VISION OF THE INSTITUTE

To provide high quality skill oriented technical education to the rural students to accomplish the global requirements.

MISSION OF THE INSTITUTE

To provide modern facilities for imparting value based teaching – learning practices, enrich the faculty members with continuous learning and career guidance for the students.

ABOUT OUR DEPARTMENT

The Department of Electrical and Electronics Engineering was established in the academic year 2006-2007 with the intake of 60 students. The EEE department has been established with the commitment of developing and producing quality Electrical and Electronic Engineers with high-technical knowledge and good practical basis, combined with leadership skills and decision making capabilities.

The Department is equipped with experienced faculty members to encourage the excellence of the students in the field of Electrical Engineering. Our teaching methodology offered to the students has been framed to meet the technical challenges and to satisfy the real time needs in the society.

VISION OF THE DEPARTMENT

To empower the students with capabilities of academic, technical and professional competence in the field of Electrical and Electronics Engineering and to nurture them in the emerging areas to serve the society.

MISSION OF THE DEPARTMENT

To provide modern facilities for imparting value based teaching – learning practices, enrich the faculty members with continuous learning and career guidance for the students.

PEOs

PEO-1: To impart strong educational foundation in the field of Electrical and Electronics Engineering for successful career in industry and higher education.

PEO-2: To provide technical skills and resources to design, analyze and create innovative solutions for engineering problems in multidisciplinary work environment.

PEO-3: To inculcate leadership qualities, ethical attitude and competence to excel individually and work with teams.

“Education is the light for future, which is a powerful tool to achieve the needs in a right manner.”

I wish the EEE faculty members and students to bring out this newsletter for this occasion.

This is the best opportunity for them to outcome their valuable thinking, different ideas and innovations.

I hope this newsletter will grow as a treasure of the reflections of student’s intelligence.

Prof. Dr. P.Appukutty,
Chairman

Dr.LakshmiAppukutty,
Vice Chairman

“Until you need a path, no one can stop your work at any time”

An Engineer is a professional practitioner of engineering who applies scientific knowledge, mathematics and ingenuity to develop solutions for technical problems.

The Department of Electrical and Electronics Engineering continues to evolve our field changes; one thing will always remain constant; our commitment to ground breaking innovation and global leadership.

My best wishes for the Electrical and Electronics Engineering department students for their achievement.

“Opportunity is like a sunrise. If you wait too long, you will miss them”

Every person has to grab the opportunities what he gets and to serve at the right time. One may not worry about how to act because it is an art which will be definitely learnt it during the course. I hope this news-letter is an exciting opportunity for the students to show their talents and learn more.

Hope it will motivate many students in their path of education.

Dr.T.Manigandan
CEO

Mr.A.Ponnambalam
Principal

“Everyone sees what you appear to be, few experience what you really are.”

Electrical Engineering is one of the continuously evolving engineering disciplines, which involves understanding, designing, analyzing and implementing the electrical and electronics system.

The objective of this programme is to prepare engineers to establish themselves in career and obtain diploma and to generate new knowledge or exercise leadership in their position to their benefit of the society.

HOD's Message

It is a technical platform to bring out the hidden talents of students and faculty. The major strength of the department is a team of well qualified and dedicated faculty members who are continuously supporting the students for their academic excellence.

I heartily congratulate them to bring out this news letter as treasure of achievements of students and faculty throughout the year.

Mr.VR.SHANKAR GANESH
Head of the Department

EDITORIAL COMMITTEE

CHIEF EDITOR

Mr.V.R.SHANKAR GANESH, M.E.,
HOD – ELECTRICAL AND ELECTRONICS ENGINEERING

EDITOR

Faculty Members
&
Students
(ASSOCIATION OF EEE)

ASSOCIATION OF ELECTRICAL AND ELECTRONICS ENGINEERING

INAUGURAL FUNCTION

In the month of September 02nd 2020, Our Department Association (FUSION 2K21) was inaugurated by The Department of Electrical and Electronics Engineering and Mr.P.Raja, Quality Engineer, Petroleum Industry, Manama, Bahrain was invited as chief guest through online. He gave an inaugural address about the role. Dr.P.Appukutty, Chairman, P.A Educational Institutions presided over the function. Mr.A.Ponnambalam, Principal, P.A. Polytechnic College, Mr.VR.ShankarGanesh, Head of the Department, and all EEE staff members were present and students of our department were attended to grasp the knowledge.

DEPARTMENT LABORATORIES

GUEST LECTURES/SEMINARS/WORKSHOP CONDUCTED

S. No.	Date	Event Title	Level
CAY (2020-2021)			
1	06.04.2021	Opportunity for Electrical and Electronics Engineering in Higher Education and in Software Industries	Institute
2	05.04.2021	Emerging Trends in Electrical Substation Design	Institute
3	22.03.2021	A live Webinar on Research Opportunity in Renewable Energy Resources	Institute
4	18.03.2021	Webinar on Nano materials for Energy Applications	Institute
5	18.02.2021	A live Webinar on PCB Design and Fabrication	Institute
6	22.01.2021	A live webinar on Electrical Estimation and Costing for Industry	Institute
7	09.11.2020	A webinar on Hybrid Energy System for Sustainable Development	Institute
8	06.11.2020	Webinar on Impact of Mathematics in the World	Institute
9	16.10.2020	Online Induction Program	Institute
10	07.10.2020	A Webinar on Green Power Generation Sugar Industries	Institute
11	21.09.2020	A live Webinar Role of Electrical Engineer in Industry	Institute
12	02.09.2020	A live Webinar Testing of Transformers in oil Industries	Institute

FDPs CONDUCTED

During the month of February, from 17.02.2021 to 21.02.2021, Five days On line Faculty Development Programme on **"Multi Level Inverters"** was conducted by The Department of Electrical and Electronics Engineering and Dr.P.Mariaraja, Assistant Professor, P.A.College of Engineering and Technology, Pollachi was a resource person. The sessions were very useful and informative to the faculty members.

PARTICIPATION IN FACULTY ENRICHMENT PROGRAMME

The faculties in EEE department have undergone different training programmes during this academic year in different topics such as

Sl.no	Name of the faculty	Date	Programme	Title of the programme	Venue
1.	Mr.R.Kabilmurugan	02.07.20	Webinar	IOT Trends to Drive Innovation for Business in Agronomics	Hindusthan Polytechnic College, Coimbatore
		22-06-20 to 26-06-20	FDP	. Emerging Challenges of Mathematical Applications in Engineering	PSG Polytechnic College, Coimbatore
		13.06.20	Webinar	Opportunities and development of electrical vehicles	Gnanamani College of Technology, Namakkal
2.	Mr.R.Karthik	02.07.20	Webinar	IOT trends to drive innovation for business in algorithms	Hindusthan Polytechnic College, Coimbatore
		13.06.20	Webinar	Opportunities and development of electrical vehicles	Gnanamani College of Technology, Namakkal
3.	Mrs.N.Kavitha	20.07.20	Webinar	Nanomaterials – A multidisciplinary approach	Saveetha Engineering College
		13.06.20	Webinar	Opportunities and development of electric vehicles	Gnanamani College of Technology, Namakkal
4.	Ms.S.Kowsalya	02.11.20 to 07.11.20	STTP	Integration of renewable energy and big data analytics of smart grid – Phase - II	P.A.College of Engineering and Technology, Coimbatore
		11.07.20	Webinar	E-Mobility :Electrification of vehicle powertrains	Sri Eshwar college of engineering and technology
		26.06.20 to 27.06.20	Webinar	Intelligent Industrial Drives	P.A.College of Engineering and Technology, Pollachi
		19.06.20	Webinar	Foot Print of Electric Vehicle in Current Automotive industry	ST.Joseph's Institute of Technology
		15.06.20 to 16.06.20	Webinar	Research Aspects In Solar PV Technology	P.A.College of Engineering and Technology, Pollachi
		13.06.20	Webinar	Opportunities and Development of Electrical Vehicles	Gnanamani college of technology
5.	Mr.S.Krishnakumar	02.11.20 to 07.11.20	STTP	Integration of renewable energy and big data analytics of smart grid – Phase - I	P.A.College of Engineering and Technology, Coimbatore

