VOL 6 | ISSUE 1 | JANUARY 2021

MECHZINE

GET TO KNOW THE WORLD !

4D Printing
The Technology of the Future

A STUDENT INITIATIVE TECHNICAL MAGAZINE

VOL 6 | ISSUE 1 | JANUARY 2021

CONTENTS :

Contact Information

Mail us at
editor.mechzine@gmail.com

Visit us at
www.facebook.com/rvrmechzine
&
http://me.rvrjcce.ac.in/dtm.php

Alumni Article

PUT CUSTOMER FIRST

- Praveen Kumar Dasari

What does 'Putting the Customer First' mean?

Putting the customer first, in simple terms, means that a business puts the needs and requirements of a customer ahead of anything and everything else. Such a business strives to build healthy relationships with their consumers by identifying their needs and providing the best-possible experience to its customers. These organizations pay special attention and emphasis on putting the customer's priorities ahead of anything else, and end up providing a personalized customer experience. They also acknowledge and thank their customers for their business from time to time, through various different methods and avenues.

Organizations that 'put the customer first' are commonly referred to as customer-oriented, customer-driven or customer-focused businesses. They are oriented towards serving the client's needs, and measure customer-satisfaction levels in order to determine the success of their business. Companies such as Apple, Samsung, Google and GE are just a few examples of customer-centric business models. These businesses strive to identify what their customers want, and do their utmost to fulfill their needs, wants and requirements with the products and services that they offer. These businesses also excel in customer-care and after-sales service. For these organizations, being putting the customers first isn't a strategy, it's a culture!

Why is it essential to put the customer first?

For one essential reason: in order to be successful, an organization needs to continuously change and adapt to their customer's ever-changing needs and wants. If they fail to do so, they will lose out to their competitors who are better at it, simple as that. Therefore, putting the customer first is essential for customer-retention and customer-loyalty. Why do people buy an iPhone every single year? Why does the iPhone – and Apple as a company – continue to dominate customer-satisfaction results year after year?

Despite the emergence of strong competition, arguably better and stronger phones with superior operating systems, and companies such as Samsung spending billions into marketing? For one simple reason: Apple knows what people want, and effectively satisfies their wants through its products. Which is why it has been able to build a strong army of loyal customers who are more than happy to pay for an iPhone or an iPad every single year!

"Strive for perfection in everything. Take the best that exists and make it better. If it doesn't exist, create it. Accept nothing nearly right or good enough."

Sir Henry Royce, co-founder of Rolls Royce

Student Article

4D PRINTING - THE TECHNOLOGY OF THE FUTURE

- N. Anil Kumar, Y18ME09

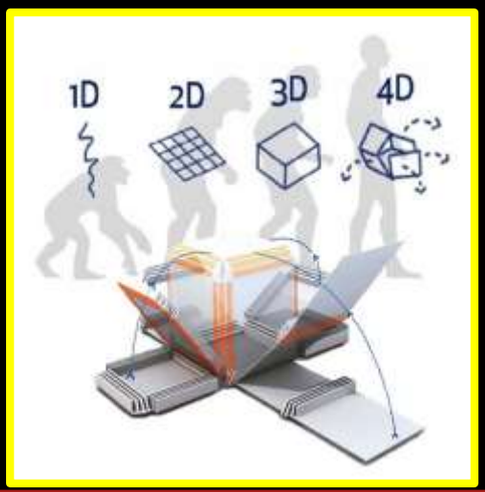
The introduction of the fourth dimension to the 3D printing technology is termed as “4D Printing”. With this new dimension, 3D printed objects possess the capability to change its shape by itself over the influence of external stimuli, such as light, heat, electricity, magnetic field, etc. By integrating the dimension of time, printed objects change their shape dynamically based on the needs and demands of the situation, without any electromechanical parts or moving parts.

