Common course B. Tech. (CSE/ECE/EE/ME/CE/FET/DE)
IDEA Lab Workshop

Course Code	**:**	**SEEC201**
Course Title	**:**	**IDEA Lab Workshop**
Number of Credits	**:**	**0 (CH- L: 2, T: 0, P: 4)**

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project

Course Contents*:*

Module 1

Either

Electronic component familiarization, understanding electronic system design flow. Schematic design and PCB layout and Gerber creation using EagleCAD. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.

And/or

Introduction to basic measuring instruments and hand tools - Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives

Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits.

Software-Fusion 360, Alias Automotive, Rhino, AutoCAD, Adobe Photoshop, Adobe Illustrator, etc.

Module 2

Either

Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output)

Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station, soldering using a temperature controlled reflow oven, automated circuit assembly, and soldering using pick and place machines.

And/or

Components of mechanical fabrication, i.e., cutting, machining, forming, joining, casting, and finishing.

Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc.

Basic welding and brazing and other joining techniques for assembly.

Concept of Lab aboard a Box.

Vinyl Cutter for signs, stickers, and soft circuit making. Processes for laser cutting and engraving on different locally available materials, i.e., bamboo, wood, and cane.

Module 3

Either

Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output.

Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging.

And/or

3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering.

Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers.

Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab

Module 4

Discussion and implementation of a mini project.

Module 5

Documentation of the mini project (Report and video).

Laboratory Activities:

S. No.	List of Lab activities and experiments
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.
2.	Machining of 3D geometry on soft material such as soft wood or modelling w
3.	3D scanning of computer mouse geometry surface. 3D printing of scan geometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3 or 6 m thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.
8.	Embedded programming using Arduino and/or Raspberry Pi.
9.	Design and implementation of a capstone project involving embedded hardwa software and machined or 3D printed enclosure.

Reference Books:

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing, New Delhi.
2. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978- 9386173393, Khanna Book Publishing Company, New Delhi.
3. Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4. 3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
5. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.

7. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374

8. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269

9. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542

10. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945,978-9352131952, 978-9352133703

11. Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586

12. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633

13. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.

14. Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978- 1484200773

15. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.

16. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

17. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

18. 'Product Design and Development' by Karl T. Ulrich and Steven D. Eppinger.

19 'The Lean Startup' by Eric Ries

20 'Making It: Manufacturing Techniques for Product Design' by Chris Lefteri

21 'Prototyping and Modelmaking for Product Design' by Bjarki Hallgrimsson