6.	Mr.A.Ponnambalam	02.07.20	Webinar	IOT trends to drive innovation for business in agronomics	Hindusthan Polytechnic College, Coimbatore
		13.06.20	Webinar	Opportunities & development of electric vehicles	Gnanamani College of Technology, Namakkal
7.	Mrs.D.Premalatha	11.01.21 to 16.01.21	STTP	New emerging trends in data analysis	Government Polytechnic College, Nagpur
		16.06.20 to 20.06.20	FDP	Energy efficient environment	Sri Eshwar College of Engineering
		15.06.20 to 16.06.20	Webinar	Research Aspects In Solar PV Technology	PACET
8.	Mr.R.B.Rajeshkumar	26.06.20 to 27.06.20	Webinar	Intelligent Industrial Drives	P.A.College of Engineering and Technology, Coimbatore
		16.06.20 to 20.06.20	FDP	Energy efficient environment	Sri Eshwar College of Engineering, Coimbatore
		13.06.20	Webinar	Opportunities and development of electric vehicles	Gnanamani College of Technology, Namakkal
9.	Mr.N.Saravanakumar	02.07.20	Webinar	IOT trends to drive innovation for business in algorithms	Hindusthan Polytechnic College, Coimbatore
		20.06.20	Webinar	Energy conservation in our daily life	Sri Ranganathar Institute of Polytechnic college, Coimbatore
		13.06.20	Webinar	Oppurtunities and development of electrical vehicles	Gnanamani College of Technology, Namakkal
10.	Mr.V.R.Shankar Ganesh	28.01.21 to 31.01.21	FDP	Foundation program on ICT for education	Sri Ramakrishna Polytechnic College, Coimbatore
		02.07.20	Webinar	IOT trends to drive innovation for business in algorithms	Hindusthan Polytechnic College, Coimbatore
11.	Mr.K.Sureshkumar	11.01.21 to 16.01.21	STTP	New emerging trends in data analysis	Government Polytechnic College, Nagpur
		16.11.20 to 28.11.20	FDP	Imparting outcome based education in technical institutions and NBA accreditation process	Rajagopal Polytechnic College, Gudiyatham

STUDENT'S CO-CURRICULAR & EXTRACURRICULAR ACTIVITIES

CO-CURRICULAR ACTIVITIES

S. No.	Name of theStudent	Event Description	Event Level (Inter-institute /State /National)	College Name	Awards/ Participation
CAY (2020-2021)					
1	M. Abineshkumar	Workshop	State	Sona College of Technology, Salem	Participated
2	D. Anantha Raksan	Workshop	State	Sona College of Technology, Salem	Participated
3	MS.Arasumadhavan	Webinar	State	St.Mother Therasa Engineering College, Thoothukudi	Participated
4	VJ.Deepak	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	Participated
5	B.Gokul Kumar	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	Participated
6	S. Jeevanandham	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	II Prize
7	I. Kamalesh	Webinar	State	Velalar College of Engineering and Technology, Erode	Participated
8	E. Naveenraj	Webinar	State	Velalar College of Engineering and Technology, Erode	Participated
9	P.Patchiraja	Online Quiz	National	Sri Ranganathar Institute of Polytechnic College, Coimbatore	I Prize
10	K.Rajeev	Paper Presentation	National	Kalasalingam Academy of Reserch and Education, Srivilliputhur	III Prize
11	P.Sathesh	Paper Presentation	National	Kalasalingam Academy of Reserch and Education, Srivilliputhur	III Prize
12	M.Sethu	Workshop	State	Sona College of Technology, Salem	Participated
13	M.S.Arulkumaran	Workshop	State	Sona College of Technology, Salem	Participated

14	K.Dharun	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	II Prize
15	S.Gokulnath	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	Participated
16	S.Keerthivasan	Online Quiz	State	Rohini College of Enginering and Technology, Kanyakumari	Participated
17	B.Mukilan	Webinar	National	New Horizon College of Engineering, Bangaluru	Participated
18	M.Ragu	Webinar	National	New Horizon College of Engineering, Bangaluru	Participated
19	M.Sampath	Online Quiz	State	CIT Sandwich Polytechnic College, Coimbatore	Participated
20	G.Kalaikathiravan	Online Quiz	State	Rohini College of Enginering and Technology, Kanyakumari	II Prize
21	B. Dhivakar	Webinar	State	Francis Xavier Engineering College, Tirunelveli	Participated
22	P.Gokulkannan	Webinar	State	Kumaraguru College of Technology, Coimbatore	Participated
23	G. Kanagaraj	Online Quiz	State	Rohini College of Enginering and Technology, Kanyakumari	II Prize
24	S.Pranesh	Webinar	State	Francis Xavier Engineering College, Tirunelveli	Participated
25	K.Samkumar	Webinar	State	Kumaraguru College of Technology, Coimbatore	Participated
26	K.Sudharsan	Online Quiz	National	Sri Ranganathar Institute of Polytechnic College, Coimbatore	I Prize
27	N.Surendran	Webinar	State	Velalar College of Engineering and Technology, Erode	Participated
28	N.Surya	Workshop	State	Sona College of Technology, Salem	Participated
29	A.Tamilarasu	Workshop	State	Sona College of Technology, Salem	Participated

30	V.Vignesh	Webinar	State	Velalar College of Engineering and Technology, Erode	Participated
31	R.Vishnukumar	Paper Presentation	National	Kalasalingam Academy of Reserch and Education, Srivilliputhur	III Prize

EXTRA CURRICULAR ACTIVITIES

S. No.	Name of theStudent	Event Description	Event Level (Inter-institute /State /National)	College Name	Awards/ Participation
CAY (2020-2021)					
1	G.Karthick	Poster Designing	State	KGISL College of Technology, Coimbatore	III Prize
2	V.Kowsik Kumar	Poster Designing	State	KGISL College of Technology, Coimbatore	III Prize
3	K.Mohamed Elyash	Talent 360	State	Narayana Engineering College, Gudur	Participated
4	P. Patchiraja	Talent 360	State	Narayana Engineering College, Gudur	I Prize
5	P.A. Harikrishnan	Minutenest	State	Kalasalingam Academy of Research and Education, Srivilliputhur	III Prize
6	D.Karthik	Cliché Puzzling	State	Kalasalingam Academy of Research and Education, Srivilliputhur	Participated
7	S.Midilesh	Minutenest	State	Kalasalingam Academy of Research and Education, Srivilliputhur	III Prize

STUDENT'S FORUM

INDUSTRIAL AUTOMATION

Industrial automation is the use of control systems, such as computers or robots, and information technologies for handling different processes and machineries in an industry to replace a human being. It is the second step beyond mechanization in the scope of industrialization.

Increase Quality and Flexibility in Your Manufacturing Process

Earlier the purpose of automation was to increase productivity (since automated systems can work 24 hours a day) and to reduce the cost associated with human operators (i.e. wages & benefits). However, today, the focus of automation has shifted to increasing quality and flexibility in the manufacturing process. In the automobile industry, the installation of pistons into the engine used to be performed manually with an error rate of 1-1.5%. Presently, this task is performed using automated machinery with an error rate of 0.00001%.

Advantages of Industrial Automation

Lower operating cost: Industrial automation eliminates healthcare costs and paid leave and holidays associated with a human operator. Further, industrial automation does not require other employee benefits such as bonuses, pension coverage, etc. Above all, although it is associated with a high initial cost it saves the monthly wages of the workers which leads to substantial cost savings for the company. The maintenance cost associated with machinery used for industrial automation is less because it does not often fail. If it fails, only computer and maintenance engineers are required to repair it.

