University of Kerala

<table>
<tr><td>Discipline</td><td colspan="5">PHYSICS</td></tr>
<tr><td>Course Code</td><td colspan="5">UK3DSCPHY204</td></tr>
<tr><td>Course Title</td><td colspan="5">LIGHT, ELECTRICITY AND EMERGING ENERGY SOURCES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 - 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>3 Hrs</td><td>-</td><td>2 Hrs</td><td>5 Hrs</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">1. Light and its properties: frequency, wavelength, intensity
2. Basics of current electricity – Potential difference, electric current, Ohm’s law, dc & ac
3. Energy levels of atoms and molecules, chemical energy, semiconductor diode</td></tr>
<tr><td>Course Summary</td><td colspan="5">Introduce different types of basic sources and detectors of light and their working principle. Give a detailed idea of the working of LASER. Give introductory knowledge about optical instruments such as laser diodes, camera, telescope and compound microscope. The course also aims the understanding of the generation of dc and ac. In a comprehensive level, the trouble shooting in electric circuits is introduced. As an energy source of the future, solar energy and its successful use in various fields such as cooking, heating, cooling, distillation, pumping etc are introduced. The impact of solar energy and solar cells on the future of humankind is analysed. Different thermo-electric effects and their applications are discussed. Introductory ideas of fuel cells such as working principle, classification etc are discussed.</td></tr>
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BOOKS FOR STUDY:

1. Light_ Introduction to Optics and Photonics, Judith Donnelly & Nicholas Massa, Photonics Media Press (2018) Second Edition
2. DC/AC Electrical Fundamentals, Dale R. Patrick, Stephen W. Fardo, Ray E. Richardson & Vigyan (Vigs) Chandra, River Publishers
3. Non-Conventional Energy Sources and Utilisation, R.K. Rajput, S. Chand & CO

BOOKS FOR REFERENCE:

1. A Text Book of Optics, Brijlal & N Subramanyam, S Chand & CO
2. Physics for Scientists and Engineers with Modern Physics (extended version) 2008, Paul A. Tipler & Gene Mosca, W. H. Freeman and Company
3. Non-Conventional Energy Resources, B H Khan, Mc Graw Hill India, 2016

DETAILED SYLLABUS: THEORY

Module	Unit	Content	Hrs	CO No
I		**Sources and detectors of light (Book 1: Chapter 2)**	**9**	
	1	Natural Light Sources, Incandescent Light Sources, Fluorescent lamps, High Intensity Discharge (HID) Lamps, Low-Pressure Sodium Lamps, Flash Lamps and Arc Lamps, Light Emitting Diodes (LEDs)	4	1
	2	Detectors- Thermal Detectors, Quantum Detectors, Photo-emissive Detectors, Photoconductive Detectors	3	1
	3	Photodiodes, Photodiode Parameters	2	1
II		**Optical Instruments & Lasers (Book 1: Chapter 8, 9 & 10)**	**9**	
	4	Simple Magnifier, The SLR Camera	2	2
	5	Optical Telescopes, The Compound Microscope	2	2
	6	Laser - Emission and absorption of photons	1	3
	7	Basic laser components, energy transitions in laser action	2	3
	8	Semiconductor lasers (laser diodes)- Homo Junction, Hetero Junction Laser, Distributed Feedback Lasers	2	2,3

III	**Sources of DC & AC Electrical Energy (Book 2: Chapter 8 & 10)**		**9**	
	9	Chemical Sources – Primary and Secondary Cells	2	4
	10	Battery Connections – Series, Parallel, Combination	1	4
	11	Light Sources, Heat Sources, Pressure Sources, Electro-Magnetic Sources	2	4
	12	AC Generator Basics	1	4
	13	Single Phase and Three Phase AC generators , Analysis and Trouble shooting	3	4
IV	**Solar Energy Applications (Book 3: Chapter 4)**		**9**	
	14	Solar water heating, space heating, space cooling	2	5
	15	Solar distillation, solar pumping, solar air heaters and drying	2	5
	16	Solar cooking, solar furnace	2	5
	17	Solar green-houses and global warming, solar power plants	2	5
	18	Solar Photo Voltaic Cells (qualitative idea only)	1	5
V*	**Emerging Technologies (Book 3: Chapter 9)**		**9**	
	19	Thermoelectric effect – Seebeck effect, Peltier effect, Thomson effect, Joule effect	1	5
	20	Thermoelectric generator – Construction and working, Thermoelectric materials and their selection, Advantages and disadvantages of thermoelectric power generator	2	5
	21	Thermionic generator/converter – Introduction, Thermionic generator, Desirable of Properties of Thermionic Converter Materials, Advantages, disadvantages/limitations and applications of thermionic converter	2	5
	22	Fuel cell: Advantages, disadvantages and applications of	1	5

