



University of Kerala

Discipline	PHYSICS				
Course Code	UK3DSCPHY204				
Course Title	LIGHT, ELECTRICITY AND EMERGING ENERGY SOURCES				
Type of Course	DSC				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 Hrs	-	2 Hrs	5 Hrs
Pre-requisites	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				
Course Summary	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 a 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 analyzed. Different thermo-electric effects and their applications are discussed. Introductory ideas of fuel cells such as working principle, classification etc are discussed.				

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 (Chapter 2 of Book 1)		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 (Chapter 8, 9 &10 of Book1)		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 , Hetro Junction Laser, Distributed Feedback Lasers	2	2,3

III	Sources of DC & AC Electrical Energy (Chapter 8 &10 of Book2)		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	2	4
	14	Analysis and Trouble shooting	1	4
IV	Solar Energy Applications (Chapter 4 of book 3)		9	
	15	Solar water heating, space heating, space cooling	2	5
	16	Solar distillation, solar pumping, solar air heaters and drying	2	5
	17	Solar cooking, solar furnace	2	5
	18	Solar green-houses and global warming, solar power plants	2	5
	19	Solar Photo Voltaic Cells (qualitative idea only)	1	5
V*	Emerging Technologies (Chapter 9 of Book 3)		9	
	20	Thermoelectric effect – Seebeck effect, Peltier effect, Thomson effect , Joule effect	1	6
	21	Thermoelectric generator – Construction and working, Thermoelectric materials and their selection, Advantages and disadvantages of thermoelectric power generator	2	6
	22	Thermionic generator/converter – Introduction, Thermionic generator, Desirable of Properties of Thermionic Converter Materials , Advantages, disadvantages/limitations and applications of thermionic converter	2	6
	23	Fuel cell: Advantages, disadvantages and applications of fuel cells	1	6

	24	Components and working theory of a fuel cell, Classification fuel cells, Requirements of electrolyte and electrode, Desirable characteristics of a fuel cell	2	6
	25	Hydrogen-oxygen fuel cell (hydrox cell)	1	6

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 of 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 measure the magnetic field at the centre of wire loops and along the axis of a coil and verify the analytical expressions.	6
14	To verify Ohm's law in a resistive circuit	6
15	To demonstrate Kirchhoff's laws in a circuit	6

COURSE OUTCOMES

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify different types of sources of light and light detectors discuss the working principle of basic optical instruments such as camera, telescope and microscope.	R, U	PSO-1,5
CO-2	Outline and describe the working principle of LASER and laser action in semiconductor diodes	R, U	PSO-1,5
CO-3	Describe dc & ac electric current and the electric circuits and practice trouble shooting of electric circuit at an understanding level.	U, Ap	PSO-1,2
CO-4	Explain and analyse usage, storage and importance of solar energy.	U, An	PSO-1,5
CO-5	Summarise and relate basic principles of emerging technologies of generation and storage of energy – Thermo-electric energy, thermionic energy, fuel cells	U, An	PSO-1,3
CO-6	Explain and demonstrate simple experiments	U, 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 ENERGY 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	Identify different types of sources of light and light detectors discuss the working principle of basic optical instruments such as camera, telescope and microscope.	PO1,2,3 ,4,6,7/ PSO-1,5	R, U	F, C	L	-
CO-2	Outline and describe the working principle of LASER and laser action in semiconductor diodes	PO1,2,3 ,4,6,7/ PSO-1,5	R, U	F, C	L	-
CO-3	Describe dc & ac electric current and the electric circuits and practice trouble shooting of electric circuit at an understanding level.	PO1,3,4 ,5,6,8/ PSO-1,2	U, Ap	F, C	L	-
CO-4	Explain and analyse usage, storage and importance of solar energy.	PO1,2,3 ,4,6,7/ PSO-1,5	U, An	F, C, P	L	-
CO-5	Summarise and relate basic principles of emerging technologies	PO1,2,3 ,4,6/ PSO-1,3	U, An	F, C	L	-

	of generation and storage of energy – Thermo-electric energy, thermionic energy, fuel cells					
CO-6	Explain and demonstrate simple experiments	PO1,2,3,4,5,6,7,8/PSO-1,6,7	U, Ap	F, C	-	P

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

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO-1	3	-	-	-	2	-	-	2	3	2	2	-	2	3	-
CO-2	3	-	-	-	3	-	-	2	2	3	2	-	2	3	-
CO-3	3	2	-	-		-	-	2	-	2	2	2	2	-	2
CO-4	3	-	-	-	3	-	-	2	2	3	2	-	2	2	-
CO-5	3	-	3	-	-	-	-	2	3	2	3	-	2	-	-
CO-6	3	-	2	-	-	3	-	2	2	2	2	2	3	3	2

Correlation Levels:

Level	-	1	2	3
Correlation	Nil	Slightly / Low	Moderate / Medium	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

CO No	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO-1	✓	✓	-	✓
CO-2	-	✓	-	✓
CO-3	-	✓	-	✓
CO-4	-	✓	-	✓
CO-5	✓	-	-	-
CO-6	✓	-	-	-