DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU/Engg./B.E./Elective/141/2015

It is hereby informed to all concerned that, on the recommendation of the Dean, Faculty of Engineering & Technology, the **Hon'ble Vice-Chancellor has permitted to include Open Elective-II "Solar Photovoltaic's Design" for B.E. ECT branch** on behalf of the Academic Council Under Section-14(7) of the Maharashtra Universities Act, 1994 as appended herewith.

This is effective from the **Academic Year 2014-2015** and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO. ACAD/ SU/ ENGG./
2015/39-73

Date:- 07-04-2015.

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Director,
Board of College and
University Development.

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Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges, Dr. Babasaheb Ambedkar Marathwada University.

2] The Director, University Network & Information Centre, UNIC, with **a request to upload this Circular on University Website.**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit] Examination Branch,
3] **The Programmer [Computer Unit-1] Examinations,**
4] The Programmer [Computer Unit-2] Examinations,
5] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter, Dr. Babasaheb Ambedkar Marathwada University,
6] The Public Relation Officer,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

Syllabus of

'Solar Photovoltaic's Design'

B.E. [ECT]

SEMESTER – II

AS AN ELECTIVE.

[Effective from the Academic Year 2014-15 & onwards]

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
FACULTY OF ENGINEERING AND TECHNOLOGY
FINAL YEAR (ECT) ENGINEERING

SEMESTER - II	
EXD-495- SOLAR PHOTOVOLTAICS DESIGN (EL-II For ECT)	
Teaching Scheme: 4 Hrs/week **Practical: 2 Hrs/week**	**Examination Scheme** **Theory Examination: 80 Marks** **Class Test: 20 Marks** **Practical/oral: ---** **Term Work:50 Marks**

Objective:

1. To understand scope of solar cell technology
2. To learn basics of solar photovoltaic cell.
3. To study cell and system designing.
4. To enhance the designing capability of students using software tools.

Unit-1 **Solar cell Fundamentals** World energy requirement, Non renewable energy sources - introduction, impact of nonrenewable energy sources, Renewable energy sources – Solar energy, advantages, challenges, current status of renewable energy sources, semiconductor as solar cell material, arrangement of atoms and energy band model : Direct and indirect band gap. Carrier motion in semiconductor, electric field and energy band bending, Generation and recombination of carriers.PN junction diode – Equilibrium and Non-equilibrium conduction, Solar cell under illumination – generation of photovoltage, light generated current, IV equation and solar cell characteristics.	8
Unit-2 **Solar radiation and cell parameters** Upper limits of cell parameters (I_{sc} , V_{oc} , FF, η) , types of losses , cell design for high I_{sc} ,high V_{oc} , high FF , high η , Analytical techniques. The sun and earth, their movement, angle of sun rays on solar collector, sun tracking, and estimation of solar radiation.	6
Unit -3 **Solar cell technology – I** Si wafer production: steps in producing si wafers, production of metallurgical grade Si [MGS] and electronics grade Si [EGS], production of Si wafer and solar grade silicon. Si wafer based solar cell technology: Development and process flow of commercial Si cell technology, processes used in solar cell technologies. High efficiency Si solar cells.	6

Unit-4 **Solar cell technology – II** Thin film PV: Advantages, Deposition techniques, Features, Amorphous PV technology , Cadmium telluride PV technology, CIGS, Thin film crystalline solar cell technology, Microcrystalline Si thin film technology, Thin film polycrystalline, large grain thin film crystalline Si. Organic, Dye-sensitised, GaAs solar cell.	7
Unit-5 **PV Concentrator and Module** Light concentration – opportunities and challenges, Concentration ratio, Optics for concentrator, Requirement of tracking and cooling, high concentrator cell. PV modules: series and parallel connections, Mismatch: in cell/module, in series connection, in parallel connection, design and structure of PV module, PV module power output.	6
Unit-6 **Balance of PV and system design** Electrochemical cell, Factors affecting battery performance, Batteries for PV system, Standalone PV system configurations, Design methodology, wire size, hybrid PV system, grid connected PV system, lifecycle costing.	7

Text Book:

1. ***Solar Photovoltaic: Fundamentals, Technology and applications*** **By Chetan Singh Solanki, PHI, New Delhi.**

Reference Books:

1. **Practical handbook of photovoltaics fundamentals and Applications by Augustin McEvoy, Tom Markvart, Luis Castaner.**
2. **Introduction to PV solar energy by Mirozeman**
3. **Applied photovoltaics by S.R.wenham**
4. **Advanced PV system design by John balfour,Michale shaw.**
5. **Handbook of Pv science and engineering by A. Luaue and S. Hegedus**
6. **Advanced silicon materials for photovoltaic applications by Sergio pizzini.**
7. **Solar photovoltaic cells:photons to electricity by Alexander p. kirk**
8. **Solar photovoltaic technology and systems: A manual for technician, trainees and engineers by chetan singh solanki.**

List of Practical: Perform any Eight

1. Study of different types of solar cells
2. Measurement of global solar irradiation using a solar cell
3. Identifying and measurement of a solar PV module in the field
4. Series and parallel connection of PV modules
5. Estimating the effect of sun tracking on energy generation by solar PV modules.
6. Efficiency measurement of standalone solar PV system.
7. Dark and illuminated current – voltage characteristics of solar cells.
8. Dependence of solar cell I-V characteristics on light intensity and temperature.
9. Carrier lifetime measurement for a solar cell
10. Spectral response measurement
11. Solar cell simulation using PC1D simulator.
12. A visit to solar power station – attach a site report in Journal [compulsory].

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6

Question paper pattern:

Six units in syllabus shall be divided in two equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weightage of units. The Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.

For 80 Marks paper:

1. **Section A and Section B should be of 40 marks each.**
2. **Five question on each section.**
3. **Out of five, four question asked should be of 15 Marks and one question should be 10 Marks.**
4. **10 Marks question will be compulsory.**