High Productivity

Although many companies hire hundreds of production workers for up to three shifts to run the plant for the maximum number of hours, the plant still needs to be closed for maintenance and holidays. Industrial automation fulfills the aim of the company by allowing the company to run a manufacturing plant for 24 hours a day 7 days a week and 365 days a year. This leads to a significant improvement in the productivity of the company.

High Quality

Automation alleviates the error associated with a human being. Further, unlike human beings, robots do not involve any fatigue, which results in products with uniform quality manufactured at different times.

High Flexibility

Adding a new task in the assembly line requires training with a human operator, however, robots can be programmed to do any task. This makes the manufacturing process more flexible.

High Information Accuracy

Adding automated data collection can allow you to collect key production information, improve data accuracy, and reduce your data collection costs. This provides you with the facts to make the right decisions when it comes to reducing waste and improving your processes.

High Safety

Industrial automation can make the production line safe for employees by deploying robots to handle hazardous conditions.

Disadvantages of Industrial Automation

High Initial Cost

The initial investment associated with making the switch from a human production line to an automatic production line is very high. Also, substantial costs are involved in training employees to handle this new sophisticated equipment.

Conclusion

Industrial automation has recently found more and more acceptance from various industries because of its huge benefits, such as, increased productivity, quality and safety at low costs.

MS ARASUMADHAVAN

III EEE

GROWTH OF SEMICONDUCTOR INDUSTRIES

Semiconductor industry sales turned south in late 2018, starting with memory chips. The downturn soon spread to other chip markets amid softening sales of smart phones, PCs and other products.

In 2019, the global semiconductor industry suffered its worst year in almost two decades. Semiconductor revenue fell 12% to $412 billion.

The semiconductor industry **returned to growth in 2020** despite disruptions from the Covid-19 pandemic, according to World Semiconductor Trade Statistics. Chip sales rose 6.8% to $440 billion in 2020, the group said. It sees semiconductor sales rising 19.7% to $527 billion in 2021. Further, it forecasts chip sales increasing 8.8% in 2022.

The fastest-growing categories of semiconductors last year were logic, sensor and memory chips. Sales of logic chips rose 11.1%, followed by sensors at 10.7% and memory at 10.4%.

Why Are Semiconductors So Important?

Semiconductors are important to the world because they power technologies that enrich the lives of consumers and make businesses and other enterprises run smarter, faster and more efficiently.

They provide the ingredient technologies for personal computers, tablets, smartphones and other gadgets. Semiconductors run communications networks and the internet. They are adding smarts to televisions, home appliances, automobiles and other devices.

Semiconductor chips also underpin such massive emerging trends as cloud computing, 5G wireless networks and artificial intelligence.

Semiconductor Companies Report First-Quarter Results

The first-quarter earnings season was largely positive for the semiconductor industry. But **chip shortages** tied to capacity constraints at semiconductor foundries limited the upside for fabless chipmakers. Some analysts have expressed concern that the current shortage situation could cause customers to double order and build too much inventory.

Many top semiconductor companies delivered beat-and-raise March-quarter reports. They included **Advanced Micro Devices** (**AMD**), **Analog Devices** (**ADI**), **MicrochipTechnology** (**MCHP**), **Qorvo** (**QRVO**), **Qualcomm** (**QC OM**) and **Texas Instruments** (**TXN**).

Other chipmakers beat first-quarter targets, but disappointed with their guidance. They included **Intel** (**INTC**) and **Taiwan Semiconductor Manufacturing** (**TSM**).

Semiconductor equipment makers in general also delivered rosy reports as chipmakers ramp up spending on new capacity. **Applied Materials** (**AMAT**), **ASML** (**ASML**), **KLA** (**KLAC**), **Lam Research** (**LRCX**) and **Teradyne** (**TER**) were among the chip-gear firms posting beat-and-raise reports.

Largest Semiconductor Companies

Chip stocks rose in early 2021 amid the semiconductor industry turnaround. But a tech stock sell-off starting in mid-April has pulled the sector down.

IBD's Electronics-Semiconductor Manufacturing group currently ranks No. 127 out of 197 industry groups that IBD tracks. Three months ago, it ranked No. 53. The group includes 35 semiconductor companies. The largest chipmakers by market cap are Taiwan Semiconductor, Intel and Texas Instruments, in descending order.

IBD's Electronics-Semiconductor Fabless group ranks No. 135. However, three months ago, it was No. 125. The group includes 30 stocks, topped by **Nvidia** (**NVDA**), **Broadcom** (**AVGO**), Qualcomm and AMD.

IBD's Electronics-Semiconductor Equipment group now ranks No. 47. Three months ago, it was in the No. 26 position. It includes 31 stocks, led by ASML, Applied Materials and Lam Research.

MOHAMED ELYASH

III YEAR EEE

SMART DUST

Smart dust is a system of many tiny microelectromechanical systems such as sensors, robots, or other devices, that can detect light, temperature, vibration, magnetism, chemicals and other stimuli.

In 1965, Gordon Moore, the founder of Intel, predicted that the number of components that could fit on a single chip could double every 2 years. His theory, dubbed Moore's Law, has not only survived the test of time, surviving over half a century in technological advancement, but has also kickstarted a fascination with the miniaturization of technology. A fascination which would go on to transform multiple industries, multiple times over the coming decades.

Which is where Smart Dust comes into the picture. By 1992, the first concepts for Smart Dust had emerged from a workshop at the Research and Development Corporation (RAND), these concepts would soon be followed by a series of studies in the mid-1990s. Interestingly, and as with many other technological advancements, the work was strongly influenced by the science fiction authors Neal Stephenson, Vernor Vinge, and Stanislaw Lem. Lem's *The Invincible* (1964), for example, was one of the first books to explore the ideas of micro-robots, artificial swarm intelligence and "necroevolution", a term suggested by Lem himself for the evolution of non-matter.

The most notable of studies on Smart Dust came in 1997 in the form of a research proposal by Berkeley's Dr. Kristofer S. J. Pister, Joe Kahn, and Bernhard Boser. The project was soon approved for funding thanks to the proposed potential military applications of the technology – "We are open to collaboration with all branches of military and the commercial sector", this proposal, which sought to rapidly deploy defense networks onto the battlefield, would secure Dr. Pister as the inventor of this technology.Fast forward to today and these devices, often smaller than the eye of a needle, can collect data and transmit it back to a base for processing. The 'dust' itself is a set of microelectromechanical systems (MEMS), more commonly known as motes, which pack an incredible punch considering their limited size.

Capable of detecting anything from light to vibrations and temperature, they combine sensing, autonomous power supplies, computing and wireless communication in a space that is typically only a few millimeters in volume.

Which is why they are referred to as Smart Dust. And, just as with their natural cousins, Smart Dust is capable of being suspended in the environment due to its minuscule size. But, unlike their duller ancestors, not only are Smart Dust's components 3D printed, these mini machines are capable of collecting data on acceleration, stress, pressure, humidity, sound and more with their sensors.

This data can then be processes with what amounts to an onboard computer system, as well as stored and communicated to the cloud, a base or others MEMS.

So, other than dominating the battle field, what other applications do MEMS have? The answer is many. Smart Dust can collect information about any environment in incredible detail. In this sense, it is better to think of Smart Dust as the pinnacle of the Internet of Things. It's IoT, but magnified (or reduced) dramatically, allowing industries to better streamline their data in order to hone their safety, compliance and productivity.

With its ability to measure anything nearly anywhere, Smart Dust is capable of tracking products within supply chains in ever more detail, monitoring crops in unprecedented scales and identifying weaknesses in systems prior to failure.

This technology can also be used to track the movement of birds, small animals and insects. In healthcare, Smart Dust can aid with diagnostic procedures and make the entire care process less invasive for the patient, as well as providing new and intuitive interfaces for the disabled.

