UNIVERSITY OF KOTA

SCHEME OF EXAMINATION

AND

COURSES OF STUDY

Department of Pure & Applied Physics
Faculty of Science

M.Tech. (Solar Energy)

Third Semester Examination, December 2019
Fourth Semester Examination, June 2020

UNIVERSITY OF KOTA
MBS Marg, Near Kabir Circle, KOTA (Rajasthan)-324 005
INDIA

Edition: 2018

Course Structure with Distribution of Marks

Year / Semester	Serial Number, Code & Nomenclature of Paper			Duration of Exam.	Teaching Hrs/Week & Credit			Distribution of Marks			Min. Pass Marks		
	Number	Code	Nomenclature		L	P	C	Conti. Assess.	Sem. Assess.	Total Marks	Conti. Assess.	Sem. Assess.	Total Marks
II Year IIISemester	3.1	SOL301	Modeling, Simulation and Decision Making	3 Hrs	4		4	30	70	100	12	28	40
	3.2	SOL302	Solar PV Power Plants	3 Hrs	4		4	30	70	100	12	28	40
	3.3	SOL 303	Seminar(Research &Development)		4		4	30	70	100	12	28	40
	3.4	SOL 304	Seminar(Industry-Society-Policies)		4		4	30	70	100	12	28	40
	3.5	SOL305	Research Project Phase I			16	8	30	70	100	12	28	40
	Total				**16**	**16**	**24**	**150**	**350**	**500**	**60**	**140**	**200**
II Year IV Semester	4.1	SOL401	Research Project Phase II			32	24	150	350	500	60	140	200
						32	**24**	**150**	**350**	**500**	**60**	**140**	**200**

Structure of the Programme:

The programme will consist of:

(i) Core and applied courses of theory as well as practical papers which are compulsory for all students.

(ii) Dissertation / Project Work / Practical training / Field work, which can be done in an organization (Government, Industry, Firm, Public Enterprise, *etc.*) approved by the Department.

Attendance:

Every teaching faculty, handling a course, shall be responsible for the maintenance of attendance Register for candidates who have registered for the course. The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students. Each student should earn 75% attendance in the courses of the particular semester failing which he or she shall not be permitted to sit for the End-Semester Examinations. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons and such exemptions should not under any circumstance be granted for attendance below 65%.

Teaching Methodologies:

The classroom teaching would be through conventional lectures or power point presentations (PPT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skills. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually. For the students of slow learning, special attention would be given.

Scheme of Examinations:

The examination shall be divided into two parts in which first part is continuous assessment or internal assessment and second part is semester assessment or external assessment. The continuous assessment for each theory paper shall be taken by the faculty members in the Department. Two periodical tests or term tests for internal assessment shall be of one hour duration and shall be taken according to academic calendar which shall be

notified by the Department/University. The semester assessment shall be three hours duration to each theory paper and six hours duration to each practical paper and shall be taken by the University at the end of each semester. Assessment pattern and distribution of maximum marks is summarized as given below:

A student cannot repeat the assessment of periodical test or term test. However, if for any compulsive reason the student could not attend the test, other tool for assessment may be framed by the teacher in consultation with the Head of the Department. If the regularity factor is similar for all the students in that case it may be merged with the term test weightage.

Semester III

SOL 301: Modeling, Simulation and Decision Making

UNIT I

System, experiment, model, simulation - definition, importance and need of modeling and simulation, difference between modeling and simulation, difference between simulation and experiment, simulation application areas, advantages, disadvantages and difficulties in simulation, types of models.

UNIT II

Steps of modeling process-problem analysis, model formulation, model abstraction, defining variables, solving, execution, verifying, analysis of results. Verification and validation, comparison of model with real system, validity of model.

UNIT III

Solar energy modeling techniques, linear and non-linear modeling techniques, global solar energy model, discrete solar energy model, comparison of solar energy prediction methods, modeling of solar energy on tilted surface, challenges in modeling solar energy.

UNIT IV

Brief introduction to the software used for simulation in solar energy field, comparative review of software for solar photovoltaics, solar thermal systems and buildings. Introduction to applications of PVSOL, PVSYST, HOMER, IES-VE, TRNSYS, SAM, SOLTRACE, METEONORM.

Unit V

Decision making- definition, need and importance, multi criteria decision making, Pugh method, Analytic Hierarchy Process (AHP), Kepner –Tregoe problem solving and decision making methods, selection of method, case studies.

