HIBBING COMMUNITY COLLEGE
COURSE OUTLINE

COURSE NUMBER & TITLE: ELM 2401: Photovoltaic Systems Theory and Design
CREDITS: 4 (3 Lecture / 1 Lab)
PREREQUISITES: ELM 1005, 1101, 1201 classes or approval of instructor

CATALOG DESCRIPTION:
Photovoltaic (PV) Systems Theory and Design covers the introduction of photovoltaic fundamentals, terms, applications and applicable National Electrical Code articles. This is the first of two courses to prepare students for the North American Board of Certified Energy Practitioners (NABCEP) Entry Level Certificate of Knowledge test.

OUTLINE OF MAJOR CONTENT AREAS:
I. Safety
II. PV Markets and Applications
III. Solar Energy Fundamentals
IV. PV Module Fundamentals

COURSE GOALS/OBJECTIVES/OUTCOMES:
Students will
1. describe history of PV technology and industry.
2. describe markets and applications for PV (grid-tie, remote homes, telecom, etc.).
3. identify types of PV systems (direct motor, standalone with storage, grid-backup, etc.).
4. associate key features and benefits of PV with applications.
5. identify safety hazards of operational and non-operational PV systems.
6. identify safety hazards, practices and protective equipment during PV systems installation and maintenance (electricity, batteries, roof work).
7. explain difference between energy and power.
8. define basic electrical terms.
9. describe the use of digital multi-meter.
10. calculate simple circuit values.
11. define basic solar terms (e.g., irradiation, Langley, azimuth).
12. determine true (solar) south from magnetic (compass) south given a declination map.
13. describe Basic solar movement and effect of earth tilt.
14. predict solar position using solar path diagrams.
15. describe angular effects on the irradiance of array.
16. identify factors that reduce/enhance solar irradiation.
17. determine average solar irradiation on various surfaces.
18. convert solar irradiation into a variety of units.
19. determine effect of horizon on solar irradiation (shading).

20. demonstrate use of Solar Pathfinder or sun charts.
21. explain how a solar cell converts sunlight into electric power.
22. label key points on a typical IV curve.
23. identify key output values of solar modules using manufacturer literature.
24. illustrate effect of environmental conditions on IV curve.
25. illustrate effect of series/parallel connections on IV curve.
26. define measurement conditions for solar cells and modules (STC, NOCT, PTC).
27. compute expected output values of solar module under variety of environmental conditions.
28. compare the performance and characteristics of various cell technologies.
29. describe the components and construction of a typical flat plate solar module.
30. calculate efficiency of solar module.
31. explain purpose and operation of bypass diode.
32. describe typical deterioration/failure modes of solar modules.
33. describe the major qualification tests and standards for solar modules.

MNTC GOALS AND COMPETENCIES MET:
N/A

HCC COMPETENCIES MET:
Working Productively and Cooperatively
Communicating Clearly and Effectively
Thinking Creatively and Critically
Social/Civic Responsibility

STUDENT CONTRIBUTIONS:
The student is expected to read the required textbook, spend sufficient time outside of class to complete assignments, submit assignments when due, take tests on scheduled dates, and participate in class discussions.

STUDENT ASSESSMENT SHALL TAKE PLACE USING INSTRUMENTS SELECTED/DEVELOPED BY THE COURSE INSTRUCTOR.

SPECIAL INFORMATION: (SPECIAL FEES, DIRECTIVES ON HAZARDOUS MATERIALS, ETC.):
National Electrical Code (Current Edition) NFPA
Scientific calculator, and safety glasses

AASC APPROVAL DATE: February 10, 2016

REVIEW DATE: February 2021

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