COURSE CODE	COURSE TITLE	L	T	P	C
1154EC107	GREEN ELECTRONICS	3	0	0	3

Course Category:

Program Elective

Preamble:

This course aims to provide students with knowledge on the theories, eco-design concepts, methods, and relevant hands-on experience for designing a range of sustainable green electronic products. It is expected that students will develop their ability to address relevant issues on environmental impact; product design, operating life, and the 3R concept (reduce, reuse, and recycle).

a. Prerequisite Courses:

Environment engineering

b. Related Courses:

Professional ethics

c. Course Educational Objectives:

The student should be made to

1. To study the introduction of green electronics
2. To study the green electronics materials and products
3. To study the green electronics assembly and recycling
4. To study the flip-chip assembly and bonding for lead-free electronics

d. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Recognise and address the issues relating to the need for a greener world, and environmental electronic design and	K2

	manufacturing in the local industry	
CO2	Recognise the importance of various environmental regulations in indifferent major countries around the world and the need for compliance with these regulations	K2
CO3	Apply the principles and practices of green electronics in selected consumer products	K2
CO4	Describe the process and techniques of assessment of the environmental hazards and suggest ways to reduce them.	K2
CO5	Realize the impact of the environmental regulations on the design, supply chain, manufacturing and recycling of the electronic products.	K2

e. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	**M**	**L**	-	-	-	-	-	-
CO2	-	M	-	-	M	-	-	-	-	-	-	-
CO3	-	**M**	-	-	**M**	-	-	-	-	-	-	-
CO4	-	-	-	-	M	**M**	-	-	-	-	-	-
CO5	-	**M**	-	-	M	-	**L**	-	-	-	-	-

H- High; M-Medium; L-Low

f. Course Content :

UNIT I INTRODUCTION OF GREEN ELECTRONICS

Environmental concerns of the modern society – Overview of electronics industry and their relevant regulations in China, European Union and other key countries. Restriction of Hazardous substances (RoHs) – Waste Electrical and electronic equipment (WEEE) – Energy using Product (EUP) and Registration Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT II GREEN ELECTRONICS MATERIALS AND PRODUCTS

Introduction to green electronic materials and products – Lead (Pb) – free solder pastes, conductive adhesives, halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products. Tin Whiskers Growth in Lead-Free Electronic Assemblies – Factors Influence Whisker Growth – Ways to Mitigate Tin Whisker Risk – Use Finite Element Modeling to Assess Tin Whisker Risk – Evaluation of Tin Whisker Impact on High-Reliability Applications.

UNIT III GREEN ELECTRONICS ASSEMBLY AND RECYCLING

Green electronic Assembly – Soldering Process – Lead-Free Solder Tip and Bumps – Mitigate Deterioration of Lead-Free Tin Solder at Low Temperatures – Fatigue Characterization of Lead-Free Solders – Thermal Fatigue of Solder Joints, Fatigue Design of Lead-Free – Electronics – Fatigue Life Prediction Based on Field Profile, Fatigue Validation of Lead-Free Circuit – Flip-Chip Technology and Assembly process – card Assembly, surface mount technology – Management on e-waste recycle system construction, global collaboration and product disassemble technology.

UNIT IV FLIP-CHIP ASSEMBLY AND BONDING FOR LEAD-FREE ELECTRONICS

Flip-Chip Assembly Process – Placement and Under fill stage-FEM of Die stress – Gold stud Bump Bonding – Materials and Process Variations – Integrating Flip Chip into a Standard SMT Lead-Free Reflow soldering Techniques and Analytical Methods – Electro migration Analysis for Mean-Time-to Failure Calculations – Gold-Tin Solder Integrating Vertical-Cavity Surface Emitting Lasers onto Integrated Circuits – Design and Processing of Flip-Chip Bonding Structures – Opto-Electronic Integration.

UNIT V REAL TIME GREEN ELECTRONIC

Lead-Free Electronic Design – Selection of the Package Type – Substrate or Die Attachment FR4 – Electrical Connections from Die to FR4 – Assess Impact of CTE Mismatch on Stress and Fatigue Life – Design Solder Balls for External Connection to PCB – Thermal Analysis of Flip-Chip Packaging – RLC for Flip-Chip Packages – Drop Test of Flip-Chip Packaging – Wei bull Distribution for Life Testing and Analysis of Test Data.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John X.Wang ‘Green Electronics Manufacturing’, CRC Press Indian Prentice Hall, 2012

2. Sammy G Shina, ‘Green Electronics Design and Manufacturing’ McGraw Hill 2008.

REFERENCE BOOKS:

1.Lee Goldberg, “Green Electronics/Green Bottom Line, Newnes Publications 2000

ONLINE RESOURCES:

www.nptel.com