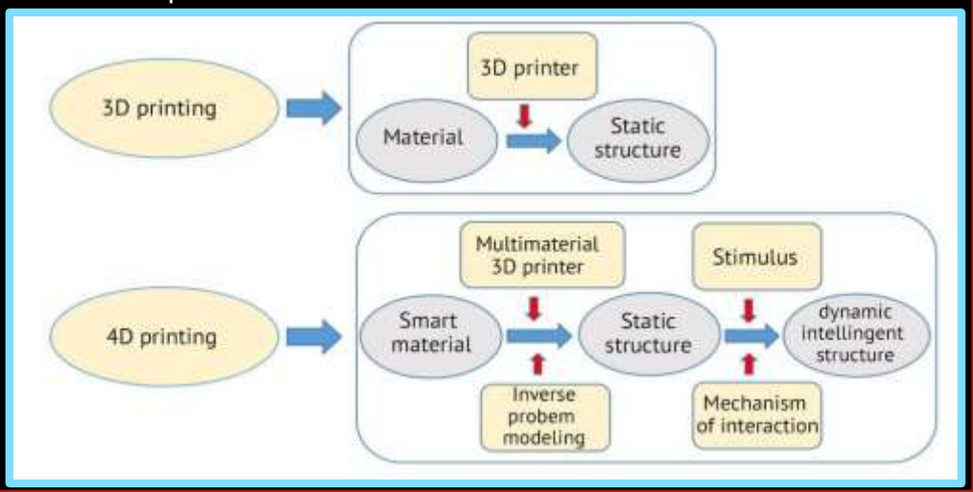
This shape-changing phenomenon of 3D printed objects is based on the material’s ability to transform over time in response to specific stimuli, and it does not require human intervention to aid the process.

Emergence of 4D Printing from 3D Printing:

3D printing, an additive manufacturing technique, is considered as one of the most disruptive innovations in the field of modern manufacturing. It has completely transformed the way parts/components and equipment are manufactured in the industry, along with their design and development. 3D printing enables manufacturers and researchers to develop complex shapes and structures, which were earlier considered impossible with traditional fabrication methods. 3D printing technology has witnessed continuous advancements over the last 3 decades and has evolved drastically. Despite its ability to create complex, bio-inspired, multi-material designs, 3D printing is not yet ready to be adopted in large-scale manufacturing. The increasing need for flexible objects in various applications, such as self-folding packaging, adaptive wind turbines, etc., has fueled the emergence of 4D printing. Researchers are currently looking ahead of conventional 3D printing, which fabricates structures from a single material, to develop a meta-material structure.

The meta-material structure is generated by combining different materials that provide superimposed structural responses when activated by external stimuli. The congruent printing of different materials will form material anisotropy, which enables the object to change the structure by bending, elongating, twisting, and corrugating along its axes. Researchers are further working on expanding these structural changes to create lockers, lifters, micro tubes, soft robots, toys, etc. This capability of objects to transform their structure over time by using the behavior of different materials is termed as 4D printing.





2020's top 10 emerging technologies

1. Microneedles for painless injections and tests

These tiny needles, at no more than the depth of a sheet of paper and the width of a human hair, could bring us pain-free injections and blood testing. "Microneedles" penetrate the skin without troubling underlying nerve endings, and can be attached to syringes or patches, or even mixed into creams. They could allow blood tests to be done at home and sent to the lab or analyzed on the spot. And because their use doesn't require expensive equipment or high levels of training, testing and treatment could be delivered in under-served areas – making care more accessible.

2. Sun-powered chemistry

Making many of the chemicals we rely on requires fossil fuels. But a new approach holds the promise of reducing the sector's emissions by using sunlight to convert waste carbon dioxide into useful chemicals. Recent developments in the sunlight-activated catalysts needed for this process are a step towards creating "solar" refineries to produce useful compounds from the waste gas, which could be turned into everything from medicines and detergents to fertilizers and textiles.

3. Virtual patients

If the goal of swapping humans for simulations to make clinical trials faster and safer sounds simple, the science behind it is anything but. Data taken from high-res images of a human organ is fed into a complex mathematical model of the mechanisms that control that organ's function. Then, computer algorithms resolve the resulting equations and generate a virtual organ that behaves like the real thing. Such virtual organs or body systems could replace people in the initial assessments of drugs and treatments, making the process quicker, safer and less expensive.