On top of this, Smart Dust may be deployed over a region to record data for meteorological, geophysical or planetary research. Particularly in cases where measurements are needed in in environments where wired sensors are unusable or lead to measurement errors. Examples include instrumentation of semiconductor processing chambers, rotating machinery, wind tunnels and anechoic chambers.

G.KARTHICK

III EEE

POLYFUSES

A **polyfuse** is a one-time-programmable memory component used in semiconductor circuits for storing unique data like chip identification numbers or memory repair data, but more usually small to medium volume production of read only memory devices or microcontroller chips. They were also used as to permit programming of Programmable Array Logic. The use of fuses allowed the device to be programmed electrically some time after it was manufactured and sealed into its packaging. Earlier fuses had to be blown using a laser at the time memory was manufactured. Polyfuses were developed to replace the earlier nickel-chromium (ni-chrome) fuses. Because ni-chrome contains nickel, the ni-chrome fuse, once blown had a tendency to grow back and render the memory unusable.

History

The first polyfuses consisted of a polysilicon line, which was programmed by applying a high (10V-15V) voltage across the device. The resultant current physically alters the device and increases its electrical resistance. This change in resistance can be detected and registered as a logical zero. An unprogrammed polyfuse would be registered as a logical one. These early devices had severe drawbacks like a high programming voltage and unreliability of the programmed devices.

Modern polyfuses

Modern polyfuses consist of a silicided polysilicon line, which is also programmed by applying a voltage across the device. Again, the resultant current permanently alters the resistance. The silicide layer covering the polysilicon line reduces its resistance (before programming), allowing the use of much lower programming voltages (1.8V–3.3V). Poly fuses have been shown to reliably store programmed data and can be programmed at high speed. Programming speeds of 100ns have been reported

K RAJEEV

III EEE

BUCK-BOOST TRANSFORMERS

A **buck–boost transformer** is a type of transformer used to make adjustments to the voltage applied to alternating current equipment.[1] Buck–boost connections are used in several places such as uninterruptible power supply (UPS) units for computers and in the tanning bed industry.

Buck–boost transformers can be used to power low voltage circuits including control, lighting circuits, or applications that require 12, 16, 24, 32 or 48 volts, consistent with the design's secondaries. The transformer is connected as an isolating transformer and the nameplate kVA rating is the transformer's capacity.[2]

Application

Buck-boost transformers may be used for electrical equipment where the amount of buck or boost is fixed. For example, a fixed boost would be used when connecting equipment rated for 230 V AC to a 208 V power source. Units are rated in volt-amperes (most commonly, kilo-volt amperes KVA) (or more rarely, amperes) and are rated for a percent of voltage drop or rise. For example, a buck–boost transformer rated at 10% boost will raise a supplied voltage of 208 V AC to 229 V AC. A rating of 10% buck will yield the result of 209 V AC if the actual incoming supplied voltage is 230 V AC.

Frequency

All transformers operate only with alternating current. Transformers change only voltage and current, not frequency. Equipment that uses synchronous motors will operate at a different speed if operated at other than the design frequency. Some equipment is marked on its nameplate to run at either 50 Hz or 60 Hz, and would need only the voltage adjusted with a buck–boost transformer to produce the rated output voltage.

Consumer and Business Application

Fixed-ratio transformer with cord, plug and receptacle for light to medium loads. 30 A version shown.

Transformers may come semi-wired, where the installer completes the last internal connections to have the unit perform the amount of buck or boost needed. Units may have multiple taps on both the primary and secondary coils to achieve this flexibility. They may be designed for hard-wired installations (no plugs) or with plug and receptacle to allow the same transformer to be used in several different applications. The same transformer can be rewired to raise or lower voltage by 5%, 10% or 15%. The primary may have wiring combinations for dual voltage usage: example for either 120 V AC or 240 V AC applications, depending on the final wiring done by the electrician.

Not all equipment requires voltage correction. These transformers are used when electrical equipment has a voltage requirement that is slightly out of tolerance with the incoming power supply.

This is most common when using 240 V equipment in a business with 208 V service or vice versa. Equipment is typically labeled with its voltage rating, and may advertise the amount of tolerance it will accept before degraded performance or damage can be expected. A unit that requires 230 V AC with a tolerance of 5% will not require a buck–boost transformer if the branch circuit (under load) is between 219 V AC and 241 V AC. Measurement should be made while the circuit is loaded, as the voltage can drop several volts compared to the open measurement. The transformer must be rated to carry the full load current or it may be damaged.

K. DHARUN

III EEE

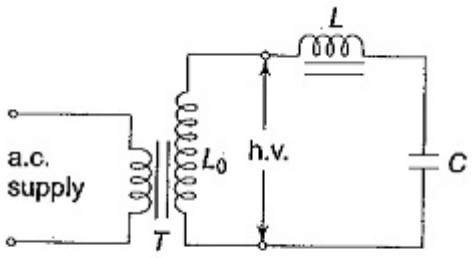
RESONANT TRANSFORMERS

The equivalent circuit of a high voltage testing Resonant Transformers consists of the leakage reactance of the windings, the winding resistances, the magnetizing reactance, and the shunt capacitance across the output terminal due to the bushing of the high voltage terminal and also that of the test object. This is shown in Fig. with its equivalent circuit in Fig. It may be seen that it is possible to have series resonance at power frequency ω, if $(L_1 + L_2) = 1/\omega C$. With this condition, the current in the test object is very large and is limited only by the resistance of the circuit. The waveform of the voltage across the test object will be purely sinusoidal. The magnitude of the voltage across the capacitance C of the test object will be

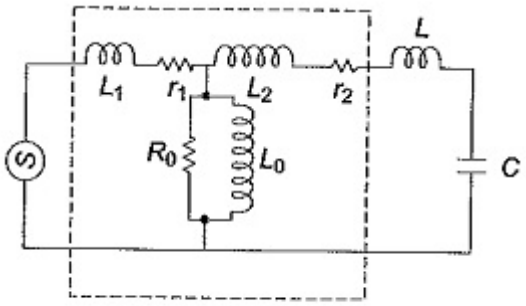
$$V_C = \left| \frac{-jVX_C}{R + j(X_L - X_C)} \right| = \frac{V}{R} X_C = \frac{V}{\omega CR}$$

where R is the total series resistance of the circuit.

The factor $X_C/R = 1/\omega CR$ is the Q factor of the circuit and gives the magnitude of the voltage multiplication across the test object under resonance conditions. Therefore, the input voltage required for excitation is reduced by a. factor 1/Q, and the output kVA required is also reduced by a factor 1/Q. The secondary power factor of the circuit is unity.

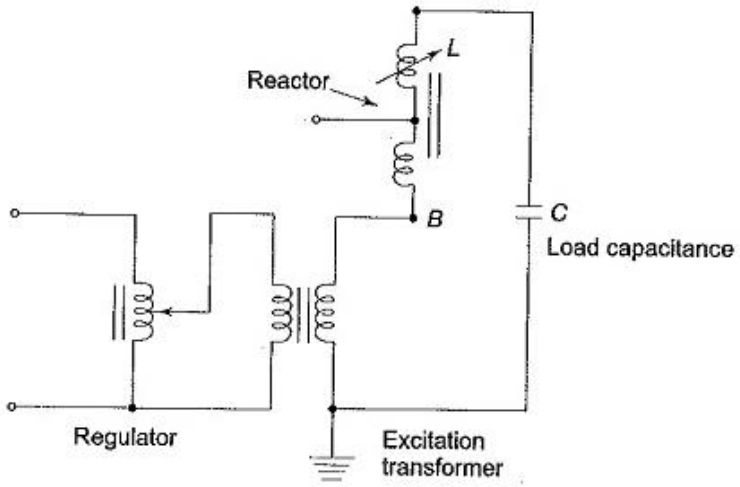


Transformer



Equivalent circuit

This principle is utilized in testing at very high voltages and on occasions requiring large current outputs such as cable testing, dielectric loss measurements, partial discharge measurements, etc. A transformer with 50 to 100 kV voltage rating and a relatively large current rating is connected together with an additional choke, if necessary.