REFERENCES

1. Bender E.A., “Introduction to Mathematical Modeling”, Dover Publ., 2000.

2. Meyer W.J., “Concepts of Mathematical Modeling”, Dover Publ.,2004.

3. Dym C.L., “Principles of Mathematical Modeling”, Elsevier, 2004.

4. Duffie J.A., Beckman W.A. “Solar Engineering of Thermal Process”,Wiley, 3rd ed. 2006.

5. Kalogirou S.A., “Solar Energy Engineering: Processes and Systems”,Academic Press, 2009.

6. Sen Z., Solar Energy “Fundamentals and Modeling Techniques”, Turkey, 2008.

7. Vanek F.M., Albright L.D. "Energy Systems Engineering", McGrawHill, 2008.

8. Tamer Khatib, Azah Mohamed, K. Sopian, "A review of solar energy modeling techniques" Renewable and Sustainable Energy Reviews 16 (2012) 2864– 2869

9. Multi-criteria analysis, Department for Communities and Local Government: London, 2009.

10. Burge Stuart, The Engineering toolbox, Pugh matrix, Strathclyde University, Glasgow, 2009.

SOL 302: Solar PV Power Plants

Unit I

Photovoltaic systems: Configuration and applications, grid –independent for small devices, PV systems for remote consumers of medium and large size, decentralized grid-connected PV systems, central grid connected PV systems. Components of PV systems-battery storage, charge controller, inverters, auxiliary generators, system sizing.

Unit II

Electrochemical storage: Fundamentals, types, parameters, comparison of batteries, selection of batteries, batteries for PV systems, connection of batteries, estimating requirement of batteries, battery bank installation and commissioning, diagnosis, testing, physical maintenance, safety measures.

Unit III

Balance of system-need, power converters, types and their efficiency, charge controllers, maximum power point tracking, wires, wire sizing, junction box, checklist, power conditioning for photovoltaic power systems, charge controller and charge equalizer, PV inverters, inverters for grid-connected and stand alone operation, power quality, active quality control in the grid, safety aspects with inverters.

Unit IV

Design methodology for SPV system, approximate design for standalone system, design of grid-connected SPV system, configuration, components, design for small power applications, grid-connected PV system design for power plants.

Unit V

Installation, troubleshooting and safety: Installation and troubleshooting of standalone SPV systems, electrical and mechanical safety in installation, safety with batteries, installation and troubleshooting of solar SPV power plants, solar PV plant installation checklist. Economic analysis.

1. Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", PHI Learning Pvt., Ltd., 2009.

2. Jha A.R., "Solar Cell Technology and Applications", CRC Press, 2010.

3. John R. Balfour, Michael L. Shaw, Sharlave Jarosek., "Introduction to Photovoltaics", Jones & Bartlett Publishers, Burlington, 2011.

4. Luque A. L. and Andreev V.M., "Concentrator Photovoltaic", Springer, 2007.

5. Partain L.D., Fraas L.M., "Solar Cells and Their Applications", 2nd ed., Wiley, 2010.

6. C. J. Winter, A. L. Sizmann, L. L. Hull, "Solar Power Plant" Springer-Verlag.

7. Antonio Luque and Steven Hegedus (Eds.), "Handbook of Photovoltaic Science and Engineering", Wiley.

8. Chetan Singh Solanki, "Solar Photovoltaic Technology and Systems.

SEMINARS

Objective: To assess the knowledge, expression and communication capability of the student to present a technical topic.

The aim of seminar is to impart training to a student to face audience and present his ideas and thus creating in him self esteem and courage that are essential for presentation of project proposals and reports. Individual students are required to choose a topic of their interest from Energy/Solar Energy/Hybrid Energy systems and give a seminar on that topic. A committee consisting of at least two faculty members shall assess the presentation of the seminar and award internal marks to the students. Each student shall submit two copies of a write up of this seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the others will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. At the semester end, the seminar report and presentation will be assessed by an external examiner.

SOL 303-Seminar (R&D)

Each student has to present six seminars on research and development during the semester. The aim of the seminar series is to equip the students with the knowledge about the research and developments in the field of energy studies and solar energy. Students have to prepare and deliver presentations on the research and development activities in the field of solar energy in India and abroad in various institutes, universities and research organisations. Further they have to give presentation on two research papers relevant to solar energy field.

SOL 304-Seminar (Industry-Society-Policies)

Each student has to present six seminars on developments in solar energy field linked to industry, society and the solar policies during the semester. The aim of the seminar series is to make students aware of the industrial developments and the challenges faced by industries in the solar energy field. They will learn to assess the potential of penetration of solar

technologies in society and their impact on socio-economic scenario. Knowledge of solar policies in India and worldwide is also important for people working in this field so it is also a component of the seminar series.

SOL 305-RESEARCH PROJECT PHASE I

Objective: The project work aims to develop the work practice in students to apply theoretical and practical tools/ techniques to solve real life problems related to industry, society and current research. The project work can be a design project/ experimental project and / or computer simulation project on any of the topics in the area of Energy/Solar energy/Hybrid energy systems. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least two faculty members. At semester end, one internal and one external expert will assess the report of the project on basis of presentation. The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4th semester (Phase 2). Phase 1 consist of preliminary thesis work, reviews of the work and the submission of preliminary report. The review would highlight the topic, objectives, methodology, expected results and scope of the work which is to be completed in the 4^{th} semester.

SOL401-RESEARCH PROJECT PHASE II

Master Research project phase II is a continuation of project phase 1 started in the third semester. There would be one internal review at the end of the semester. The review would be a pre-submission presentation before the internal evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be the external evaluation.