4. Spatial computing

Spatial computing is the next step in the bringing together of physical and digital worlds we're already seeing with virtual-reality and augmented-reality apps. As with VR and AR, it digitizes objects that connect via the cloud, allows sensors and motors to react to one another and creates a digital representation of the real world. But it goes even further, adding spatial mapping that lets a computer "coordinator" track and control the movements and interactions of objects as a person moves through the digital or physical world. This technology will bring new developments in how people and machines interact, in industry, healthcare, transportation and the home.

5. Digital medicine

Digital medicine won't replace doctors any time soon, but apps that monitor conditions or administer therapies could enhance their care and support patients with limited access to health services. Many smart watches can already detect if their wearer has an irregular heartbeat, and similar tools are being worked on that could help with breathing disorders, depression, Alzheimer's and more. Pills containing sensors are even being developed – these send data to apps to help detect things like body temperature, stomach bleeds and cancerous DNA.

6. Electric aviation

Electric propulsion would allow air travel to cut out carbon emissions, slash fuel costs and bring about big noise reductions. A host of organizations from Airbus to NASA are working on technology in this area, and while long-haul electric flights may still be some way off, and there are cost and regulatory hurdles, there is significant investment in the space. There are about 170 electric plane projects in development, mainly for private, corporate and commuter travel – but Airbus says it could have 100-passenger electric planes ready for take-off in 2030.

7. Lower-carbon cement

Today, 4 billion tonnes of cement – a key component of concrete – are produced every year, in a process that requires the burning of fossil fuels. This accounts for around 8% of global CO2 emissions. As urbanization increases over the next 30 years, this figure is set to rise to 5 billion tonnes. Researchers and start-ups are working on lower-carbon approaches, including tweaking the balance of ingredients used in the process, employing carbon capture and storage technology to remove emissions, and taking cement out of concrete altogether.

8. Quantum sensing

Imagine self-driving cars that can "see" around corners, or portable scanners that can monitor a person's brain activity. Quantum sensing could make these things and much more a reality. Quantum sensors operate with extreme levels of precision by exploiting the quantum nature of matter – for example, using the difference between electrons in different energy states as a base unit. Most of these systems are complex and expensive, but smaller, more affordable examples are being developed that could open up new uses.

9. Green hydrogen

When hydrogen burns, the only by-product is water – and when it's produced through electrolysis using renewable energy it becomes "green". Earlier this year it was predicted green hydrogen will become a $12 trillion market by 2050. Why? Because it could have a key role in the energy transition by helping decarbonize sectors – like shipping and manufacturing – that are harder to electrify because they require high-energy fuel.

10. Whole-genome synthesis

Improvements in the technology needed to design genetic sequences that are then introduced into microbes are making it possible to print ever-larger amounts of genetic material and alter genomes more extensively. This can give insights into how viruses spread or help in producing vaccines and other treatments. In the future, it could help sustainably produce chemicals, fuels or construction materials from biomass or waste gases. And it could even allow scientists to design pathogen-resistant plants, or us to write our own genome – opening the door to possible misuse, of course, but also to cures for genetic diseases.

Every four years countries from all around the globe bring their top athletes from all different sports to compete in the Olympic Games. These athletes spend their entire lives and give up so much to get to the level to be an Olympian. The Olympic Games have been around for many years, but have you ever wondered how the first ones came about? In the year of 776 BC the first staged Olympics were held in Olympia, Greece. They did not bring nearly the audience that the games bring now, and in fact, those were the last Olympic Games that were held until 1896. The Olympic Games in 1896 were the first International Olympic Games, and included 9 sports and 43 events. Over the years these games have grown into a huge event. There are now 35 different sports and over 400 events in the Olympic Games. The first Olympic Games in 776 BC had only the town watching, and the 2016 Olympics Games held in Rio de Janeiro had 3.2 Billion watchers. The games have developed into something that people look forward to watching every two or four years. The Winter Olympics are held every two years, and the summer Olympics are held every four years. In the 2016 Olympic Games the most watched events were gymnastics, swimming, tack and field. These sports have been the most watched for four Olympic Games in a row. With old and new athletes competing in the games, many people are eager to see if this will continue for this year's Games. This year the Games will be even more special for Athletes and watchers due to the fact that the Games couldn't be held last summer due to the Coronavirus. These athletes had to wait another year, but they trained and worked hard to get to where they are today. All of the athletes for this year's Games are excited and eager to face their competition. So, who's ready to tune into their televisions to watch the Olympic Games from 23 July 2021 ?

