



FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Technology

Semester I

Course Code: 102450107

Course Title: MATERIALS FOR SOLAR DEVICES

Type of Course: Program Elective II

Course Objectives: To explain the concept and the diverse materials used for solar devices. To explicate in depth knowledge of about solar cells, thermal energy storage and electrical energy storages. To gather some idea of system balance and analysis with reference to its cost.

Teaching & Examination Scheme:

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|------------------------|----------|-----------|----------------|---------------------------------------|---------|----------|---------|----------|
| Lecture | Tutorial | Practical | | Internal | | External | | Total |
| | | | | Theory | J/V/P* | Theory | J/V/P* | |
| 3 | 2 | 0 | 4 | 30 / 15 | 20 / 10 | 70 / 35 | 30 / 15 | 150 / 75 |

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

| Sr. | Contents | Hours |
|-----|--|-------|
| 1 | MATERIALS FOR SOLAR COLLECTORS: Collector Materials for Low, Medium and High Temperature Applications - Glazing Materials, Optical Materials - Absorber Coatings, Insulations, Desiccants, Use of Plastics - Reliability and Durability of Solar Collectors - Environmental Degradation of Low Cost Solar Collectors. | 9 |
| 2 | MATERIALS FOR SOLAR CELLS: Silicon, Cadmium Telluride, Gallium-Arsenic, GaInP / GaAs / Ge - Thin Film, Single Crystalline, Polycrystalline Materials - Multi Junction and Tandem Junction Solar Cells - Low Cost and High Efficiency Materials - Conversion Efficiency of Solar Cells. | 9 |
| 3 | ELECTRICAL ENERGY STORAGE MATERIALS: Chemical storage Concepts - Rechargeable Batteries - Types, Operating range, Comparison and suitability for various applications - Super Capacitors. | 6 |
| 4 | THERMAL ENERGY STORAGE MATERIALS: Thermal Storage Concepts - Materials for Sensible and Latent Heat Energy Storage. Organic, Inorganic Eutectic Materials, Materials for Low and High Temperature Storage Applications. | 9 |



| | | |
|----------|--|----------|
| 5 | BALANCE OF SYSTEM MATERIALS & COST ANALYSIS: Functional requirements of other materials for components like Invertors, Charge Controllers, Wires, Pipes, Valves, etc. and identification of suitable materials - Simple Cost Analysis for alternative selection of materials - Case studies. | 6 |
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Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

| Distribution of Theory Marks | | | | | | R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create |
|------------------------------|----|----|----|----|----|--|
| R | U | A | N | E | C | |
| 20 | 20 | 20 | 15 | 15 | 10 | |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

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|---|--|
| 1 | Thermal Energy Storage: Systems and Applications, Ibrahim Dincer and Marc A Rosan, John Wiley. |
| 2 | Solar Energy: Principles of Thermal Collection & Storage Sukhatme and Nayak, , Tata McGraw-Hill, 2008. |
| 3 | The Physics of Solar Cells, Nelson, J., Imperial College Press, 2003. |
| 4 | Thin Film Solar Cells, JefPoortmans and Vladimir Arkhipov, John Wiley and Sons. |
| 5 | Solar Electricity, Thomas Markvart, John Wiley and Sons. |
| 6 | Solar Cell Technology and Applications, A.R. Jha, Aurbach Publications. |
| 7 | Solar Thermal Energy Storage, H.P.Garg., S.C.Mullick, A.K.Bhargava, D.Reidal, Springer. |

Course Outcomes (CO):

| Sr. | Course Outcome Statements | %weightage |
|------|---|------------|
| CO-1 | Understand and identify the material of collector for solar system. | 20 % |
| CO-2 | To know and able to select the Solar cell materials. | 30 % |
| CO-3 | Understand and demonstrate the thermal energy storage and electrical energy storage system. | 30 % |
| CO-4 | Students able to material cost analysis of storage system | 20 % |

List of Practicals / Tutorials:

| | |
|---|---|
| 1 | To get acquainted with the operation, construction, use and capabilities of a metallographic microscope. |
| 2 | To study procedure of specimen preparation for microscopic examination and to carry out a specimen preparation. |
| 3 | To study about different materials and its effect on performance of solar collector. |
| 4 | To study the effect of number of glazing on the optical efficiency factor of a flat plate solar collector. |
| 5 | To study and understand about different materials for solar cell. |
| 6 | To study the voltage and current of the solar cell in series and parallel combination. |
| 7 | To study the I-V Characteristics of a Si solar cell with varying temperature at constant irradiation. |



| | |
|-----------|--|
| 8 | To study about different electrical energy storage materials and its suitability for various applications. |
| 9 | To study concept of thermal storage and materials for low and high temperature applications. |
| 10 | To carry out cost analysis for alternative selection of material with case studies. |

Supplementary learning Material:

Curriculum Revision:

| | |
|--------------------------------|----------|
| Version: | 1 |
| Drafted on (Month-Year): | Apr-20 |
| Last Reviewed on (Month-Year): | Jul-20 |
| Next Review on (Month-Year): | Apr-22 |