Electric Vehicles

An elective, Credit Point Course!

Proposed by
Pupilfirst Pvt. Ltd.
Bengaluru

In Collaboration with
All India Council for Technical Education (AICTE)
New Delhi

Contents

Course Coding Nomenclature:

- EV denotes "Electric Vehicles" open electives.
- 101, 201 are courses in the order they have to be taken, if taken in different semesters. Multiple courses may also be taken in the same semester.

Creating a Head start to industry for students

To create a head start for students into emerging technologies, a student of any branch, who has completed second semester may be admitted to this EV elective program.

The course work for EV101 and EV201 may be spread over 1 or 2 semesters. Institutions and their respective affiliating universities may plan the implementation details together with Faculty.

Introduction

The paradigm shifts from Internal Combustion Engines (ICE) to Electric Vehicles that is happening globally is creating new opportunities not just for engineering students to get jobs in the EV industry, but is also an opportunity for academic faculty to engage in interdisciplinary research opportunities in the emerging EV Industry.

As modern electric vehicles combine diverse engineering fields, it is important for faculty to receive well-planned training that shall enable them to brush up skills across electrical, mechanical, electronics and computer science fields to teach this subject to inquisitive students.

As part of AICTE's Leadership in Teaching Excellence (LITE) program, select faculty members shall be professionally trained by industry coaches in technology tools, EV related curriculum and continuous assessments methods that shall empower them with necessary skills and knowledge required to implement the program through a learner-centered pedagogy that is in-line with the National Educational Policy 2020.

In-order to aid faculty to understand both the pedagogical and curriculum approach, this document is divided into three chapters:
Chapter 1. Key Approaches from NEP 2020 that are covered in AICTE's Leadership in Teaching Excellence (LITE) program
Chapter 2. Role of a Faculty in Learner Centered Pedagogy
Chapter 3. Credit Structure - EV Open Electives

Congratulations to institutions and faculty who have stepped us as pioneers to herald the foundations of a modern electrical vehicle transportation industry in India.

Need for inclusion of Electric Vehicle as a Credit point course

The latest UN Intergovernmental Panel on Climate Change (IPCC) Assessment Report makes abundantly clear the scientific perspective of impending large scale global disasters due to global warming. This evolving global situation is the prime mover that urgently necessitates a paradigm shift to green energies, as fossil fuels are a significant contributor to climate change.

The Government of India has committed at COP21 Summit held at Paris to reduce emission intensity by 33- 35% by 2030. Subsequently, Central and State Governments have announced policies to promote electric vehicles as the future of transportation.

In line with these national policies, our nation has been receiving significant foreign and domestic investments in the Electric Vehicle manufacturing sector, including the 10,440 Crore investments announced by Suzuki Motor Corporation at India-Japan Economic Forum on March 19, 2022.

It is in the light of these global and national developments that AICTE is introducing the Model "Interdisciplinary" Curriculum as Open Electives in Electric Vehicles to meet the manpower requirements that are required for India to achieve its stated goal of transition to 30% electric vehicles by 2030.

In line with NEP 2020 recommendation for interdisciplinary education, the AICTE Model EV Elective Curriculum has been designed along with the support from Micelio Mobility Private Limited and Industry experts to bring together interdisciplinary learning from fields of Electrical, Electronics, Mechanical and Computer Science domains to enable our students with practice oriented engineering skills.

Committee for Electric Vehicles course

S.No	Name	Designation & Organization
1	Er. Swapnil Mankame	Founder & CEO, Mankame Automotive
2	Er. Sanjay Vijayakumar	Chairman & Co-founder, Pupilfirst
3	Er. Suma Sundararajan	COO, Pupilfirst
4	Dr. Reena Singh	Senior Course Manager, Pupilfirst
5	Er. Nandhu Suresh	Associate Manager (Course Operations), Pupilfirst

Chapter #1 - Key Approaches from NEP 2020 that are covered in AICTE's Leadership in Teaching Excellence (LITE) program

This chapter covers an overview of 10 salient goals of NEP 2020 that are being covered through the AICTE LITE[1] programme. The overall goal of LITE Program is to train 100,000 faculty and 2.4 Crore students in emerging technologies using NEP 2020 pedagogical approaches.