Faculty Article

OPTIMIZATION & RELIABILITY

"Its Significance as a separate introductory course for undergraduate students of various Engineering disciplines". - Dr.G.Chaitanya, Associate Prof.

Engineering graduates enter into various industrial sectors after graduating from their respective domains of Engineering. The undergraduate Engineering design course in most of the institutions (bearing few) across length and breadth of the nation is formulated considering only the functional and safety aspects of components, sub-assemblies and assemblies. In today's highly competitive and cost conscious industrial sectors across the globe, every industry irrespective of their field of operation (Mechanical, IT, Electrical, Chemical, Civil etc) is constantly trying to optimize (minimize) their production cost and production lead times. The knowledge of development of various mathematical models and their optimization procedures is thus very important for designers and Engineers to get a quantifiable estimate of reduction in production cost, production down times, Increment in net profits etc. So, for Engineering graduates it's important to have good conceptual understanding and application ability to model and optimize Engineering designs to meet various criteria (Minimization of Structural weight, Maximization of critical buckling stress etc). Also, they should acquire necessary skills to program and solve various optimization models by the time they graduate. This attribute gives the students an edge over others to acquire jobs in various industrial sectors.

As mentioned above, design optimization is the process of determining the best possible set of design variables that gives optimum (maximum or minimum) value to the objective function satisfying a set of constraints and variable bounds. The general mathematical model for a constrained optimization problem formulated is as shown below:

$$\begin{aligned} &\min / \max f(\mathbf{x}) \\ \text{subject to} \quad &g_i(\mathbf{x}) = c_i \quad \text{for } i = 1, \ldots, n \quad \text{Equality constraints} \\ &h_j(\mathbf{x}) \geq d_j \quad \text{for } j = 1, \ldots, m \quad \text{Inequality constraints} \end{aligned}$$

where $g_i(\mathbf{x}) = c_i$ for $i = 1, \ldots, n$ and $h_j(\mathbf{x}) \geq d_j$ for $j = 1, \ldots, m$

Based on the physics of the problem and the experimental data available, the objective function or constraints or both can be linear or nonlinear. Here f(X) denotes the objective function that is to be optimized and X is the design vector with asset of design variables. The design variables x1, x2, x3….etc are sometimes governed by lower and upper limits known as bounds. For example, thickness (x1) of a specimen should be in the range of 15mm to 45mm to comply with assembly requirements. It is represented as: 15<=x1<=45

g(X) and h(X) denote the equality and inequality constraints. As an example, if the safe stress limit for a specimen is 280 MPa, the designers and engineers model the induced stress in terms of design variables as an inequality constraint with maximum value equal to the safe limit. Various conventional and metaheuristic optimization procedures are available to solve the closed form mathematical models of optimization. Some of them are Newton-Raphson approach, Sequential quadratic programming approach, Gauss-Seidal approach, Genetic Algorithm, Particle swarm algorithm, Simulated annealing. Etc. The choice of optimization algorithm depends on type of the optimization model, whether global or local optimum is needed. Etc.

The optimization models discussed above are all deterministic models which do not take into account various uncertainties that arise in real life situations. Uncertainties due to various factors like human error, inherent material defects. Etc. are bound to arise in real life. For example the magnitude / direction of external force or load acting on a component, the yield strength of all of thousands of samples tested may not have a deterministic value. Under such conditions modelling the constraints as deterministic constraints may lead to failure of components / structures. Hence determining the reliability of structure, machine, process under such uncertain circumstances is very important.

Reliability is the probability that the structure / component / process. Etc will deliver its intended function under a given set of conditions for a stipulated period of time. To get a quantitative estimate of reliability of structural forces induced, material strengths. Etc for a large group of components, assemblies being tested, various statistical distribution functions like normal, gamma, Weibull etc, various sampling procedures like Monte Carlo simulation, Importance sampling and various reliability based design approaches like First order reliability method, Second order reliability method, Reliability index estimation approaches are put into use. In recent times new methods are also developed to estimate reliability of engineering data that does not conform to any particular statistical distribution. Many mathematical models combining reliability and optimization of engineering processes / structures are developed recently. These approaches are generally called as reliability based design optimization models. Hence it is important for engineering graduates to gain mastery over this course in tandem with principles of optimization.

