NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**I Year M.Tech, EEE**		
Course Title	**Distributed Generation and Microgrids**		
Course Code	**EE684**	**No. of Credits**	**03**
Session	**July 2020**	**Section (if, applicable)**	**MTech PS and PE**
Name of Faculty	**Dr. Aneesa Farhan M A**	**Department**	**EEE**
Email	aneesa@nitt.edu **aneesafma@gmail.com**	**Telephone No.**	**7598164452** **8015877137**
Name of Course Coordinator(s) (if, applicable)	**N A**		
Course Type (please tick appropriately)	☐ **Elective**		

Syllabus (approved in BoS)

Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.
Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultra-capacitors, flywheels
Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems
Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.
Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids- modeling & analysis- Micro-grids with multiple DGs – Micro- grids with power electronic interfacing units. Transients in micro-grids - Protection of micro-grids – Case studies.

Reference Books:

1. H. Lee Willis, Walter G. Scott ,'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press,2000.
2. M.GodoySimoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.

3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson 'Facility Microgrids', Subcontract report, May 2005,
6. General Electric Global Research Center, Niskayuna, New York.

COURSE OBJECTIVES

The main objective of the course is to enable the students to gain an insight into the deregulation aspects and the need for DG. The student will understand the interfacing technologies of the DG, Control aspects of Synchronous and inverter-based DG. After that when the DG is connected to the system the impact of the DG upon the power system especially the Distribution Side. The course also studies about the steady state and transient studies including different protection issues during the DG interconnection. Additionally, course also extend these concepts into the study of microgrid

MAPPING OF COs with Pos

Course Outcomes	**Programme Outcomes (PO)** (Enter Numbers only)
Upon completion of the course, the students will be able to	
1. Understand the current scenario of Distributed Generation and the need to implement DG sources	**2 of PS**
2. Investigate the different types of interfaces for Grid integration of DGs.	**PO 4 of PE and 6 of PS,**
3. Appraise the technical impacts of DGs upon transmission and `distribution systems	**PO 3 of PS**
4. Evaluate the various control aspects and techniques of different distributed generation sources.	**PO 4, 6, 7 of PE**
5. Associate different types of micro-grids and analyse the transients and protection related issues in micro-grids.	**PO 3,7 8 of PS**

COURSE PLAN – PART II

COURSE OVERVIEW

The course Distributed generation and microgrids emphassis on the different DG Technology and the need of it in the present scenario. The course gives insight into the grid interconnection principle of the new inverter based DG's and the different interfacing techniques with their control. The course in addition to looking at the DG as a source connected to the grid but also helps to have insights into the system aspects and issues after grid interconnection. The study include system studies like steady state load flow,Voltage regulation and control , transient studies that include protection issues etc..

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	Week 15-09-2020 to 18-09-2020 (2 Contact Hour)	Course plan, Need for Distributed generation.	**Online mode**
2	Week 2 2 Week 2 21-09-2020 to 25-09-2020 (3 Contact Hours)	De-regulation, Renewable sources in distributed generation, Current scenario in Distributed Generation,	**Online mode**
3	Week 3 28-09-2020 to 02-10-2020 (3 Contact Hours)	Energy storage elements: Batteries, ultra-capacitors, flywheels. Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces -	**Online mode**
4	Week 4 05-10-2020 to 09-10-2020 (3 Contact Hours)	Aggregation of multiple DG units Economic Aspects of DG Market facts, issues and challenges - Limitations of DGs.	**Online mode**
5	Week 5 12-10-2020 to 16-10-2020 (3 Contact Hours	control aspects of DGs – Voltage control techniques, Reactive power control **Assignment Part 1**	**Online mode**
6	Week 6 19-10-2020 to 23-10-2020 (3 Contact Hours)	Technical impacts of DGs – Transmission systems, Distribution systems,	**Online mode**
7	Week 7 26-10-2020 to 30-10-2020 (2 Contact Hours)	**Assessment 1** Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.	**Quiz Online mode**
8	Week 8 02-11-2020 to 06-11-	**Assignment Part 2**	**Online mode**

	2020 (3 Contact Hours)	Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems	
9	Week 9 09-11-2020 to 13-11-2020 (3 Contact Hours)	Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Micro-grids with multiple DGs	**Online mode**
10	Week 10 16-11-2020 to 20-11-2020 (3 Contact Hours)	Sizing of micro-grids- Modelling & analysis	**Online mode**
11	1 Week 11 23-11-2020 to 27-11-2020 (3 Contact Hours)	**Assessment 2** - Protection of micro-grids – Case studies	**Online mode** **Quiz**
13	Week 12 30-11-2020 to 04-12-2020 (2 Contact Hours)	Micro- grids with power electronic interfacing units. Transients in micro-grids.	**Online mode**
	Week 13 07-12-2020 to 11-12-2020 (3 Contact Hours)	Harmonics, Power quality issues. Reliability of DG based systems	**Online mode**
	Week 14 14-12-2020 to 18-12-2020 (3 Contact Hours)	**Compensation Assessment** **Assessment 3 Discussion**	**Quiz** **Online mode**

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Type of assessment	Duration	% Weightage
1.	**Assessment I**	Quiz	75 min	**20%**
2.	**Assessment II**	Quiz	75 min	**20%**
CPA	**Compensation Assesment (entire syllubus)**	quiz	75 min	**20%**
3.	**Assessment III Group Task**	Assignment (Part1+Part2) (simulation)		**30%**
4	**Assessment IV Final sem(entire syllabus)**	Quiz	120 min	**30%**

COURSE EXIT SURVEY

1. Students feedback through class committee meetings
2. Feedback questionnaire from students – twice during the semester
3. Feedback from students on the course outcomes shall be obtained at the end of the course

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

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Dr. Aneesa Farhan M A

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

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.