S.No	NEP 2020 Goal	How this is Implemented through LITE
1	Training teachers in learner-centred pedagogy and using online teaching platforms and tools **(NEP 24.g)**	Students in this programme would be learning in a learner-centered model. Faculty would receive continuous support from professional industry experts to learn and deploy learner centered pedagogy.
2	For achievement of learning outcomes, classroom transactions shall shift towards competency-based learning **(NEP 4.6)**	With real-world competencies mapped into the curriculum, faculty would be able to work with industry experts and upskill their knowledge to be in sync with the latest industry standards and techniques.
3	Training teachers in latest pedagogies for formative and adaptive assessments and implementing pedagogical plans based on competency-based education. **(NEP 5.15)**	Faculty shall be equipped to perform diagnostic, formative and summative assessments using technology tools. This shall enable faculty to see the overall course progression of the class and spend more time on weaker students such that nearly all students in the class are able to achieve the course learning outcomes.
4	University Admissions for students with singular interest **(NEP 4.45)**	AICTE shall select CBSE schools into the LITE program. University faculty shall be connected with school teachers to identify gifted students who can have a direct admission to university programmes.

[1] https://www.aicte-india.org/sites/default/files/fdc/AICTE-LITE%20Programme.pdf

5	Continuous Professional Development of Faculty **(NEP 5.15)**	In associated with AICTE Training and Learning Academy, LITE shall provide a continuous model of faculty development with professional support from industry all-round the year.
6	Focus on greater industry partnerships and innovation amongst student communities **(NEP 11.2)**	With deep industry integration, faculty shall be able to guide students towards applying knowledge to practical use cases like an industry setting.
7	Creating Optimal Learning Environments for high-quality learning outcomes **(NEP 12.1)**	Faculty shall receive support to set up learning environments right from creating awareness, student selection, diagnostic assessments, formative assessments, summative assessments, identifying teaching assistants, guiding course graduation (Internship/Entrepreneurship) and feedback for improvements of the above steps.
8	Classrooms shall have access to the latest educational technology that enables better learning outcomes. **(NEP 13.2)**	AICTE has selected the open-source tooling built by pupilfirst after a careful multistep selection process and demonstrating proven learning outcomes for students. Faculty shall have the ability to learn about the tooling in depth and enhance student experience through more inputs.
9	Research in Educational Technology for improving teaching-learning-evaluation process and increasing access to education **(NEP 23.1)**	Institutions and Faculty who are part of LITE after training shall form part of an Industry-Academia Research Group to identify new areas of research and themes to be submitted to AICTE for support.
10	Creating pilot studies for digital education, training teachers to be effective online educators and creating tools for blended models of learning **(NEP 24.1, 24.3, 24.4)**	AICTE has designed the LITE programme to start with 50 institutions and faculty who shall demonstrate a new model of teaching-learning to the other 10,000 affiliated institutions.

Chapter #2- Role of Faculty in Learner Centered Pedagogy

Overview: NEP 2020 envisions that the role of a faculty in a technology based teaching-learning environment be slowly transformed from being a lecturer to a guide who empowers students to become learners who can direct both their own learning experience and learning paths.

The AICTE Leadership in Teaching Excellence (LITE) program is designed to train 100,000 faculties and empower them to transition in this new paradigm of learner centered pedagogy.

In this chapter, we shall cover the role of faculty, define the duties and responsibilities, stress on learner-centred pedagogy envisioned by NEP 2020 and provide an introduction to digital learning tools at the disposal of the faculty.