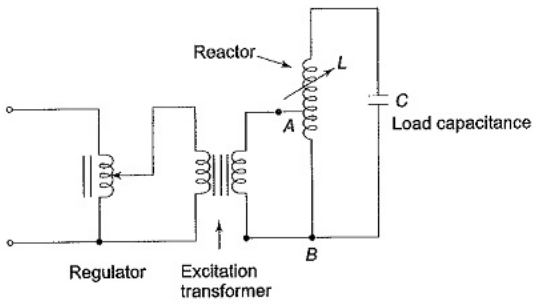
Series resonant a.c. test system

The test condition is set such that $\omega(L_e + L) = 1/\omega C$ where L_e is the total equivalent leakage inductance of the transformer including its regulating transformer.

The chief advantages of this principle are:

- it gives an output of pure sine wave,
- power requirements are less (5 to 10% of total kVA required),
- no high-power arcing and heavy current surges occur if the test object fails, as Resonant Transformers ceases at the failure of the test object,
- cascading is also possible for very high voltages,
- simple and compact test arrangement, and
- no repeated flashovers occur in case of partial failures of the test object and insulation recovery. It can be shown that the supply source takes Q number of cycles at least to charge the test specimen to the full voltage.

The disadvantages are the requirements of additional variable chokes capable of withstanding the full test voltage and the full current rating.



Parallel resonant a.c. test system

Ratings: *Regulator: 10 – 100 kVA*
Excitation transformer: 10 – 100 kVA with an output voltage of about 10 kV.
Reactor voltage — each unit up to 300 kV.

Resonant transformer and equivalent circuit

A simplified diagram of the series resonance test system is given in Fig. and that of the parallel resonant test system. A voltage regulator of either the auto-transformer type or the induction regulator type is connected to the supply mains and the secondary winding of the exciter transformer is connected across the H.V. reactor, L, and the capacitive load C. The inductance of the reactor L is varied by varying its air gap and operating range is set in the ratio 10 : 1. Capacitance C comprises of the capacitance of the test object, capacitance of the measuring voltage divider, capacitance of the high voltage bushing etc.

The Q-factor obtained in these circuits will be typically of the order of 50. In the parallel resonant mode the high voltage reactor is connected as an auto-transformer and the circuit is connected as a parallel resonant circuit. The advantage of the parallel resonant circuit is that more stable output voltage can be obtained along with a high rate of rise of test voltage, independent of the degree of tuning and the Q-factor. Single unit Resonant Transformers test systems are built for output voltages up to 500 kV, while cascaded units for outputs up to 3000 kV, 50/60 Hz are available.

D.KARTHIK

II EEE

TOP 10 MICROCONTROLLERS (MCU) MANUFACTURERS FOR 2020

Microcontroller is a type of processor on a single integrated circuit, containing memory, processor, and input /output peripheral. It is installed in automatically controlled products and electronic devices such as remote controls, office machines, home appliances, power tools, toys, and others. Usage of microcontroller in electronic devices makes their functioning error free and ensures smooth process flow.

The microcontroller market growth is largely driven by the increase in number of automated machines. In addition, increase in number of portable electronics such as personal computers, tablet, and smart phones; and growth in number of luxury cars, which use advanced electronic systems have contributed to growth of this market. However, malfunctioning of microcontroller in extreme climatic conditions such as extremely low and high temperatures could limit the market. The global microcontroller market size is estimated to reach $15.67 billion by 2022 from $8.60 billion in 2015, growing at a CAGR of 8.4% from 2016 to 2022.

Analog Devices

Analog Devices has been tapping the emerging IoT processing application with its microcontroller units (MCUs) offerings. Analog Devices allows analog and digital sensing. Ability of low-power consumption, Analog Devices MCUs can even be powered through a single coin cell battery. Matching different applications need, Analog Devices MCUS are apt for industrial, automotive, and instrumentation applications, as well as Internet of Things (IoT) applications.
Website: https://www.analog.com/en/index.html

Cypress Semiconductor

Cypress extensive Microcontrollers(MCUs) offering pan across many domains and applications. With broad offering of MCUs, Cypress portfolio includes low-power to high-performance microcontrollers (MCUs) for various markets. Cypress MCUs are tailored for consumer, industrial and automotive markets. Cypress also has a unique PSoC® MCU, Flexible MCU (FM) and Automotive MCU Portfolios. Cypress MCUs has matched market demands with its unique low-power, flexible and high-performance MCUs.
Website: https://www.cypress.com/

Infineon

The giant German semiconductor manufacturer, Infineon is a leading player in the microcontroller(MCUs) segment. Infineon has a lot to offer in MCUs technology. Innovation kept as prime Infineon MCUs are addressing various applications. Infineon, 32-bit-Microcontroller(MCUs) are among them. The 32-bit-Microcontroller(MCUs) from Infineon has special features which makes it an ideal choice for applications offering connectivity, safety and security. Infineon MCUs portfolio includes, The XMC™ family: One MCU platform, The AURIX™ family.
Website: www.infineon.com

Maxim Integrated

Maxim Integrated 32-bit microcontrollers (MCUs) have been enabling to build robust devices in the IoT segment. Focusing on 32-bit microcontroller devices, Maxim Integrated MCUs combine the biggest embedded memories of any MCUs in their class with ultra-efficient power management. Maxim Integrated MCUs performs in an low-power and small footprints with best-in-class security. Maxim MCUs with secure 32-bit microcontrollers integrate advanced cryptography and physical security leverages high-level security.
Website: https://www.maximintegrated.com/

Microchip

Microchip has a leading offering in the Microcontrollers(MCUs)segment. Microchip MCUs meet the demand of the continuous changing electronics. Microchip MCUs portfolio includes scalable 8-, 16- and 32-bit microcontrollers. Microchip comes with intuitive design environments and visual configuration tools. Microchip with its wide offering of MCUs caters varied applications. Its extensive assistance through reference designs and software libraries, Microchip's MCUs becomes the first-choice for customers.

Website: https://www.microchip.com/

NXP

NXP in MCUs offering is no behind as it has innovative and advanced offering catering to various IoT demands. NXP has a comprehensive portfolio in MCUs with extensive software and development environment. NXP's MCU offering pans across broad portfolio of MCUs across our 8-, 16-, and 32-bit platforms. NXP MCUs features leading-edge low-power, analog, control, and communications IP. NXP MCUs combines best of Kinetis and LPC technologies with two decades legacy of industry-leading products.

Website: https://www.nxp.com/

ON Semiconductor

ON Semiconductor offers a wide portfolio of MCUs in their own tailored category. ON Semiconductor offerings expands from 8-bit and 16-bit general purpose and application-specific microcontroller devices. From Ultra-Low Power Microcontroller for RF Applications to 8-bit Microcontroller with Full-Speed USB integrated 32K-byte Flash ROM and 2048-byte RAM are few examples from the gamut of ON Semiconductor MCU offerings.

Website: https://www.onsemi.com/

Panasonic

Panasonic with no shock makes into the leading MCU offerings as the company has a lot to offer in the growing MCU market. From embedded device software and system needs, the Panasonic AM1 (MN101C/MN101E/MN101L) and AM3 (MN103H/MN103S/ MN103L) Series signal a new concept in Microcomputer design. Panasonic MCUs comes in 8-bit and 32-bit models. Panasonic Microcomputers combine high performance with low power consumption. Panasonic MCUs are tailored for a wide range of applications, including high-performance embedded controllers and key devices in multimedia hardware.