Therefore, it is high time for Engineering institutions to recognize the need and introduce a separate course on OPTIMIZATION AND RELIABILITY in their undergraduate curriculum.

Faculty Article

PRECISION AGRICULTURE

- Dr. Reddy Srinivasulu, Asst. Professor

Agriculture is the backbone of the Indian economy over 60% of livelihoods depends on farming as their source of income. Identifying particular need according to farming land design and management, analyzing suitability of crop and finding out the most appropriate and best solution, using internet of things, cloud computing, GPS, artificial intelligence and robotics is somehow called as precision agriculture. Conventional farming practices are area-centric. All the farmers in particular farm field follow the same procedures with respect to sowing, nourishing, irrigation and harvesting period, causes overuse of resources and uncontrolled waste production. Precision farming focusing on reducing the production cost and wastage, as tailored needs of each farming land catered to. Precision farming concentrates on data collection, and analysis of farming lands using sensors, drones and robots. Now a day's farmers felt unhappy due to losses occurred in their crop with natural calamities and unpredictable changes weather conditions. Precision agriculture is the most recent innovation technology based on sustainable agriculture and healthy food production and it consists of profitability and increasing production, economic efficiency and the reduction of side effects on the environment. In this view, climate-smart agriculture is necessary for achieving this goal; it is possible only by implementing artificial intelligence. AI bots can yield at a high quantity and faster speed than human labor working in the agricultural farm. This paper throws the scope on how the use of artificial intelligence & robotics (AI &R) technology can be fueled the result of agricultural industries.

Fig: Ag-bot that automate business of growing food

Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and analysis tools. PA is a new concept adopted throughout the world to increase production, reduce labor time, and ensure the effective management of fertilizers and irrigation processes. It uses a large amount of data and information to improve the use of agricultural resources, yields, and the quality of crops. PA is an advanced innovation and optimized field level management strategy used in agriculture that aims to improve the productivity of resources on agriculture fields. Thus PA is a new advanced method in which farmers provide optimized inputs such as water and fertilizer to enhance productivity, quality, and yield. It requires a huge amount of information about the crop condition or crop health in the growing season at high spatial resolution. Independently of the data source, the most crucial objective of PA is to provide support to farmers in managing their business.

Current available technology in PA

- ✓ **Smart Phones**
- ✓ **Robots**
- ✓ **Drones**
- ✓ **Remote Sensing**
- ✓ **GIS**
- ✓ **GPS**
- ✓ **Image Processing**
- ✓ **Internet Of Things**
- ✓ **Intelligent Irrigation**
- ✓ **Sensors**
- ✓ **Sprinklers**

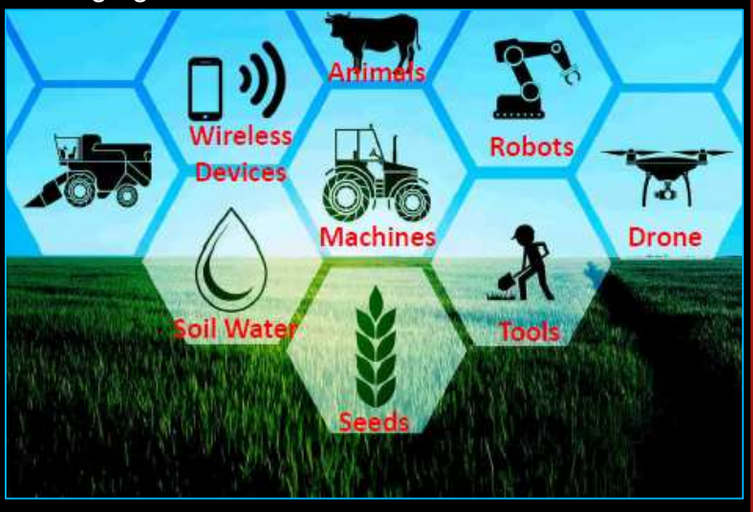


Fig: Outline of technology needs in P.A

Guide to your world of robotics: COBOTS !