Primary Role: *The primary role of faculty members is to guide each student to progress through a learner-centered pedagogy and achieve course learning outcomes. The emphasis is shifted from teaching by faculty to students' learning by doing.*

Faculty members shall leverage digital learning tools, digital curriculums that are dynamically updated along with industry changes, student teaching assistants and online connected learning communities with industry coaches to guide learning process of individual students.

Secondary Role: The secondary role is to complete the academic administrative duties necessary for the course to run efficiently at the institution.

Research Role: NEP 2020 envisions academic institutions and faculty to be creators of new knowledge through research.

Faculty members who are successful in both primary and secondary roles may apply to join the LITE Research Group and contribute to research in evolution of tools, teaching-learning processes and curriculum.

Duties and Responsibilities of a LITE Faculty Member

The primary duty of a faculty member is to switch his/her mindset from being a teacher to becoming a guide to enable students to take charge of their own learning experience. This includes:

1. Preparing the mindset of students to take charge of their own learning.
2. Undertaking Diagnostic assessments to benchmark current learning level of each student in the classroom.
3. Answering questions posted by students in the communities.
4. Commit to undertake continuous self-development to learn modern pedagogical techniques
5. Support students across different learning speeds to learn at their own pace but with thorough understanding of the course curriculum.
6. Assist in summative assessments to benchmark the final learning level of students and map the progress of individual students.
7. Assist in identifying potential students who can take the role of teaching assistants.
8. Guiding students to make their own choice of Research, Entrepreneurship or industry Jobs as outcomes as they graduate from the institution.

LITE Faculty Members and Learner Centered Teaching Pedagogy

1. NEP 2020 promotes a discovery, discussion and analysis-based learning where students are to be guided to take inspiration, thinking alone and thinking together.
2. The curriculum is designed and dynamically updated by industry experts and delivered to students using an LMS. This frees up time for faculty to take up an active role in interacting with each individual student to find out how their learning journey is progressing and what specific help they require to progress.
3. To assist in this endeavour, the top students are nominated by faculty members as teaching assistants.
4. The classroom environment is to be reimagined as a place to explore, experiment, and reflect about the learning progress made by students on an individual basis and help them overcome learning difficulties.

Digital Tools for LITE Faculty Members

The course curriculums are hosted online in the open-source teaching-learning platform, Pupilfirst LMS, which is developed keeping all learners of the classroom in mind, and by taking the feedback from teachers and students from universities into consideration. The tool supports quality teaching and learning via many inbuilt processes. A few of them are listed below -

- **Community -** This is a place where Students, Teachers, Coaches, Teaching Assistants, Student-graduates (from previous batches) come together to build a connected learning ecosystem that supports peer-learning. This acts as a repository of questions /discussions from previous batches of students, that help a new student clarify their doubts with ease.

- **Dynamic Content -** The course content in the LMS is written by Industry experts, and it is revised frequently based on feedback from students on concepts/topics and updates in technology so that it is always of high relevance and quality.

- **Review Checklist -** Giving an elaborate, qualitative feedback to students is critical in their learning. The LMS supports creation of custom quality templates of review feedback by the coach, based on the quality and features implemented by a student in the submission, that can be re-used by the educator to give high-quality template feedback to the students.

All these open-source educational tools and teaching-learning processes are under constant development by taking feedback inputs of faculty, students and industry experts. The features under development are prioritized and can be seen at https://github.com/pupilfirst/pupilfirst/projects/1.

At an appropriate stage, high-performing faculty members shall be inducted into the LITE Research Group to take up research that can enable the further development of educational tools and teaching-learning processes.

Chapter #3 - Credit Structure - EV Open Electives

In this chapter, we shall discuss the outline of the electric vehicle courses and skills gained by the student as they complete the course. The course curriculum is set in a manner to engage and drive the students to develop specific competencies required by the electric vehicle industry so that they are ready to contribute to it when they graduate from the course.

