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Interdisciplinary Integration of Life Sciences and Engineering: Innovations in Biotechnology, Instrumentation, and Molecular Systems

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Abstract: *The convergence of life sciences and engineering has led to groundbreaking innovations that impact healthcare, agriculture, environmental sustainability, and biotechnology. Life science for engineers is an interdisciplinary domain that combines biological systems with engineering methodologies to analyze, model, and manipulate living organisms at various scales—from molecular biology to whole-body systems. This evolving field encompasses diverse areas such as anatomy, physiology, food technology, biochemistry, molecular genetics, pharmacology, and computational biology. With the advancement of recombinant DNA technology, genetic engineering, bioinstrumentation, and nano-biotechnology, life science engineering plays a crucial role in the development of new medical devices, biosensors, imaging systems, and targeted drug delivery systems. Furthermore, the integration of computational models and artificial intelligence in biological research enhances precision in diagnostics, gene editing, and cellular modeling. This interdisciplinary synergy not only expands the scope of problem-solving in engineering but also offers sustainable solutions to real-world challenges in health and environmental systems.*
Keywords:- *Life Science, Biotechnology, Instrumentation, Imaging, Genes.*

I. Introduction

Life science engineering is an interdisciplinary field that applies engineering principles to understand and manipulate biological systems. All living organisms can be interpreted as intricate engineering systems involving complex mechanisms such as fluid and gas exchange, thermoregulation, biochemical processing, and signal transduction. This field bridges biology with traditional branches of engineering—mechanical, electrical, chemical, and computer science—to develop tools, technologies, and processes that address biological challenges.Bioengineering, at its core, merges the knowledge of life sciences with physical sciences and advanced engineering practices to design systems that improve human health, agriculture, and environmental monitoring. For example, biophysics encompasses subfields such as biomechanics, biophotonics, bioelectronics, and biosensors—all of which help engineers design advanced prosthetics, non-invasive imaging systems, and smart healthcare monitoring devices.Computational biology and bioinformatics are now integral to storing, analyzing, and modeling biological data, especially in the post-genomic era. These disciplines utilize machine learning and AI-driven algorithms to interpret genetic sequences, simulate cellular behavior, and predict disease outcomes.Nanoscale engineering or nanobiotechnology has revolutionized gene and drug delivery systems, allowing for precise targeting at the molecular level. Nanoparticles and nano-carriers are employed in bioimaging, diagnostics, and therapeutic applications, reducing side effects and enhancing treatment efficacy.Thus, life science for engineers is not merely a fusion of disciplines but a transformative approach to solving contemporary challenges using biological insights and engineering innovation. It opens pathways for novel research, product development, and sustainable technologies in sectors ranging from medicine to environmental conservation.

BIOMEDICAL ENGINEERING:

Biomedical engineering or scientific engineering is the software of engineering ideas and layoutideas to medication and biology for healthcare purposes.This discipline is concerned with developing and improving of living health through or by introducing new devices, system, algorithms drugs and medicines. With the clear knowledge on the anatomic and physiologic functions along with certain instrumentational facts and ideas, it is possible to come up with artificial limbs and organs.

Bio-molecular engineering, a divisional branch of biomedical engineering includes the useful manipulation of cells and the organic molecules they compriseand are capable to troubleshoot specific problem and solve. Similarly, cellular engineering is concerned with genetic engineering, protein engineering, DNA microarray fabrication, biosensors and tissue engineering.

PRINCIPLE:

It is a combination of principles like

- Electricals and electronics [Bioamplifers]
- Mechanical[artificial limbs/organs; prostheses]
- Physical[diagnosing images; therapeutic devices]
- Chemical [Chemical analyzers, chromatography in quality analysis]
- Optics [fiber optics ,optical measurements]
- Computer science [computational medicines, signal and image analysis]
- Material sciences [implanted devices, artificial tissues]

INSTRUMENTS:

- Analyzing instruments like calorimeter, spectrometer
- Monitoring instruments like bedside monitor, foetal monitor
- Controlling instruments like defibrillator, dialysis instrument, heart and lung machine
- Therapeutic instruments like nuclear medicine, electro surgery, ultrasound therapy
- Supplementary instruments like hearing aid, pacemaker
- Recording instruments like blood cell counter (haemocytometer), blood pressure meter, pH meter, Stethoscope, electrocardiograph, electromyography, thermograph, ultra sonograph, radiograph(x-ray)