WHY COBOTS?

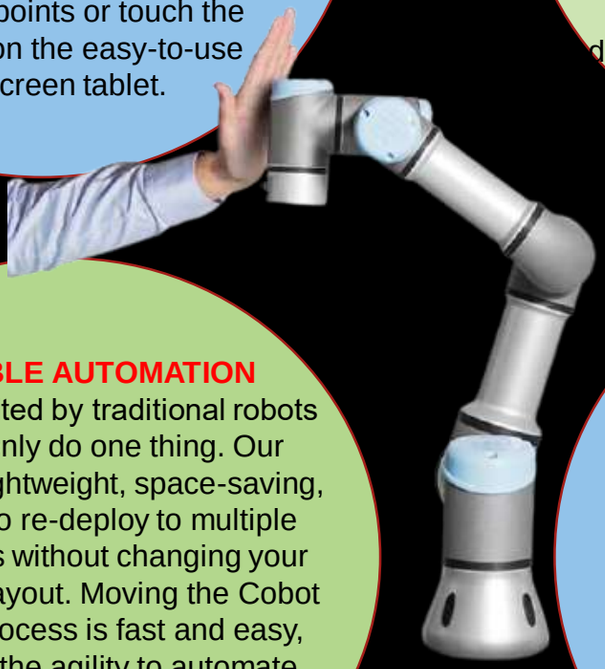
Cobots are Collaborative robots that are cost-effective, safe, and flexible to deploy. Collaborative robots or Cobots - are making automation easier than ever, even for small and mid-sized companies around the world. Cobots are designed to share a workspace with humans, making automation easier than ever before for businesses of all sizes. All of these benefits have made our Cobots a game-changer for a wide variety of applications.

EASY PROGRAMMING

Cobots are designed to be far more straightforward than traditional industrial robots. Free your employees from routine work and let them become robot operators with more time for the most important tasks. With intuitive, 3D visualization you simply move the robot arm to desired waypoints or touch the arrow keys on the easy-to-use touchscreen tablet.

FAST SETUP

Universal Robots has revolutionized Cobot set-up, significantly reducing deployment time. Many common Cobot processes can be programmed and operated after free online essential training. Instructor-led online or in-class modules are available for more advanced tasks. Want to realize the full benefits of automation more quickly? Expert advice is available from distributors, certified training partners and systems integrators



FLEXIBLE AUTOMATION

Don’t be limited by traditional robots that can only do one thing. Our robots are lightweight, space-saving, and easy to re-deploy to multiple applications without changing your production layout. Moving the Cobot to a new process is fast and easy, giving you the agility to automate even small batch runs and frequent line change-overs.

COLLABORATIVE AND SAFE

Give dirty, dangerous, and dull jobs to Cobots to reduce repetitive strain and accidental injuries to humans. 80% of the thousands of our robots worldwide operate with no safety guarding (after risk assessment). The safety system in Cobots is approved and certified.

career

The best brains of the nation
may
be found on the
last benches of the classroom.
-APJ Abdul Kalam