Definition of Credit

1 Hour of Lecture (L) / Week	**1 Credit**
1 Hour of Tutorial (T) / Week	**1 Credit**
2 Hours of Practical (P) / Week	**1 Credit**

There are three courses that can be offered as Open Electives:

1. Electric Vehicles 101 - Mathematical Modelling of an Electric Vehicle
2. Electric Vehicles 201 - Design and Build Your Own EV Powertrain
3. Electric Vehicles TA 101 - Teaching Assistant Training for EV 101 and EV 201

Open Electives in Electric Vehicles

Course Structure						
S.N	**Course Code**	**Title**	**L**	**T**	**P**	**Credits**
1	EV101	**Electric Vehicles 101** Mathematical Modelling of an Electric Vehicle	0	2	0	2
2	EV201	**Electric Vehicles 201** Design and Build Your Own EV Powertrain	0	3	4	5
3	EV TA101	**Electric Vehicle TA 101** Teaching Assistant training for EV 101 and EV 201	0	1	2	2
TOTAL			**0**	**6**	**6**	**9**

Detailed Syllabus

Course Code	**:**	**EV101**
Course Title	**:**	**Mathematical Modelling of an Electric Vehicle**
Number of Credits	**:**	**2 (L: 0; T: 2; P: 0)**
Course Category	**:**	**Electric Vehicles (EV)**

Course Objective:

The course is a beginner-level course designed to introduce students to Electric vehicles and give them a brief idea about electric vehicles, and its importance. This course gives some basic technical foundations regarding electric vehicles In-order to help them move on to advanced electric vehicle courses.

Prerequisites:

- Students should have access to a computer with minimum requirements (Pentium 4, Windows 7, 2 GB RAM, 5 GB Hard Disk Space) and a stable Internet connection.

Course Outline:

Module 1: Introduction to Electric Vehicles 101

This module introduces the students to the relevance of electric vehicles, current demand in EV industry and opportunities of skilled EV engineers.

Module 2: Electric Vehicle Foundations

In this module, students will learn the history and evolution of electric vehicles and what goes into building them. Students will be able to appreciate the actual impact of EVs in the world.

Module 3: Understanding the Foundations of an Electric Vehicle

Here we look into what is considered as an electric vehicle, and what electric vehicles are made up of. This module will cover the necessary components of an electric vehicle.

Module 4: Mathematical Modeling of an electric vehicle

In this module, students learn about modelling the conversion of an ICE vehicle to electric. They choose a target vehicle in the Indian market, finalize the vehicle specifications and simulate the energy consumption for their electric vehicle conversion using SCILAB.

Text/Reference Books:

- This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go

through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Micelio Mobility Pvt. Ltd.

- Link to EV101 course - https://www.pupilfirst.school/courses/641/curriculum
- This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.

Course Outcomes:

By completing the EV101 course, students will be introduced to electric vehicles, their importance and identify various components of an EV.

By the end of this course, students will:

- Get introduced to electric vehicles, understand how are EVs different from ICE vehicles and identify various parts of an electric vehicle.
- Learn the fundamentals of Lithium-ion cells.
- Analyse EVs based on power sources and calculate range of an EV.
- Perform motor power and torque calculations to select a motor to build their own EV.
- Learn the basics of converting any petrol 2-wheeler into an electric vehicle.

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Course Code	**:**	**Electric Vehicles 201**
Course Title	**:**	**Design and Build Your Own EV Powertrain**
Number of Credits	**:**	**5 (L: 0; T: 3; P: 4)**
Course Category	**:**	**Electric Vehicles (EV)**

Course Objective:

This course is designed to make a student capable of intuitively understanding all the important elements of an EV powertrain, and also be able to design a miniaturized electric vehicle powertrain using electrical/electronic components with knowledge acquired in this course.

Prerequisites:

- Students should have completed EV101 before beginning this course.
- Access to a computer (minimum Requirements - Pentium 4, Windows 7, 2 GB RAM, 5 GB Hard Disk Space) and a stable Internet connection.
- Students will need to have access to/ procure the electrical/electronic components as mentioned in Appendix 1. The cost shall not exceed INR 2500 per student.

