

MS 101 Makerspace

EE Lect 0 : Introduction

2024-25/II (Spring)

Electrical Engg Department, IIT Bombay

MS 101 Makerspace

- The primary objective of this course is to inculcate a spirit of “making it by hand” among the students.
- It replaces the earlier Engineering Drawing and Workshop courses (which were Institute UG Core Courses).
- At present ME and EE departments are jointly offering MS101.
- From the EE side you will learn basic circuit theory, passive and active devices, operational amplifier circuits, digital circuit basics, microcontroller basics and Arduino board based interfacing techniques and controlling of motors.

Summary of EE Laboratory Activities

- During the **first half** of the semester, five EE Experiments will involve
 - Use of bread boards for assembling and testing of electronic circuits, use of digital multimeters (DMM) for measuring voltages and resistances and learning to use the major Lab equipment.
 - Waveform Generator (Tektronix AFG 1022) for generating test signals (sine and triangle waveforms).
 - Digital Storage Oscilloscope (Tektronix TBS 1072C) for displaying and measuring time varying voltage signals.
 - DC Power Supply (Keithley 2231A Triple Channel DC Power Supply) to give the required DC Power Supply voltages to amplifier ICs.
 - Operational amplifier based amplifier circuits.
 - Unregulated and regulated DC power supplies.
 - Familiarization with the Arduino microcontroller board and driving battery-operated (BO) DC motors.
 - Remote control (Wi-Fi) of BO motors using ESP32 and Arduino microcontroller boards.

...Summary of EE Laboratory Activities

- **Second half** of the semester

- Design and implementation of the MS101 Project (involves application of all the learning of ME and EE).
- Projects done in groups of six (assigned by us).
- Project work carried out during the 10 – 12 lab sessions of MS101.
- Progress of the project evaluated every week.
- Project demonstration and a viva voce during the last lab session of the semester.

MS 101 Project

- Project problems (previous semesters):
 - 2022-23/I - Aut – Line Follower with an extra mechanical task
 - 2022-23/II - Spr – BOT for Mountain Cargo delivery (a track with 10 deg, 20 deg and 30 deg slopes)
 - 2023-24/I – Aut – Automatic tensile testing apparatus to break paper board strips
 - 2023-24/II – Spr – Remote-controlled Drone (Mobile remote control)
 - 2024-25/I – Aut – Remote-controlled Drone (using Joystick)
- Project problem statement (for the current semester)
 - Remote controlled Drone using Joystick - involves Drone frame design, Joystick PCB design and Joystick case design.

Course Weightages

- EE Total: 30 %
 - Labs: 15 % (Pre-lab quizzes + Lab Expts)
 - Midsemester Exam: 10 %
 - Lecture Attendance: 5 % (1 absence condoned)
- ME Total: 30%
- Project: 40 %
 - Project Lab work (up to Final Demo) : ME:15 % ; EE: 15 %
 - Final Demo & Viva: 10 %

Instructors for the EE Part of MS101

- Division D3 (Sections P13 and P14)
Prof Madhav P Desai and Prof Joseph John
- Division D3 (Sections P15 and P16)
Prof Kushal Tuckley and Prof Saravanan Vijayakumaran
- Division D4 (Sections P19 and P20)
Prof Kasturi Saha and Prof Arun Surendran
- Division D4 (Sections P21 and P22)
Prof PC Pandey and Prof Joseph John

Lecture and Lab Schedules

- Lectures:
 - 11 EE lectures
 - Except Lect 1 all lectures will be held in the Lecture Hall Complex during the **Quiz slots - Wed and Fri (8:15-9:20am)**
 - Detailed EE lecture schedule is uploaded on Moodle
- Labs:
 - 5 EE lab experiments
 - Detailed EE lab schedule is uploaded on Moodle