Website: *https://na.industrial.panasonic.com/*

Renesas Electronics

Renesas Electronics offers microcontroller(MCUs) with immaculate expandability and scalability allowing customers to make full use of existing resources. Renesas MCUs comes in a wide array of memory and package options. Renesas microcontrollers are fast, highly reliable, low in cost, and deliver eco-friendly performance. Renesas Electronics touts to render the best-in-class and most powerful solutions based on a wide selection of microcontrollers (MCUs). Renesas Electronics MCUs incorporates the most advanced technologies and one can innovate according to the need and market demand.

Website: https://www.renesas.com/

ROHM Semiconductor

ROHM is a company which ones opts when thinking about MCUs. ROHM has an extensive offering the MCU space. ROHM caters the advanced needs of electronics through its MCU offerings. ROHM has High Performance & Ultra Low Power MCU, Ultra Low Operating Voltage & Ultra Low Power MCU, Sensor Hub MCU, ARM-Based MCU. ROHM MCUs also cater the growing market of IoT enhancing the connected world.

Website: https://www.rohm.co.jp/

STMicroelectronics

Catering the embedded application domain, STMicroelectronics is a dominating name in the MCU segment. ST offers a massive microcontroller product portfolio. ST MCUs are robust, low-cost 8-bit MCUs up to 32-bit Arm®-based Cortex®-M microcontrollers which comes with a comprehensive choice of peripherals. The STM32 Microcontroller (MCU) portfolio also features wireless connectivity solutions.

Website: https://www.st.com/

Texas Instruments

TI MCUs are helping develop the autonomous future. TI offers vast 16-bit and 32-bit MCUs. TI MCUs are high-performance, low-power solutions building the next world of IoT. TI portfolio of low-power, high-performance microcontrollers (MCUs) comes in wired and wireless options. TI gives access to a robust development ecosystem that includes LaunchPad™ Development Kits. TI MCUs offer silicon, software and development tools to help designers bring their designs quick in the market.

Website: http://www.ti.com/

S KEERTHIVASAN

II EEE

RTOS (REAL TIME OPERATING SYSTEMS)

A **real-time operating system** (**RTOS**) is an operating system (OS) intended to serve real-time applications that process data as it comes in, typically without buffer delays. Processing time requirements (including any OS delay) are measured in tenths of seconds or shorter increments of time. A real-time system is a time-bound system which has well-defined, fixed time constraints. Processing must be done within the defined constraints or the system will fail. They are either event-driven or time-sharing. Event-driven systems switch between tasks based on their priorities, while time-sharing systems switch the task based on clock interrupts. Most RTOSs use a pre-emptive scheduling algorithm.

Characteristics

A key characteristic of an RTOS is the level of its consistency concerning the amount of time it takes to accept and complete an application's task; the variability is 'jitter'. A 'hard' real-time operating system (Hard RTOS) has less jitter than a 'soft' real-time operating system (Soft RTOS). The late answer is a wrong answer in a hard RTOS while a late answer is acceptable in a soft RTOS. The chief design goal is not high throughput, but rather a guarantee of a soft or hard performance category. An RTOS that can usually or generally meet a deadline is a soft real-time OS, but if it can meet a deadline deterministically it is a hard real-time OS.[2]

An RTOS has an advanced algorithm for scheduling. Scheduler flexibility enables a wider, computer-system orchestration of process priorities, but a real-time OS is more frequently dedicated to a narrow set of applications. Key factors in a real-time OS are minimal interrupt latency and minimal thread switching latency; a real-time OS is valued more for how quickly or how predictably it can respond than for the amount of work it can perform in a given period of time.[3]

Design Philosophies

An RTOS is an operating system in which the time taken to process an input stimulus is less than the time lapsed until the next input stimulus of the same type.

The most common designs are:

- Event-driven – switches tasks only when an event of higher priority needs servicing; called preemptive priority, or priority scheduling.
- Time-sharing – switches tasks on a regular clocked interrupt, and on events; called round robin.

Time sharing designs switch tasks more often than strictly needed, but give smoother multitasking, giving the illusion that a process or user has sole use of a machine.

Early CPU designs needed many cycles to switch tasks during which the CPU could do nothing else useful. Because switching took so long, early OSes tried to minimize wasting CPU time by avoiding unnecessary task switching.

Scheduling

In typical designs, a task has three states:

1. Running (executing on the CPU);
2. Ready (ready to be executed);
3. Blocked (waiting for an event, I/O for example).

Most tasks are blocked or ready most of the time because generally only one task can run at a time per CPU. The number of items in the ready queue can vary greatly, depending on the number of tasks the system needs to perform and the type of scheduler that the system uses. On simpler non-preemptive but still multitasking systems, a task has to give up its time on the CPU to other tasks, which can cause the ready queue to have a greater number of overall tasks in the ready to be executed state (resource starvation).

Usually, the data structure of the ready list in the scheduler is designed to minimize the worst-case length of time spent in the scheduler's critical section, during which preemption is inhibited, and, in some cases, all interrupts are disabled, but the choice of data structure depends also on the maximum number of tasks that can be on the ready list.

If there are never more than a few tasks on the ready list, then a doubly linked list of ready tasks is likely optimal. If the ready list usually contains only a few tasks but occasionally contains more, then the list should be sorted by priority. That way, finding the highest priority task to run does not require iterating through the entire list. Inserting a task then requires walking the ready list until reaching either the end of the list, or a task of lower priority than that of the task being inserted.

Care must be taken not to inhibit preemption during this search. Longer critical sections should be divided into small pieces. If an interrupt occurs that makes a high priority task ready during the insertion of a low priority task, that high priority task can be inserted and run immediately before the low priority task is inserted.

The critical response time, sometimes called the flyback time, is the time it takes to queue a new ready task and restore the state of the highest priority task to running. In a well-designed RTOS, readying a new task will take 3 to 20 instructions per ready-queue entry, and restoration of the highest-priority ready task will take 5 to 30 instructions.

In more advanced systems, real-time tasks share computing resources with many non-real-time tasks, and the ready list can be arbitrarily long. In such systems, a scheduler ready list implemented as a linked list would be inadequate.

Algorithms

Some commonly used RTOS scheduling algorithms are:

- Cooperative scheduling
- Preemptive scheduling
  - Rate-monotonic scheduling
  - Round-robin scheduling
  - Fixed priority pre-emptive scheduling, an implementation of preemptive time slicing
  - Fixed-Priority Scheduling with Deferred Preemption
  - Fixed-Priority Non-preemptive Scheduling
  - Critical section preemptive scheduling
- Earliest Deadline First approach
- Stochastic digraphs with multi-threaded graph traversal

Intertask resource and communication sharing

A multitasking operating system like Unix is poor at real-time tasks. The scheduler gives the highest priority to jobs with the lowest demand on the computer, so there is no way to ensure that a time-critical job will have access to enough resources. Multitasking systems must manage sharing data and hardware resources among multiple tasks. It is usually unsafe for two tasks to access the same specific data or hardware resource simultaneously.[4] There are three common approaches to resolve this problem:

Temporarily masking/disabling interrupt

General-purpose operating systems usually do not allow user programs to mask (disable) interrupts, because the user program could control the CPU for as long as it wishes. Some modern CPUs do not allow user mode code to disable interrupts as such control is considered a key operating system resource. Many embedded systems and RTOSs, however, allow the application itself to run in kernel mode for greater system call efficiency and also to permit the application to have greater control of the operating environment without requiring OS intervention.

On single-processor systems, an application running in kernel mode and masking interrupts is the lowest overhead method to prevent simultaneous access to a shared resource. While interrupts are masked and the current task does not make a blocking OS call, the current task has *exclusive* use of the CPU since no other task or interrupt can take control, so the critical section is protected. When the task exits its critical section, it must unmask interrupts; pending interrupts, if any, will then execute. Temporarily masking interrupts should only be done when the longest path through the critical section is shorter than the desired maximum interrupt latency.