Overview:

What will the students be learning?

- Breaking down an EV into its subcomponents
- Building and experimenting with a physical model of an EV powertrain
- Typical power ratings of chargers
- Simulating a vehicle for International drive cycles
- Motor power and torque calculations
- Weight distribution in EVs
- Specification of EV components
- Various power sources (Fuel Cell Electric Vehicles/Battery Electric Vehicles)
- Fundamentals of Lithium-ion cells
- Charging of Lithium-ion cells
- Power conditioning and noise filtering
- Fundamentals of motors used in EVs
- Building and simulating communication systems
- Motor control for BLDC motors
- Understand how carbon credits work and how companies utilize it to reduce their emission values.
- Rules and regulations set by the Indian government to be followed while designing an EV or a retrofit kit.

Course Outline:

Module 1 - Introduction

In this module, students are taken through a recap of EV101 and an introduction towards EV 201.

Module 2 - Basics of electric motors

In this module, the students learn to assemble their own motor from scratch, which includes winding their own coils and designing their motors. Students also learn Finite Element Method Magnetics (FEMM) modelling by simulating the motor they have built, which helps them simulate and model efficient motors.

Module 3 - Motor controller basics

In this module, the students design their own motor controller from scratch using MOSFETs, and an Arduino circuit and in turn learn the theory and operation behind the working of a motor controller.

Module 4 - Modelling energy consumption

This module teaches students about various driving cycles and energy consumption. The students learn to simulate the energy consumption and vehicle range using the WLTP energy consumption model.

Module 5 - Understanding Batteries

In this module, students learn the basics of Lithium-ion batteries. It covers how batteries work, how to choose the appropriate batteries and how to handle them. They also learn about the dos and don'ts when designing battery packs and possible hazards caused by design errors.

Module 6 - Battery management systems

This module touches on Battery management system design and introduces students to various battery parameters and terminologies. Students are guided towards building a battery monitoring circuit that monitors various parameters like current, voltage, temperature and energy consumption of the battery pack they have built using alkaline batteries.

Module 7 - Charging Technology and Implementation

This module goes into the basics of charging technology and types of charging architecture existing globally. Students learn about the charging process and the variables associated with charging an EV.

Module 8 - Communication Protocols

In this module, students learn about automotive communication, various communication protocols used in EVs. Students gain practical learning by designing and building an I2C (Inter-Integrated Circuits) communication bus to communicate between the Motor controller and BMS to act as an intelligent system similar to a CAN (Controller Area Network) bus, which is widely used in the industry to communicate with various components of an automobile.

Module 9 - Looking into practical case studies

In this module, students look into a case study specifically on a Formula electric design paper and understand their design process. They also reverse engineer and simulate a BLDC motor using Finite Element Method Magnetics (FEMM).

Module 10 - Regulations for Electric Powertrain Vehicle manufacturers

In this module, students learn about various types of regulations and standards set in the CMVR (Central Motor Vehicles Rules - 1989) for selecting and manufacturing various components of an electric vehicle. Students will also gain an understanding about retrofitment solutions and also the rules and regulations they will need to follow while designing a retrofit powertrain model.

This module also covers the basics of Carbon footprint of companies and understand how companies utilize carbon credits to reduce their carbon footprint issues and touches on international and national carbon credit incentives and policies to further help reduce greenhouse gases in the environment.

Text/Reference Books:

- This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Micelio Mobility Pvt. Ltd.
- Link to EV201 course - https://www.pupilfirst.school/courses/643/curriculum
- This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.

Course Outcomes:

By the end of the EV201 course, the students will be able to:

- Students will be able to visualize the working of an EV powertrain.
- Gain confidence to build and design their own motors and powertrain components from scratch.
- Gain a basic understanding of how EV power electronic systems work by building a Motor controller.
- Identify various communication protocols and technologies used in vehicle networks.
- Develop an electric vehicle powertrain prototype using locally procured hardware components.