EE Lab Slots and Associated EE Faculty

- **Div D3 (P13 & P14) ; Div D3 (P15 & P16)**
- **Div D4 (P19 & P20) ; Div D4 (P21 & P22)**
- **Division D3 – P13 & P14 - Prof Madhav P Desai and Prof Joseph John**
EE Lab slots : **P13 & P14 ()** – Mon, 2-5pm (in DH) ; **P14()** – Thu, 2-5pm (in DESE-101&108)
- **Division D3 – P14 & P4 - Prof Kushal Tuckley and Prof Saravanan Vijayakumaran**
EE Lab slots: **P15 & P16 ()** –Tue, 2-5pm (in DH) ; **P16 ()** – Fri, 2-5pm (in DESE-101&108)
- **Division D4 – P19 & P20 - Prof Kasturi Saha and Prof Arun Surendran**
EE Lab slots: **P20 ()** – Mon, 9:30-12:30 (in DESE-101&108) ; **P19& P20 ()** - Thu, 9:30-12:30 (in DH)
- **Division D4 – P21 & P22 - Prof PC Pandey and Prof Joseph John**
EE Lab slots: **P22 ()** – Tue, 8:30-11:30 (in DESE-101&108) ; **P21 & P22 ()** – Fri, 9:30-1230 (in DH)

EE Lab Rules

- 100% Attendance in Labs is compulsory.
- Arrive at least 5 min before the Lab starting time at the Lab venues.
- Students should come fully prepared by going through the EE Lab expt handout.
- **There will be a Pre-lab Quiz during the first 10 minutes of the lab (based on the Lab handout).**
- Wear proper dress as per MS101 Lab instructions.
- Wear formal shoes or canvas shoes. Slippers will not be allowed.
- EE Lab expts will be done in groups of two (groups will be allotted strictly as per the roll list).
- **Each one should have his/her Lab Record (a dedicated note book to record observations and results of each experiment). There will be mark penalty for not bringing your Lab record.**
- TAs will evaluate your Lab preparation and Lab performance, and award you marks out of 10. We shall communicate these marks to you within a week.

List of EE Tool-Set

- Digital Multimeter
- Bread board (see the figure on next slide)
- Wire stripper
- Flat screw driver (3 mm)
- Nose plier (small one for general use – soldering, straightening wires etc)
 - Note: Even though students will be performing experiments in groups of 2, we encourage all students to buy their Tool-set.
 - There will be mark penalty for not bringing Tool-set (one set per group).



Digital Multimeter (DMM)

Tool set for Electronics Lab



Wire Stripper



Solderless Breadboard



**Flat Tip
Screwdriver**



Nose Plier

*Images are given for your reference

Objective and Major Components of the EE Syllabus

- To give students sufficient background in Electronic Circuits - to design and implement their final project
- Major components of the EE Syllabus (Lectures: 11)
 - Passive Components, Transformer, Independent & dependent sources, KCL, KVL
 - Electronic devices: *pn* junction diode, Zener diode, LED, Photodiode, solar cell
 - Diode circuits – half-wave and bridge rectifiers
 - Operational amplifiers, feedback circuits, and comparators
 - Logic gates and digital circuits, digital-to-analog converter (DAC), and analog-to-digital converter (ADC)
 - Microprocessors, microcontrollers, memory and I/O devices
 - Microcontroller board (Arduino) with real-world interfacing
 - BJT and MOSFET switches
 - Electromechanical devices: Relays, DC motors, Servo motors

EE Lab Experiments

- 1) Familiarization with basic measuring instruments and other lab equipment (DMM, DSO, AFG); measurement of frequency response of an RC high-pass filter.
- 2) Op amp based inverting amplifier; op amp I-to-V converter for displaying the I-V characteristics of rectifier diodes, LEDs, Zener diodes and photodiodes.
- 3)
 - a) Unregulated DC power supply using transformer and bridge rectifier; measurement of ripple voltage.
 - b) Regulated DC power supply using a 3-pin regulator IC; measurement of line and load regulations.
- 4)
 - a) Familiarization with the Arduino Board and interfacing.
 - b) Controlling BO motors using Arduino boards.
- 5) Remote Control of BO Motors.

Reference Books

- W H Hayt, J E Kemmerly, and S M Durbin, Engineering Circuit Analysis, 8th ed., Mc Graw-Hill, (Indian Edition), 2013.
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th ed. (Indian edition), 2017.
- MA Mazidi, S Naimi, S Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson India, 1st edition 2013.
- *Note: No need to buy these books. E-copies of the required portions will be uploaded on Moodle.*