits using thyristors	**No**	
30.	Quiz	**No**	
31.	Review of Unit IV	**No**	
32.	Surprise Test		
UNIT V	**MICROPROCESSOR BASED RELAYS**		
33.	Microprocessor based relayshardware	**No**	[T_1]
34.	Microprocessor based relayssoftware for the measurement of voltage	**No**	
35.	Microprocessor based relayssoftware for the measurement of current	**No**	
36.	Microprocessor based relayssoftware for the	**No**	

	measurement of frequency		
37.	Microprocessor based relayssoftware for the measurement ofphase angle	**No**	
38.	microprocessor implementation of over current relays	**No**	
39.	inverse time characteristics	**No**	
40.	impedance relay	**No**	
41.	directional relay-mho relay	**No**	
42.	Quiz	**No**	
38.	Review of Unit V	**No**	
39.	Surprise Test	**No**	
40.	Revision For UNIT I	**No**	
41.	Revision For UNIT II	NO	
42.	Revision For UNIT III	NO	
43.	Revision For UNIT IV	NO	
44.	Revision For UNIT V	NO	
45.	Discussion For University Exam	NO	

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 **HOD/EEE**

(Mrs.V.Sumathi) ( )