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Course Code	**:**	**EV TA101**
Course Title	**:**	**Teaching Assistant Training for EV 101 and EV 201**
Number of Credits	**:**	**2 (L: 0; T: 1; P: 2)**
Course Category	**:**	**Electric Vehicles (EV)**

Course Objective:

The course is designed to train students who have completed EV101 and EV201 and are interested in teaching, to become a Teaching Assistant for these two courses.

Students will get an opportunity to interact with course coaches'/course authors who are industry experts and practitioners in the EV domain. Students will assist in the learning process of students and while doing so, they will develop a more in-depth understanding of EV concepts and practices.

Prerequisites:

- Students should have access to a computer with minimum requirements (Pentium 4, Windows 7, 2 GB RAM, 5 GB Hard Disk Space) and a stable Internet connection.

- Students should have completed EV101 and EV201 courses and filled in the application for EV TA101 course.

Course Outline:

Module 1: Orientation to becoming a Teaching Assistant

This module introduces students to the responsibilities of an EV Teaching Assistant (TA) and best practices involved in fulfilling them. Students get a better understanding of learner-centered pedagogy and learning-by-doing that they have experienced while taking the course and how they are implemented in the creation and delivery of EV101 and EV201

courses. Students also interact with the course coaches/authors directly to get a better understanding of any concept in EV.

Module 2: Working with Industry Expert Coaches to maintain online Community

In this module, the Teaching Assistants are given training on the best ways to approach and answer the questions posted by students in the online course community. They are trained by course coach on how to: write effective answers, help students debug the errors they encounter, and guide students towards the solution, enable students to learn to solve problems on their own. Once trained, the TAs will continue answering students' questions in the community under the supervision of the course coach through the complete course duration.

Module 3: Reviewing student submissions

In this module, TAs are given an introduction to review process of assignments submitted by the students. The assignment review consists of assigning a grade and giving feedback for improvement. To make the review process easier, effective and consistent, a review checklist is created for each assignment by the course coach. The TAs will do pair-review of assignments along with the course coaches and get trained at using the review checklist for evaluation of student submissions. Once trained, the TAs will continue reviewing students' assignment submissions under the supervision of the course coach through the complete course duration.

Text/Reference Books:

- This course does not require students to use physical textbooks. Instead, original course material (videos, text and images) has been prepared for students to go through and is open-sourced under Creative Commons Attribution-ShareAlike 4.0 International License © Micelio Mobility Pvt. Ltd.
- Link to EV101 course - https://www.pupilfirst.school/courses/641/curriculum
- Link to EV201 course - https://www.pupilfirst.school/courses/643/curriculum
- This course material may include some third-party content with a compatible license, and external links for additional reading on the Internet. Students are also taught how to search for information on their own.

Course Outcomes:

By completing the EV TA101 course, students shall have a more in-depth understanding of introduction to electric vehicles, their importance and identify various components of an EV and be able to visualize the working of an EV powertrain.

By being TAs, students shall master the concepts and skills taught in EV101 and EV201

courses and build leadership skills to mentor and motivate fellow students and, eventually, their workplace colleagues.

In summary, at the end of this course, students who are trained as TAs will:

- Get a more in-depth understanding of the concepts in EV101 and EV 201 courses.
- Get experience as a Teaching Assistant for EV101 and EV201 courses.
- Learn ways to apply theoretical concepts to practical learning and help students do the same.
- Learn the art of mentoring and carry on the learnings to a workplace setting.
- Practice the importance and role of communication in learning.
- Be able to critique the work done by others and appreciate multiple solution perspectives for the same problem.
- Give feedback to improve the course content.
- Appreciate iterative learning and be able to apply it for self-improvement.
- Get an opportunity to join as TA multiple times during their UG degree (based on need and time availability) to improve their learning with a suggested limit that credits gained from TA courses not be higher than 10% of overall credits required for graduation.

