

Introduction, importance, classification: Natural food colourants (Anthocyanins, Carotenoids, Chlorophyll), Examples of Pigments in common food (turmeric, tomato, carrot, orange); Nature-identical colourants (β -Carotene, Canthaxanthin and Riboflavin); Artificial/synthetic colourants: Azo dyes (e.g. amaranth dye, tartrazine, citrous red); Quinoline (e.g. quinoline yellow); Phthalein (e.g. erythrosine); Triarylmethanes and indigoid (e.g. indigo carmine), FD&C Dyes and Lakes.

Practicals/Hands-on-Training

(15 WEEKS)

1. Determination of the taste threshold for the different sensations – sweet, salty, sour.
2. Extraction of limonene from orange peels using supercritical carbon dioxide.
3. Quantitative determination of food dyes in powdered drink mixes by spectrophotometric method.
4. Extraction and separation of pigments present in spinach by Thin Layer Chromatography (TLC).
5. Experiment to demonstrate the enzymic browning and its prevention.
6. Determination of rancidity of edible oils by Kriess Test.
7. Estimation of carotenoids in sample by colorimetric method.

References:

Theory:

1. DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), **Principles of Food Chemistry**, 4th Edition, Springer.
2. Msagati, T.A.M. (2013), **Chemistry of Food Additives and Preservatives**, Wiley-Blackwell.
3. Fennema, O.R. (2017), **Food Chemistry**, 5th Edition, CRC Press.
4. Attokaran, M. (2017), **Natural Food Flavors and Colorants**, 2nd Ed., Wiley-Blackwell.
5. Potter, N.N., Hotchkiss, J.H. (1995) **Food Science**, 5th Ed., Chapman & Hall.
6. Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), **Food Additives**, 2nd Edition, CRC Press.
7. Coultate, T. (2016), **Food: The Chemistry of its Components**, 6th Edn., Royal Society of Chemistry.
8. Belitz, H. D.; Grosch, W. (2009), **Food Chemistry**, Springer.
9. Course: FOOD CHEMISTRY (iasri.res.in)

Practicals:

1. Ranganna, S. (2017). **Handbook of analysis and quality control for fruits and vegetable products**, 2nd Edn., McGraw Hill Education
2. Sawhney, S.K., Singh, R. (2001), **Introductory Practical Biochemistry**, Narosa Publishing House

PCB Designing and Fabrication

CREDIT DISTRIBUTION, ELIGIBILITY AND PREREQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		

PCB Designing and Fabrication	2	-	-	2		Basic Knowledge of Electronics
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Course Learning Objectives

The Learning Objectives of the course are as follows:

The main objective of this course is to give a comprehensive understanding and hands-on exposure to the various processes, industrial tools, protocols, and design specifics which are involved in PCB Designing so that the students can design an electronic printed circuit board for a specific application using industry-standard software after going through the complete procedural steps of developing circuit schematic, board files, image transferring, assembly, soldering, and testing.

Course Learning Outcomes

The Learning Outcomes of the course are as follows:

- Familiarization of the various types of devices/components that may be mounted on PCB
- Understanding of the PCB layout techniques for optimized component density and power saving.
- Pre-requisite knowledge to perform design and printing of PCB with the help of various image transfer and soldering techniques
- Understanding of the current trends and scope of the PCB industry

(Semester-I)

Syllabus Contents

Unit-I: PCB Fundamentals

(3 Weeks)

PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD). Classification of PCB - single, double, multilayer, and flexible boards, Manufacturing of PCB, PCB standards.

Unit-II : Schematic & Layout Design

(4 Weeks)

Schematic diagram, General, Mechanical, and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for a library, Tracks, Pads, Vias, power plane, grounding.

Unit-III : PCB Design Processes

(5 Weeks)

Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper-clad laminates materials of copper-clad laminates, properties of laminates (electrical & physical), types of laminates, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques, Etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing, and quality controls.

Unit-IV : PCB Technology

(3 Weeks)

Introduction of PCB prototyping machines, Schematic Entry, PCB Parts creation, Auto Routing, Post Design, Brief overview of various models available, Recent Trends, and environmental concerns in the PCB industry.

List of Practicals/Exercises

PCB Designing, Fabrication, Component Mounting and Testing using Standard Procedures (Hardware)

A. Analog Electronic Circuits

1. Verification of Thevenin theorem
2. Designing of RC Low Pass Filter and High Pass Filter circuits
3. To study current-Voltage characteristics of a p-n junction diode (forward bias and reverse bias)
4. Designing of Centre tapped full wave rectifier – without and with shunt capacitance filter.
5. Simple circuit to glow an LED
6. Design, fabrication, and testing of a 9 V power supply with Zener regulator
7. Design and study of voltage divider biasing.
8. Designing of a CE based amplifier of given gain

B. Digital Electronic Circuits

1. To verify and design AND, OR, NOT and XOR using NAND gates
2. Design a Half adder and Full Adder
3. Design a Half Subtractor and Full Subtractor

PCB Design Softwares recommended

- KiCAD (Open Source Electronics Design Automation Suite) <https://www.kicad.org/>
- EasyEDA (Online PCB Design Tool) <https://easyeda.com/>
- PADS - Siemens EDA (PCB Design Software) <https://eda.sw.siemens.com/en-US/pcb/pads/>
- Any other similar PCB designing software

Essential/recommended readings

1. Printed Circuit Board – Design & Technology, Walter C. Bosshart, Tata McGraw Hill, 2008.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, First Edition, Tata McGraw-Hill Education Pvt. Ltd., 2005.
3. Printed Circuit Board Design Using Autocad, Chris Schroeder, Newnes Publisher, 1998.
4. Printed Circuits Handbook, Clyde F. Coombs, Jr, Happy T. Holden, Sixth Edition, Publisher: McGraw-Hill Education, 2016.

Examination scheme and mode:

Total Marks: 100

Internal Assessment: 25 Marks

Practical Exam (Internal): 25 Marks

End Semester University Exam: 50 Marks

The Internal Assessment for the course may include Class participation, Assignments, Class tests, Projects, Field Work, Presentations, amongst others as decided by the faculty.