STATE UNIVERSITY OF NEW YORK !
COLLEGE OF TECHNOLOGY !
CANTON, NEW YORK !

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
AREA 321 - SOLAR ENERGY UTILIZATION

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Canino School of Engineering Technology !

Department: Mechanical & Energy Technology !

Semester/Year: Fall/2018 !

A. **TITLE**: Solar Energy Utiltization

B. **COURSE NUMBER:** AREA 321

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 3 **per week**
 # Lab Hours: **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER !
***If course satisfies more than one*:** GER !

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☒ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

Solar Energy Utilization is an introductory course on solar energy with an emphasis on thermal processes. Topics include solar radiation, heat transfer, flat-plate collectors, thermal energy storage, and solar thermal applications.

H. **PRE-REQUISITES: None** ☐ **Yes** ☒ **If yes, list below:**

MECH 225, Introduction to Thermodynamics or permission of instructor

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
determine angles to locate the sun based on location, time, and date.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets
calculate incident radiation for a flat or sloped surface.	SO #2 An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology by applying these areas to renewable energy systems		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets
evaluate the performance of flat-plate and other solar collectors and explore the current and future state of solar thermal technologies.	SO # 11 A commitment to quality, timeliness, and continuous improvement		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets
estimate hourly and annual energy output of solar collectors.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	CA Subsets Subsets Subsets
calculate energy storage requirements for solar thermal processes.	SO # 6 An ability to identify, analyze and solve technical problems.		2-Crit Think 5-Ind, Prof, Disc, Know Skills ISLO	PS Subsets Subsets Subsets

KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator !

J. APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. TEXTS:

Solar Engineering of Thermal Processes (2nd edition) by J. A. Duffie and W. A. Beckman (John Wiley & Sons, Inc.) 1991

L. REFERENCES:

Solar Energy: Fundamentals, Design, Modelling and Applications by G. N. Tiwari (Narosa Publishing House) 2002

M. EQUIPMENT: None ☒ Needed:

N. GRADING METHOD: A-F

O. SUGGESTED MEASUREMENT CRITERIA/METHODS:

Grading may include homework, quizzes, exams, and a design project.

P. DETAILED COURSE OUTLINE:

1. Solar Radiation
- **i. The sun and solar radiation spectrum**
- **ii. Direction of beam radiation (solar angles)**
- **iii. Shading**
- **iv. Extraterrestrial radiation on a horizontal surface**

2. Available Solar Radiation
- **i. Measuring solar radiation**
- **ii. Solar radiation data**
- **iii. Atmospheric attenuation of solar radiation**
- **iv. Beam and diffuse components of solar radiation**
- **v. Radiation on sloped surfaces**

3. Selected Heat Transfer Topics
- **i. Radiation and radiation heat transfer coefficient**
- **ii. Natural convection between flat parallel plates**
- **iii. Wind convection coefficients**
- **iv. Heat exchanger effectiveness**

4. Radiation on Opaque Materials
- **i. Kirchoff's law**
- **ii. Absorptance, emittance, and reflectance**
- **iii. Selective surfaces**

5. Radiation Transmission Through Glazing
- **i. Optical properties of glazing**
- **ii. Transmittance and transmittance-absorptance product**
- **iii. Absorbed solar radiation**

6. Flat-Plate Collectors
- **i. Collector overall heat loss coefficient**
- **ii. Temperature distribution and collector efficiency**
- **iii. Collector heat removal factor and flow factor**
- **iv. Critical radiation level**
- **v. Mean plate and fluid temperatures**
- **vi. Effective transmittance-absorptance product**
- **vii. Measuring collector performance**
- **viii. Practical considerations**

7. Concentrating Collectors
- **i. Collector configurations**
- **ii. Thermal performance**
- **iii. Optical performance**

8. Energy Storage
- **i. Comparing loads to collector output**
- **ii. Energy storage in solar thermal processes**
- **iii. Energy storage techniques**

9. Solar Process Loads
- **i. Hot water loads**
- **ii. Space heating loads**
- **iii. Swimming pool loads**

10. System Considerations and Calculations
- **i. System component models**
- **ii. Collector heat exchanger factor**
- **iii. Duct and pipe losses**
- **iv. Controls**
- **v. Other system considerations**

11. Solar Thermal Applications
- **i. Solar water heating**
- **ii. Industrial process heat**
- **iii. Solar thermal power systems**
- **iv. Solar cooling**

Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