		fuel cells		
	23	Components and working theory of a fuel cell, Classification fuel cells, Requirements of electrolyte and electrode, Desirable characteristics of a fuel cell	2	5
	24	Hydrogen-oxygen fuel cell (hydroxy cell)	1	5

DETAILED SYLLABUS: PRACTICALS

Part A – At least 5 Experiments to be performed		**CO No**
Sl No	**Name of Experiment**	
1	Experiment to determine the Wavelength of Sodium Light Using a Diffraction Grating/prism and Spectrometer	6
2	Determine and plot the characteristics of the light emitting diode in the forward-bias region, and to compare between different coloured diodes.	6
3	To study the VI Characteristics of Photodiode	6
4	Study the operating characteristics for a diode laser, including threshold current, output power versus current, and slope efficiency	6
5	Study diffraction by single slit	6
6	Study diffraction by double slit	6
7	Determine the voltage and current by connecting 3 dry cells (a) Series (b) Parallel	6
8	Study the Characteristics of Thermistor	6
9	Study the Characteristics of Solar cell	6
10	To verify the relationship between the voltage, the electric field and the spacing of a parallel plate capacitor.	6
11	To verify superposition theorem/Thevenin's theorem/Norton's theorem/ Maximum power transfer theorem in a circuit	6
12	Set up simple circuits with resistors, capacitors, and/or inductors and use a Multimeter to measure voltages, currents, and resistances at different points in the circuit.	6
Part B* – At least One Experiment to be performed		

11	To Calibrate the given thermistor with standard thermistor, hence to find the temperature of the unknown liquid.	6
12	Demonstration of Seebeck Effect and determination of Seebeck Coefficient and Figure of Merit	6
13	To verify Ohm's law in a resistive circuit	6
14	To demonstrate Kirchhoff's laws in a circuit	6

COURSE OUTCOMES

CO No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explaining different types of sources of light and light detectors	Ap	PSO-1,5
CO-2	Analyze the working principle of basic optical instruments such as camera, telescope and microscope.	An	PSO-1,5
CO-3	Accessing the working principle of LASER and laser action in semiconductor diodes	E	PSO-1,2
CO-4	Formulating dc & ac electric circuits and practice troubleshooting of electric circuits.	C	PSO-1,5
CO-5	Illustrating the usage, storage and importance of solar energy, Thermo-electric energy, thermionic energy, fuel cells	An	PSO-1,3
CO-6	Demonstrating simple experiments	Ap	PSO-1,6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Name of the Course: LIGHT, ELECTRICITY AND EMERGING lENERGY SOURCES

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO / PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
CO-1	Explaining different types of sources of light and light detectors	PO1,2,3,4, 6,7 / PSO-1,5	Ap	F, C	L	-
CO-2	Analyze the working principle of basic optical instruments such as camera, telescope and microscope.	PO1,2,3,4, 6,7/ PSO-1,5	An	F, C	L	-
CO-3	Accessing the working principle of LASER and laser action in semiconductor diodes	PO1,3,4,6, 8/ PSO-1,2	E	F, C	L	-
CO-4	Formulating dc & ac electric circuits and practice troubleshooting of electric circuits.	PO1,2,3,4, 6,7/ PSO-1,5	C	F, C, P	L	-
CO-5	Illustrating the usage, storage and importance of solar energy, Thermo-electric energy, thermionic energy, fuel cells	PO1,2,3,4, 6/ PSO-1,3	An	F, C	L	-
CO-6	Demonstrating simple experiments	PO1,2,3,4, 6,7,8/PSO-1,6,7	Ap	F, C	-	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive