NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE PLAN – PART I			
Name of the programme and specialization	**M.Tech. (Construction Technology & Management)**		
Course Title	**Distributed Generation and Micro-Grids**		
Course Code	**EE684**	**No. of Credits**	**3**
Course Code of Pre/ Co-requisite subject(s)			
Session	**January 2021**	**Section (if, applicable)**	**-**
Name of Faculty	**Dr. M. P. SELVAN**	**Department**	**EEE**
Email	**selvanmp@nitt.edu**	**Telephone No.**	**9444170638**
Name of Course Coordinator(s) (if, applicable)			**NA**
E-mail	**-**	**Telephone No.**	**-**
Course Type	☐ **Core course** ☑ **Elective course**		

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. Godoy Simoes, 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, General Electric Global Research Center, Niskayuna, New York.

COURSE OBJECTIVES	
To understand the planning and operational issues related to Distributed Generation and Microgrids.	
COURSE OUTCOMES (CO)	
Course Outcomes	**Aligned Programme Outcomes (PO)**
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. Investigate the different types of interfaces for grid integration of DGs.	
3. Appraise the technical impacts of DGs upon transmission and distribution systems.	
4. Evaluate the various control aspects and techniques of different distributed generation sources.	
5. Associate different types of micro-grids and analyze the transients and protection related issues in micro grids.	

COURSE PLAN – PART II

COURSE OVERVIEW

The use of distributed generators (DGs) is becoming very popular in the modern electric grid due to its technical advantages as well as the awareness among the stackholders to conserve depleting fossil fuel and to reduce the enviornmental pollution. This course introduces the concept of distributed generation and different renewbale sources used in distributed generation. The need for optimal placement and sizing of distribted generators will be explained. Students will be made aware of various technical and financial benefits of using DGs. The drawbacks and challenges faced by the utility due to the integration of DGs will also be demnostrated to the students. Further, the power electronic interfaces to be used to integrate rotating and non-rotating type DG units in to the grid will be discussed. Arising protection issues due to the integration DG units will be presented. At the end of the course, students will learn the concept of micro-grid and formation of micro-grid using multiple DG units and suitable power electronic interfaces. Different topologies of micro-grid will be introduced. By attending this course, students will gain knowledge on selction of DG units, selection of power electroinc interfaces and selection of energy storage systems for formation and operaton of micro-grid both in isolated and grid connected modes.

COURSE TEACHING AND LEARNING ACTIVITIES			
S.No.	**Week/Contact Hours**	**Topic**	**Mode of Delivery**
1	Week 1 18-01-2021 to 22-01-2021 (2 Contact Hours)	Course Plan Details & Introduction Need for Distributed generation	Online MS Teams
2	Week 2 25-01-2021 to 29-01-2021 (2 Contact Hours)	Renewable sources in distributed generation, current scenario in Distributed Generation	Online MS Teams
3	Week 3 01-02-2021 to 05-02-2021 (3 Contact Hours)	Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems	Online MS Teams
4	Week 4 08-02-2021 to 12-02-2021 (3 Contact Hours)	Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces	Online MS Teams
5	Week 5 15-02-2021 to 19-02-2021 (3 Contact Hours)	Aggregation of multiple DG units. Energy storage elements: Batteries, ultra-capacitors, flywheels	Online MS Teams
6	Week 6 22-02-2021 to 26-02-2021 (1 Contact Hour)	**Assessment-1**	Online MS Teams
7	Week 7 01-03-2021 to 05-03-2021 (3 Contact Hours)	Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation	Online MS Teams
8	Week 8 08-03-2021 to 12-03-2021 (3 Contact Hours)	Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems	Online MS Teams
9	Week 9 15-03-2021 to 19-03-2021 (3 Contact Hours)	Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs. Voltage control techniques, Reactive power control	Online MS Teams
10	Week 10 22-03-2021 to 26-03-2021 (1 Contact Hour)	**Assessment - 2**	Online MS Teams
11	Week 11 29-03-2021 to 02-04-2021 (2 Contact Hours)	Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis	Online MS Teams
12	Week 12 05-04-2021 to 09-04-2021 (3 Contact Hours)	Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids- modeling & analysis-	Online MS Teams
13	Week 13 12-04-2021 to 16-04-2021 (3 Contact Hours)	Micro-grids with multiple DGs – Micro- grids with power electronic interfacing units.	Online MS Teams
14	Week 14 19-04-2021 to 23-04-2021 (3 Contact Hours)	Transients in micro-grids - Protection of micro-grids – Case studies.	Online MS Teams

15	Week 15 26-04-2021 to 30-04-2021 (3 Contact Hours)	**Assessment 3 (Group Task)**	Online
16	Week 16 03-05-2021 to 07-05-2021 (1 Contact Hour)	**Compensation Assessment**	
17	Week 17 10-05-2021 to 14-05-2021 (2 Contact Hours)	**Final Assessment**	

COURSE ASSESSMENT METHODS (shall range from 4 to 6)

S.No.	Mode of Assessment	Week	Duration	% Weightage
1	Surprize Quiz			5
	Scheduled Quiz	Week 6	60 Minutes	20
2	Surprize Quiz			5
	Scheduled Quiz	Week 10	60 Minutes	20
3	Group Task/ Take Away Tasks	Week 15		20
CPA	Compensation Assessment	Week 16	60 Minutes	20
4	Final Assessment	Week 17	90 Minutes	30

COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)

Feedback from the students during class committee meetings

Institute end semester feedback

COURSE POLICY (preferred mode of correspondence with students, compensation assessment policy to be specified)

MODE OF CORRESPONDENCE (email/ phone etc)

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ any other information regarding this course) will be done through their Webmail only. Conduct of course and sharing of course material will be done through MS Teams. Suitable platform/software tool will be chosen for the conduct of assessments and will be informed to the students.
2. Queries (if required) to the course teacher shall only be emailed to selvanmp@nitt.edu.

COMPENSATION ASSESSMENT POLICY

1. Attending all the assessments are MANDATORY for every student.
2. If any student is not able to attend any of the assessments (1 and 2, scheduled quizzes only) due to genuine reason, student is permitted to attend the compensation assessment (CPA).
3. At any case, CPA will not be considered as an improvement test.

ATTENDANCE POLICY

As directed by the Academic Office.

ACADEMIC DISHONESTY & PLAGIARISM

- Copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark will 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.

ADDITIONAL INFORMATION

The faculty is available for consultation at times as per the intimation given by the faculty.

FOR APPROVAL

Course Faculty	CC-Chairperson	HOD
		Head Department of Civil Engineering National Institute of Technology Tiruchirappalli - 620 015.