MECHANICAL ENGINEERING

Opportunities

- **Job opportunities**
  - **Government**
    - **State**
      - **Core**
        - AP Genco
        - Dr NTTPS
        - Dockyard's
        - Vizag steel plant
        - Civil Services
        - Many other opportunities
      - **Other**
        - APPSC
        - Groups
        - IT dept.
        - CRDA
    - **Central**
      - **Core**
        - UPSC (IES)
        - NTPC
        - SAIL
        - HAL
        - HPCL
        - NHPC
        - BHEL
        - BDL
        - NPCIL
        - NHDC
        - BARC
        - RRB
        - PGCIL
        - IOCL
        - GAIL
        - EIL
        - Navy
        - NFC
        - BEML
        - DRDO
        - ECIL
        - ONGC
        - BPCL
        - NALCO
        - CIL
        - ISRO
        - TIFR
        - NLC
        - BEL
        - NMDC
        - RailTel
        - RITES
        - Mazagon Dock
        - SSC
        - Many other opportunities
      - **Other**
        - UPSC → IAS, IPS, IFS
        - IB&CBI
        - Other state jobs
        - BPO's in MNC's
        - LIC
        - BANKING → Central level → IBPS & RBI, Other; State level → All state level banks
        - AAI
        - DAE
        - Metro rail
        - MNC's
          - TCS
          - Infosys
          - HCL Tech
          - Wipro
          - Tech Mahindra
          - Oracle
          - Mindtree
          - Mphasis
          - Hexaware
          - Tata Elxsi
          - 3i Infotech
          - Aditi Tech
          - Birla soft
          - C-DAC
          - CTS
          - Honeywell
          - HSBC
          - IGATE
          - L&T Infotech
          - Microsoft
          - IBM
          - Polaris
          - Samsung
          - CMC
          - Reliance
          - GMR group
          - Many other companies
  - **Private**
    - Hyundai
    - Tata Motors
    - Tata Steel
    - CaterPillar
    - Simens
    - L&T
    - Reliance
    - Adani Groups
- **Entrepreneurship**
- **Higher education**
  - **ICET/ CAT/ XAT/ MAT** → **MBA**
  - **GATE/ PGECET**
    - **Jobs**
      - NTPC
      - SAIL
      - HPCL
      - BHEL
      - PGCIL
      - IOCL
      - GAIL
      - ECIL
      - ONGC
      - NALCO
      - DAE
      - Many other opportunities
    - **Post Grad.**
      - Design Engg
      - Thermal Engineering
      - Metallurgy
      - Adv Manufacturing
      - Robotics
      - CAD / CAM
      - Machine Design
      - Industrial Engineering
      - Automobile Engg
      - Industrial Safety Engg
  - **UGC NET/ CSIR NET/ SLET (JRF)**
    - **Ph.D**
      - **Post Doc.**
        - **Teaching jobs** (IIT's, NIT's, IIIT's, Central Univ., State Univ., Private Univ.,)
  - **GRE/ TOEFL/ IELTS/ PTE/ GMAT/ SAT/**