There are also various types of transducers that are important to be noted, such as

- Resistive transducers for muscle force and stress humidity respiration (thermistor)
- Inductive transducers for flow measurements muscle movements (LVDT)
- Capacitive transducer for heart sound measurement, pulse pick up
- Photoelectric transducer used for pulse transducers blood pressure oxygen analysis
- Chemical transducers -electrodes and pH electrodes

Biomedical engineering is an emerging and upcoming platform due to

- Fast and non-invasive way
- Used in immunoassay proteomic studies
- Serves a methodology to study different mi RNA from larger pools
- Along with nanotechnology ,they are used in the identification of micro RNA biomarkers in neuro-oncology (in the cases of pediatric ependymoma, anaplasticglioma, gliomameningioma, pituatary adenoma and acoustic schwannoma)

Few examples include, artificial CT scanners for better imaging, artificial blood: polymerized human hemoglobin, continuous glucose monitoring(or)glucose detection by surface-enhanced Raman spectroscopy, in ear device for controlling stuttering, confocal microwave frequency for breast cancer detection, microelectrodes in neuro-transplant, earthworm like robotic endoscope for small intestine

Artificial CT scanners for better imaging of heart:

This rapid and high performing scanner CT for blocked arteries is an aquilon 64 CFX multi-slice scanner by Toshiba that includes clear quality and speed image production that overcame the use of angiograms/cardiac catheterization for checking our real blocks. This is done with passing a thin tube from growing to arteries of heart along with the dye for the production of contrast X-rays the high resolution of the picture (64)is produced by a machine that is computer controlled passes X rays that produces signals in the form of digital and are detected, recorded and reconstructed.

There are also cellular and molecular level engineering that includes genetic engineering, recombinant DNA technology. Genetic engineering is a process which involves culturing of organisms(i.e.)as a result we obtain number of products, from which gene or a genetic material serves as the raw material whereas recombinant DNA technology is concerned with the modification of the genetic material and that plays a significant role in genetic engineering thereby overcoming the drawbacks and enhances the specificity.

GENETIC ENGINEERING:

Genetic engineering was introduced in 1970's which is an emerging field of recombinant DNA technology. Genetic engineering is broadly defined as the process of combining two pieces of DNA in order to obtain the specific traits with desirable characteristics. Since this kind of combinations really doesn't happen biologically, we tend to produce them in laboratory conditions under controlled environment. The manipulation and altering the genetic composition of an organism's genetic material is capable of modifying the characteristic

of an organism. The purpose of developing an engineered organism differs from species to species. This process has ethical issues in human engineering.But through r DNA technology there are many beneficiary effects for human. For example genetically engineered plants are constructed to produce economically and commercially important and valuable organism, for therapeutic drug production prevention of genetic abnormalities.

Cloning small pieces of DNA and propagating them in bacteria was the base and simplest form of cloning but now it has evolved to an enormous field where the whole genomes are being clone and moved from cell to cell to cell, to cell using variations of techniques and that would come under genetic engineering as a very broad definition. Even though there are many statements available, the proper definition does not yet stated. Genetic engineering includes gene identification, gene targeting, gene delivery, gene editing, etc

The schematic representation of the process of genetic engineering takes place in the following steps;

- **Selection and isolating the gene of interest from the donor**-The gene of interest that is desired must be only a few kb with high content with low repetitive DNA sequences. Isolation of the gene is done with the help of restrictive enzymes on digestion are true polymerase chain reaction
- **Plasmid selection and construction (vector)** - This is one of the most important step because the plasmids serves as the carrier molecule that is, they carry the selected cell and are ready to transform. Plasmid DNA as a circular double stranded cytoplasmic DNA that is found in found in bacteria. They are used as plasmids because of their independent replication.
- **Transformation of genes-**This tedious process depends accordingly and are discussed below(gene delivery)
- **Insertion of the desired DNA into the host genome**
- **Selection of transformants**-Earlier methods of detection of the transformer used selectable markers to differentiate the transform and untransformed cells. Currently polymerase chain reaction (PCR) based detection method is widely accepted. This method uses primers that are designed complementary to the gene of interest and amplified. In the case of mutation in the DNA, DNA sequencing methods are used for identification.