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Appendix 1 - List of Equipment's Required for EV 201 Course.

The below list of equipment's may be procured by students who wish to take EV Open Electives. The total cost is not expected to be more than Rs. 2500 per student.

Last updated on April 12, 2021			
S. No.	**Component**	**Quantity**	**Supplier**
1	Cheap AA battery	4	Available in local shops
2	Neodymum Magnet (10mm x 2.5mm)	4	https://www.electronicscomp.com/10mm-2.5mm-neodymium-disc-strong-magnet?search=10x
3	Safety pin	2	Available in local shops
4	10 meter 25 gauge Copper enameled coil	5	Available in local shops
5	Ball bearing 608ZZ	1	https://www.electronicscomp.com/radial-ball-bearing-608zz-for-3d-printer-robot?search=Ball%20bearing%20608ZZ
6	MS bolt (8mm x 25mm)	4	Available in local shops
7	Breadboard	2	https://www.electronicscomp.com/gl12-840-points-solderless-breadboard?search=bread
8	Glue (feviquik)	1	Available in local shops
9	Arduino Nano board	2	https://www.electronicscomp.com/arduino-nano-3.0-development-board?search=arduino%20nano
10	USB A Male to mini B cable	1	https://www.electronicscomp.com/usb-a-male-to-mini-b-cable?search=arduino%20nan
11	IRFZ48N N-type mosfet	6	https://www.electronicscomp.com/irfz48n-55v-64a-n-channel-power-mosfet-to-220-package?search=IRFZ48N
12	IR2104S (IR2104) gate driver IC	2	https://www.electronicscomp.com/ir2104-half-bridge-driver-ic?search=IR2104%20
13	20 ohm resistor	1	https://www.electronicscomp.com/22-ohm-1-watt-resistor?search=22%20ohm%20resistor
14	12V 2A DC Power Supply Adapter	1	https://www.electronicscomp.com/12v-2amp-dc-adaptor?search=2a%20adapter
15	33k ohm resistor	6 pieces	https://www.electronicscomp.com/33k-ohm-2-watt-resistance?search=33k%20ohm%20resistor
16	10k ohm resistor	6 pieces	https://www.electronicscomp.com/10k-ohm-1-watt-resistance?search=10k%20ohm%20resistor

17	100 ohm resistor	10 pieces	https://www.electronicscomp.com/100-ohm-1-watt-resistance?search=100%20ohm%20resistor
18	1N4148 diode	6 pieces	https://www.electronicscomp.com/1n4148-diode?search=1N4148%20
19	Male to male Jumper wires	40	https://www.electronicscomp.com/male-to-male-jumper-wires-20cm-40-pieces-pack?search=male%20to%20male%20Jumper%20wires
20	4 in 1 soldering iron kit	1	https://www.amazon.in/soldering-startup-solder-desold-paste/dp/B08TVWVX1T/ref=asc_df_B08TVWVX1T/?tag=googleshopdes-21&linkCode=df0&hvadid=397006678480&hvpos=&hvnetw=g&hvrand=17795769683988473334&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=1007771&hvtargid=pla-1362239320481&psc=1&ext_vrnc=hi
21	2 Channel 5V Relay Module	1	https://www.electronicscomp.com/2-channel-5v-relay-module?search=relay
22	Red LED - 5mm	3	https://www.electronicscomp.com/red-led-5mm-diffused-india
23	Pushbutton	3	https://www.electronicscomp.com/push-button-switch-2-pin-5mm
24	LM35 Temperature Sensor	1	https://www.electronicscomp.com/lm35-temprature-sensor?search=lm35
25	AA battery cell holder	1	https://www.electronicscomp.com/4-aa-battery-holder-black-good-quality?search=battery%20holder

Note: The list is tentative and subject to change

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