Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electrical and Electronics Engineering
BEE051 & DISTRIBUTED GENERATION ANDMICROGRID
Fifth Semester (Core Elective I) (odd Semester)

Course (catalog) description

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Micro grid and its configuration

Compulsory/Elective course: Elective for EEE students

Credit hours : 3 credits

Course Coordinator : Mrs.Anitha Sampath kumar

Instructors : Mr.P.Kathiravan

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@ bharathuniv.ac.in	Consultation
Mr.P.Kathiravan	Final year EEE	KS 303		Kathirped@gmail.com	9.00-9.50 AM

Relationship to other courses:

Pre –requisites **:** BME203 - Basic Mechanical Engineering

Syllabus Contents

UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages, Energy crises, Non - conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids,

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids

Reference Books:

R1. AmirnaserYezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.

R2 DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.

R3 Chetan Singh Solanki, "Solar Photo Voltaics", , PHI learning Pvt. Ltd., New Delhi, 2009

R4 J.F. Manwell, J.G "Wind Energy Explained, Theory Design and Applications,".McGowan Wiley publication, 2nd Edition, 2009.

R5 D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", , John Wiley, New York, 1987.

John Twidell and Tony Weir, "Renewable Energy Resources", Taylor and Francis Publications, Second Edition, 2006

Computer usage:

Professional component

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

Broad area :

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 illustrate the concept of distributed generation • To analyze the impact of grid integration. • To study concept of Microgrid and its configuration	Correlates to program outcome		
	H	**M**	**L**
1. Review the conventional power generation		a,b,c,e,j,l	k
2. Analyze the concept of distributed generation and installation	a,c,e,	k,l	
3. Design the grid integration system with conventional and non-conventional energy sources	d	a,e,g	
4. Design the dc and ac micro grid	a,d	b,e,j	
5. Analyze power quality issues and control operation of micro grid		b,c,e,k,l	j

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

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I			
1.	Conventional power generation:	NO	
2.	advantages and disadvantages	NO	

3.	Energy crises	NO	[R1], [R5]
4.	Non - conventional energy (NCE) resources: review of Solar PV	NO	
5.	Wind Energy systems,	NO	
6.	Fuel Cells	NO	
7.	micro-turbines	NO	
8.	biomass,	NO	
9.	tidal sources	NO	
UNIT II			
10.	Concept of distributed generations	NO	[R1]
11.	topologies,	NO	
12.	selection of sources	NO	
13.	regulatory standards/ framework,	NO	
14.	Standards for interconnectingDistributed resources to electric power systems: IEEE 1547.	NO	
15.	. DG installation classes	NO	
16.	security issues in DG implementations.	NO	
17.	Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants	NO	
18.	Revising the entire unit	NO	
UNIT III			
19.	Requirements for grid interconnection, limits on operational parameters	NO	[R1], [R5]
20.	voltage,	NO	
21.	frequency	NO	
22.	THD,	NO	
23.	, islanding issues	NO	
24.	Impact of grid integration with NCE sources on existing power system: reliability,	NO	
25.	stability	NO	
26.	power quality issues.	NO	
27.	response to grid abnormal operating conditions	NO	
28.	Revising the entire unit	NO	
UNIT IV			
29.	Concept and definition of microgrid	NO	
30.	microgrid drivers	NO	
31.	benefits,	NO	

32.	review of sources of microgrids,	NO	[R1], [R5]
33.	typical structure	NO	
34.	configuration of a microgrid,	NO	
35.	AC and DC microgrids	NO	
36.	Power Electronics interfaces in DC and AC microgrids,	NO	
37.	Continuation of previous class	NO	
38.	Revising the entire unit	NO	
UNIT V			
39.	Modes of operation and control of microgrid	NO	[R2]
40.	grid connected and islanded mode	NO	
41.	Active and reactive	NO	
42.	power control,	NO	
43.	protection issues, anti-islanding schemes: passive, active and communication based techniques	NO	
44.	microgrid communication infrastructure, Power quality issues in microgrids,	NO	
45.	regulatory standards, Microgrid economics, Introduction to smart microgrids.	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	-	10%
Cycle Test – II	-	10%
Model Test	-	25%
Attendance	-	5%
Final exam	-	50%

Prepared by: **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.Anitha Sampathkumar	

Course Coordinator
(Mrs.Anitha Sampathkumar)

HOD/EEE
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