MUKILAN B

II EEE

IMPACT OF COVID-19 ON INDIAN ECONOMY

As per the official data released by the ministry of statistics and program implementation, the Indian economy contracted by 7.3% in the April-June quarter of this fiscal year. This is the worst decline ever observed since the ministry had started compiling GDP stats quarterly in 1996. In 2020, an estimated 10 million migrant workers returned to their native places after the imposition of the lockdown. But what was surprising was the fact that neither the state government nor the central government had any data regarding the migrant workers who lost their jobs and their lives during the lockdown.

The government extended their help to migrant workers who returned to their native places during the second wave of the corona, apart from just setting up a digital-centralized database system. The second wave of Covid-19 has brutally exposed and worsened existing vulnerabilities in the Indian economy. India's $2.9 trillion economy remains shuttered during the lockdown period, except for some essential services and activities. As shops, eateries, factories, transport services, business establishments were shuttered, the lockdown had a devastating impact on slowing down the economy. The informal sectors of the economy have been worst hit by the global epidemic. India's GDP contraction during April-June could well be above 8% if the informal sectors are considered. Private consumption and investments are the two biggest engines of India's economic growth.

All the major sectors of the economy were badly hit except agriculture. The Indian economy was facing headwinds much before the arrival of the second wave. Coupled with the humanitarian crisis and silent treatment of the government, the covid-19 has exposed and worsened existing inequalities in the Indian economy. The contraction of the economy would continue in the next 4 quarters and a recession is inevitable. Everyone agrees that the Indian economy is heading for its full-year contraction. The surveys conducted by the Centre For Monitoring Indian Economy shows a steep rise in unemployment rates, in the range of 7.9% to 12% during the April-June quarter of 2021. The economy is having a knock-on effect with MSMEs shutting their businesses. Millions of jobs have been lost permanently and have dampened consumption. The government should be ready to spend billions of dollars to fight the health crisis and fast-track the economic recovery from the covid-19 instigated recession. The most effective way out of this emergency is that the government should inject billions of dollars into the economy.

The GDP growth had crashed 23.9% in response to the centre's no notice lockdown. India's GDP shrank 7.3% in 2020-21. This was the worst performance of the Indian economy in any year since independence. As of now, India's GDP growth rate is likely to be below 10 per cent.

The Controller General of Accounts Data for the centre's fiscal collection indicates a gross-tax revenue (GTR) of rupees 20 lakh crore and the net tax revenue of rupees 14 lakh crore for 2020-21. The tax revenue growth will be 12 per cent, which would mean the projected gross and the net tax revenues for 2020-21 would be rupees 22.7 lakh crore and 15.8 lakh crore respectively.

This suggests some additional net tax revenues to the centre amounting to rupees 0.35 lakh crores as compared to the budget magnitudes. The main expected shortfall may still be in the non-tax revenues and the non-debt capital receipts. If we look down in the past, the growth rate for the non-tax revenues and non-debt capital receipts have been volatile, but if we add them together, they average to a little lower than 15% during the five years preceding 2020-21.

How have different sectors been affected due to Covid-19?

Hospitality Sector:

As many states have imposed localised lockdowns, the hospitality sector is facing a repeat of 2020. The hospitality sector includes many businesses like restaurants, beds and breakfast, pubs, bars, nightclubs and more. The sector that has contributed to a large portion of India's annual GDP has been hit hard by restrictions and curfews imposed by the states.

Tourism Sector:

The hospitality sector is linked to the tourism sector. The sector that employs millions of Indians started bouncing back after the first wave, but the second wave of covid was back for the devastation! The tourism sector contributes nearly 7% to India's annual GDP.
It comprises hotels, home stays, motels and more. The restrictions due to the second wave have crippled the tourism sector, which was already struggling to recover from the initial loss suffered by the businesses in 2020.
Aviation and Travel sector:
Aviation and other sector establishments faced a massive struggle during the second wave of the pandemic. The larger travel sector is also taking a hit as people are scared to step out of their homes. For airlines and the broader travel sector, its recovery will depend on whether people in future will opt for such services. At present, the outlook for the aviation and broader travel sector does not look good.

Automobile sector:

The automobile sector is expected to remain under pressure in the near term due to the covid-19 situation in India.

Real Estate and Construction sector:

The real estate and construction activities have started facing a disruption during the second wave as a large number of migrant workers have left the urban areas. The situation has not been grave as of 2020 for this sector.

Fiscal Deficit:

The Covid-19 pandemic has not affected our fiscal deficit and disinvestment target much. In this year's union budget, Finance minister Nirmala Sitharaman announced a fiscal deficit target of 6.8% for 2021 to 2022. India's fiscal deficit for 2020-21 zoomed to 9.5% of GDP as against 3.5% projected earlier. Our finance minister has promised to achieve a fiscal deficit of 4.5% of GDP by 2025-26 by increasing the steaming tax revenues through increased tax compliance as well as asset monetization over the years. According to the medium-term fiscal policy statement that the government had presented in February 2020, the fiscal deficit for 2021-22 and 2022-23 was at 3.3% and 3.1% respectively.

The impact of the lockdowns and restrictions:

The extent to which localised lockdowns and restrictions have been imposed in the past have impacted the economic recovery timeliness. There is a scope for sustained fiscal stimulus going throughout the year. To some extent, if credit is made available to businesses at low-interest rates, then monetary stimulus is also possible. The second wave has pushed back India's fragile economic recovery. Rising inequality and strained household balance sheets have constrained the recovery. From growing only 4% in 2019-20 to contracting 7-8% in 2020-21 to staring at another low economic growth recovery in 2021, India has been virtually stopped in all its tracks. Therefore, fiscal policy must lend a generous helping hand to lead vulnerable businesses and households towards economic recovery.

What is the path to recovery?

If the outbreak worsens over time, or if the case numbers are very high, this would elevate the risk to India's economic and fiscal recovery. The Indian economy should resume its recovery once the covid waves recede and the Indian economy will continue to grow at a faster pace than its peers at similar levels of per capita income around the world. On the downside, there will be less vigorous recoveries in the government revenues and severe downside scenarios may entail additional fiscal spending. Commodities and the automobile sector are severely affected by the initial stream of infections and associated lockdown measures. It recovered strongly in the second half of 2021.

The recovery in the global economy has made it unlikely that a sharp price decline like 2020 will happen again. The pent up demand in the automobile sector will likely drive a strong recovery when curbs are relaxed as was seen in 2020.

The second wave of covid-19 has challenged an otherwise strong recovery for Indian Infrastructure. As consumers strive to maximize their utility, they will maintain earning due to regulated returns, fixed tariffs and quick recovery in demand. Airports are most at risk with international traffic recovery likely delayed by another year. This may impede a strong domestic recovery if the government increases the severity and scope of restrictions on mobility. A strong recovery is needed after a crushing 2020.

Downgrades are a warning not to take economic recovery for granted. The slow pace of vaccinations is likely to be a burden on India's economic recovery. The Indian recovery has been vigorous across many sectors particularly in the last quarter of fiscal 2021. Halts to domestic air traffic and subdued international travel have dismantled recovery for airports. The covid wave has hit small and medium-size enterprises particularly hard.

It has delayed recovery in banks' asset quality. Mobility has been down to 50-60% of the normal levels. Therefore, people are staying home more and spending less. Recovery will take hold later this year. India's budding economic recovery throughout March solidified government revenues.

Power Sector: The Indian power sector will generate huge revenues and it would track the recovery of the GDP of India.

Airports: The second wave has threatened India's air recovery traffic. The domestic passenger traffic has decreased by 75% of the pre-covid levels. The traffic recovery in the worst-case scenario could be 10% lower than what is predicted. Weaker traffic hits the cash flows of the airports. There will be a sharp recovery in road traffic after a short disruption. The commercial vehicle traffic will see better resilience as it supports logistics and essential services.