Prospects of Mechanical Engineering

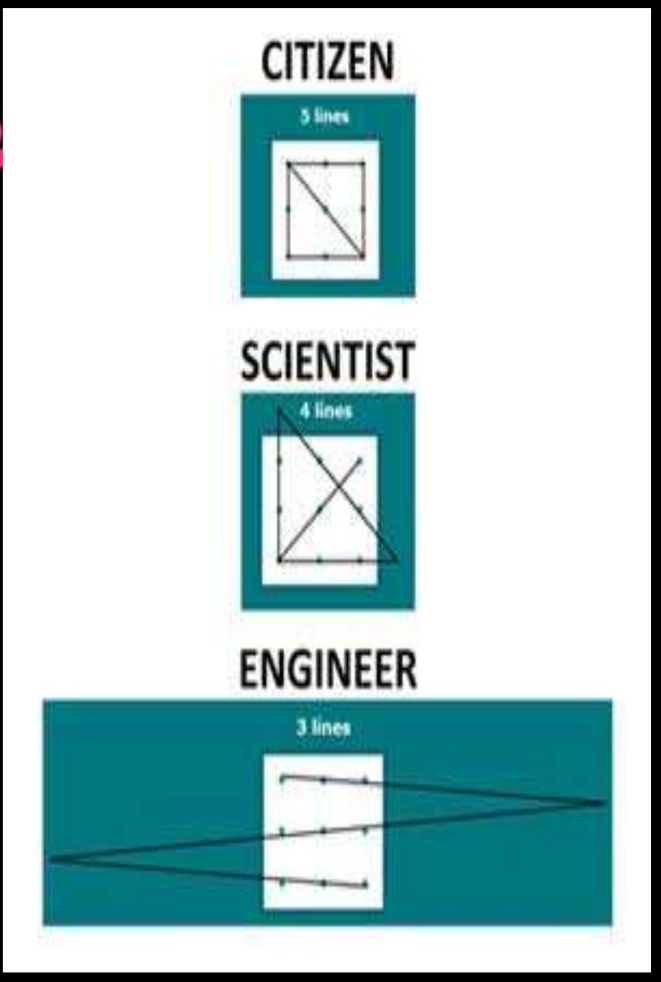
Different Worldviews

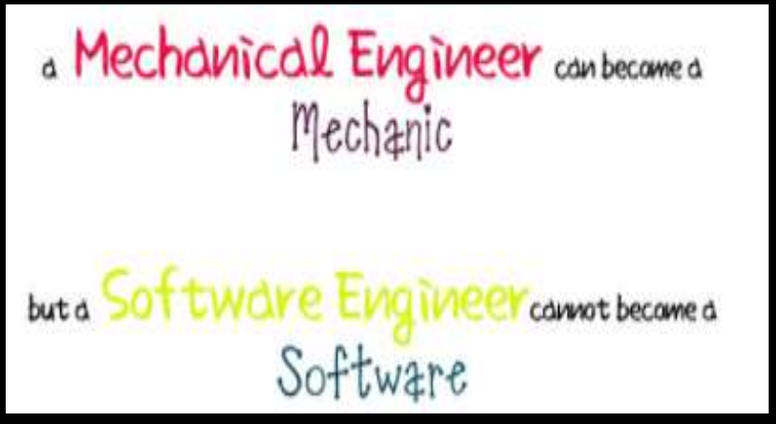
To an optimist, the glass is half full.
To a pessimist, the glass is half empty.
To an engineer, the glass has a Factor of Safety of 2.0

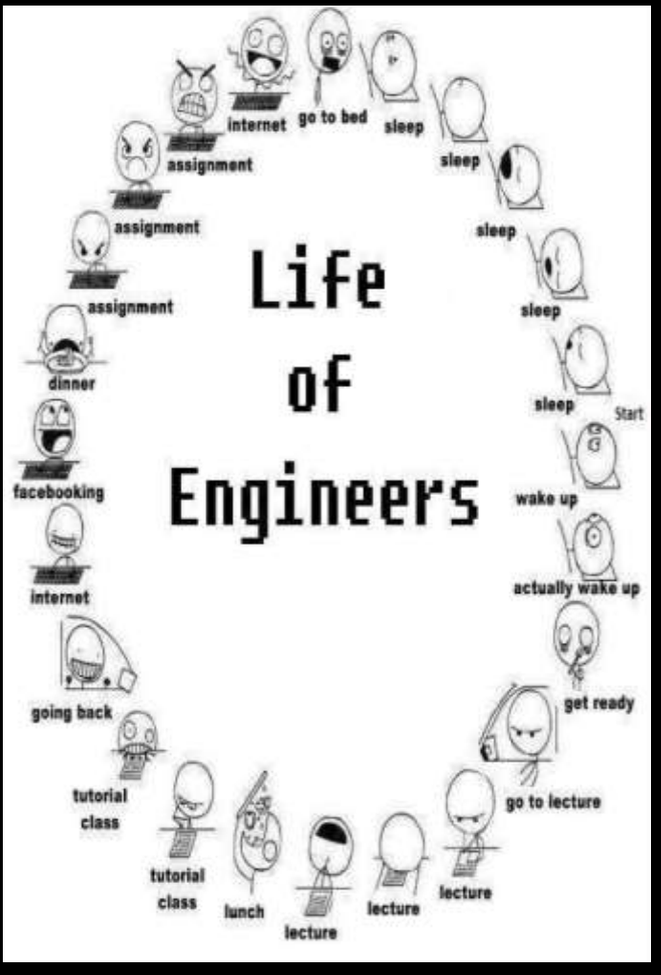
Fun Zone

The value of an engineer

There was an engineer who had an exceptional gift for fixing all things mechanical. After serving his company loyally for over 30 years, he retired. Several years later the company contacted him regarding a seemingly impossible problem it was having with one of its multimillion-dollar machines. He spent a day studying the huge machine. At the end of the day, he marked a small “x” in chalk on a particular component of the machine and proudly stated, “This is where your problem is.” The part was replaced and the machine worked perfectly again. The company received a bill for $50,000 from the engineer for his service. They demanded an itemized accounting of his charges. The engineer responded with the following: “Chalk: $1. Knowing where to put it: $49,999.”







Department of Mechanical Engineering
R. V. R. & J. C.
COLLEGE OF ENGINEERING
(AUTONOMOUS)
Chandramoulipuram
Chowdavaram
Guntur-522019
Andhra Pradesh