Ports: A modest recovery will be witnessed by import volumes. Fertilizers and containers will increase at a greater pace than crude and coal segments.

Operating cash flows will recover most infrastructure and utilities such as water, sewage, dams and natural gas segments. Credit loss will remain high in the fiscal year 2022 at 2.2% of the total loans before it recovers to 1.8% in 2023. India's strong economic recovery and the steps taken by the central governments and the state government to mitigate the effects of the economic crisis have lessened the burden on the banks. Additionally, banks have raised capitals to strengthen their balance sheets. This will smoothen the hit from covid related losses. The weak consumption accompanied by large scale job losses and the salary cuts in the formal sector may hit the banking sector's loans and 'credit card' loans. This is accompanied by lower recovery rates in the bank's non-performing assets. That could lead to a rise in weaker loans.

If we have to move towards sustained and real economic growth against v-shaped, k-shaped or w-shaped paths, the states and the centre need to work towards a cooperative strategy through their “cooperative federalism” scheme to increase the vaccination drive.

Last year, the government chose life over livelihoods. By choosing to protect the former, the covid 1.0 was delayed in September and its intensity was much lower than predicted. By January 2021, the government had declared victory over covid-19. The first threat to economic recovery is the regional cases which are resulting in further extension of lockdowns and hence they are limiting the pace of economic recovery. The second threat is the vaccination rates arising from the vaccine supply. Without inoculating a major portion of our labor force, there is a threat that viruses will disrupt our real economy. It is apparent from the worldwide cases of Covid-19.

NITHYANANDH B

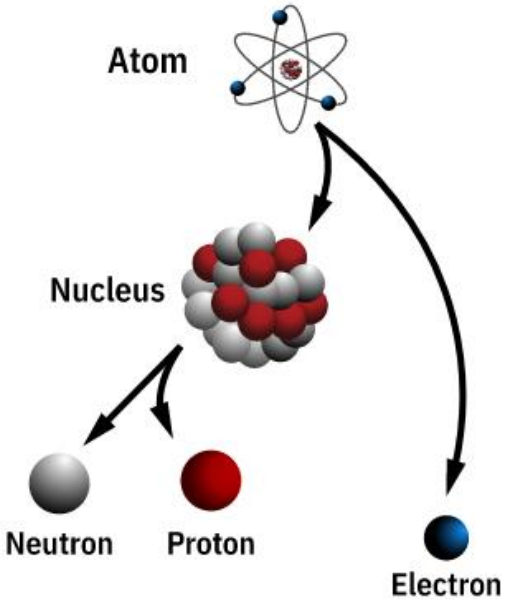
I EEE

INTRODUCTION TO ATOM THEORY

Atomic energy is the source of power for both nuclear reactors and nuclear weapons. This energy comes from the splitting (fission) or joining (fusion) of atoms. To understand the source of this energy, one must first understand the atom.

Components of the atom

An atom is the smallest particle of an element that has the properties characterizing that element. Knowledge about the nature of the atom grew slowly until the early 1900s. One of the first breakthroughs was achieved by Sir Ernest Rutherford in 1911. He established that the mass of the atom is concentrated in its nucleus. He also proposed that the nucleus has a positive charge and is surrounded by negatively charged electrons, which had been discovered in 1897 by J. J. Thomson.



This theory of atomic structure was complemented by Niels Bohr in 1913. The Bohr atom placed the electrons in definite shells, or quantum levels. Understanding the atom continues to be a focus for many scientists.

Atomic Structure

An atom is a complex arrangement of negatively charged electrons arranged in defined shells about a positively charged nucleus. This nucleus contains most of the atom's mass and is composed of protons and neutrons (except for common hydrogen which has only one proton). All atoms are roughly the same size. A convenient unit of length for measuring atomic sizes is the angstrom (Å), which is defined as 1×10^{-10} meters. The diameter of an atom is approximately 2-3 Å.

In 1897, J. J. Thomson discovered the existence of the electron, marking the beginning of modern atomic physics. The negatively charged electrons follow a random pattern within defined energy shells around the nucleus. Most properties of atoms are based on the number and arrangement of their electrons. The mass of an electron is 9.1×10^{-31} kilograms.

One of the two types of particles found in the nucleus is the proton. The existence of a positively charged particle, a proton, in the nucleus was proved by Sir Ernest Rutherford in 1919. The proton's charge is equal but opposite to the negative charge of the electron. The number of protons in the nucleus of an atom determines what kind of chemical element it is. A proton has a mass of 1.67×10^{-27} kilograms.

The neutron is the other type of particle found in the nucleus. It was discovered by a British physicist, Sir James Chadwick. The neutron carries no electrical charge and has the same mass as the proton. With a lack of electrical charge, the neutron is not repelled by the cloud of electrons or by the nucleus, making it a useful tool for probing the structure of the atom.

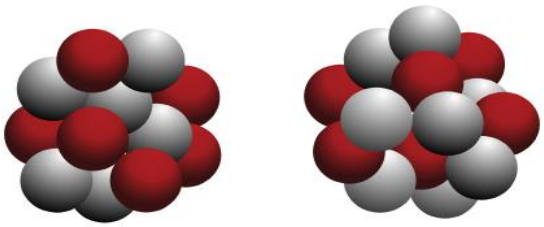
Even the individual protons and neutrons have internal structure, called quarks. Six types of quarks exist. These subatomic particles cannot be freed and studied in isolation. Current research continues into the structure of the atom.

Atomic Isotopes

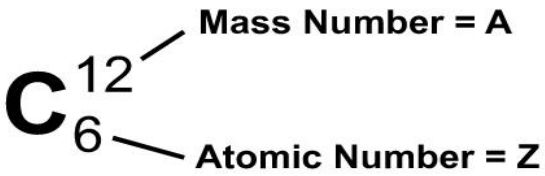
A major characteristic of an atom is its atomic number, which is defined as the number of protons. The chemical properties of an atom are determined by its atomic number and is denoted by the symbol Z. The total number of nucleons (protons and neutrons) in an atom is the atomic mass number. This value is denoted by the symbol A. The number of neutrons in an atom is denoted by N. Thus the mass of an atom is A = N + Z.

Nuclear Isotopes

Atoms with the same atomic number but with different atomic masses are called isotopes. Isotopes have identical chemical properties, yet have very different nuclear properties. For example, there are three isotopes of hydrogen. Two of these isotopes are stable, (not radioactive), but tritium (one proton and two neutrons) is unstable. Most elements have stable isotopes. Radioactive isotopes can also be created for many elements.



C_6^{12} C_6^{14}



Einstein's Equation: $E = mc^2$

The mass of the nucleus is about 1 percent smaller than the mass of its individual protons and neutrons. This difference is called the mass defect. The mass defect arises from the energy released when the nucleons (protons and neutrons) bind together to form the nucleus. This energy is called the binding energy. The binding energy determines which nuclei are stable and how much energy is released in a nuclear reaction. Very heavy nuclei and very light nuclei have low binding energies. This implies that a heavy nucleus will release energy when it splits apart (fission), and two light nuclei will release energy when they join (fusion).

The hydrogen 2 nucleus, for example, composed of one proton and one neutron, can be separated completely by supplying 2.23 million electron volts (MeV) of energy. Conversely, when a slowly moving neutron and proton combine to form a hydrogen 2 nucleus, 2.23 MeV are liberated.

The mass defect and binding energy are related by Albert Einstein's formula, $E = mc^2$. In 1905, Einstein developed the special theory of relativity. One of the implications of this theory was that matter and energy are interchangeable with one another. This equation states, a mass (m) can be converted into an amount of energy (E), where c is the speed of light. Because the speed of light is a large number and thus c squared is huge, a small amount of matter can be converted into a tremendous amount of energy. This equation is the key to the power of nuclear weapons and nuclear reactors.

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