Gene identification is the selection of desired gene from the donor (i.e.) the **gene of interest**is selected accordingly.**Gene delivering** is the process of delivering the gene of interest into the target or host for further ligation and recombination to occur.There is two methods of gene delivery techniques namely

- Viral mediated
- Non-viral mediated

Viral mediatedgene delivery technique deals with the use of viruses to transfer the transformed DNA into the host. Examples include adenoviruses, T4 bacteriophage, retroviruses, etc.**Non viral mediated** gene delivery technique includes physical and chemical methods where Physical method involves the use of physical force for increasing the cell membrane permeability for entry of transformed cell. They include microinjection, electroporation, gene gun, ultrasound mediated methods and hydrodynamic systems. While
Chemical methods use natural polymers, liposome, dendrimers, synthetic proteins, and lipids. They are of less immunogenic and less toxic

Particle bombardment method or DNA bio-listics method is the use of DNA coated micro projectile which is used to transfer the transformed cells after it is accelerated. The micro projectile is allowed to penetrate the cell wall membrane to interact with the host cells. This projectile is small and are capable to penetrate the cell with limited damage and efficient for the introduction of the transform cell into the host. Biological methods include liposome mediated transfer, agro bacterium mediated transfer.

Electroporation is the most used and best suited for the transformation of plant cells and chloroplast both the linear and circular DNA materials can be transformed by this method. This is done by application of electric voltage of about 1000-1500 volts.**Sonoporation** is application of ultrasound for delivering the DNA that disrupts the cell membrane.

Microinjection also called as transformation of cells by intranuclear microinjection method. This process requires micro-capillaries and microscopic devices for delivering the DNA material into the cell. It is also used to understand the inter intracellular transport and fluorescent dyes that are being injected for a variety of purposes.

Polyethylene glycol (PEG) treatment is the least toxic for the plant cell transformation. This is done during the

somatic hybrid production. The protoplast is subjected with the polyethylene glycol for the uptake of the naked DNA.

Gene editing is the process of altering the messages of the DNA in order to modify the sequence of the genetic material thereby with the possible and effective product. The ultimate aim of this procedure is to fix the defective, damaged or abnormal portion of the DNA.

HISTORY OF GENE EDITING:

- In late 70s Herb Boyer and Stanley Cohen discovered the antibiotic resistant organism (genetically engineered bacteria).
- In 2012 a group of scientist from the University of California introduced the bacterial immune system which is able to edit genes at the targeted location and they named it as CRISPR-CAS9 system. This editing remains as the spark of the genetic and this idea aroused when the human insulin-producing bacteria was discovered. After the FDA approval of the synthetic insulin genetically modified tomato named as flavr-savr tomato and some species of cotton were under implementation for editing.

TYPES OF GENE EDITING:

Depending on the type of nucleus that is involved in the process there are three major techniques that are used in gene editing.

ZFNS (Zinc Finger Nuclease)

- TALEN (Transcriptional Activator-Like Effector Based Nuclease)
- CRISPR-CAS9 (Clustered Regularly Interspaced Short Palindromic Repeats)

STEPS INVOLVED:

The process of gene editing can be into the following steps:-

- Identification of a particular site in an organisms genome
- Designing the undamaged DNA copy of that particular site
- Guide RNA designing
- Use of enzymes to cut the damaged DNA
- Insertion of new DNA
- Repairing the site

RECOMBINANT DNA TECHNOLOGY:

Recombinant DNA technology is the integration of foreign DNA into the target DNA that is integration of foreign gene into the target gene in order to obtain additive traits both in phenotype and genotypic means.

History:

The recombinant DNA was first proposed by Peter Morgan belongs to the biochemistry department at Stanford University medical school. The first publication involves the intracellular replication of the recombinant DNA which took place during 1972 and 1973. In 1980 Paul Berg, the professor at Stanford was awarded the Nobel prize for his to work on nucleic acids in regard to recombinant DNA.

A team of scientists(Werner Arber, Hamilton Smith and Daniel Nathans) in 1978 were awarded Nobel prize in physiology or medicine for discovering restriction endonuclease which enhanced the technique of our DNA technology. The very first licensed recombinant DNA product was patented by list of scientist from Stanford University for human insulin production.

Every genetically engineered product undergoes a process where the desired gene is inserted into the plasmid, transformed into the organism and the transformant is allowed to integrate. Recombinant DNA products include genetically modified organisms, recombinant vaccines, transgenic animals and plants, etc.

Genetically modified organisms:

Herbert Boyer and Stanley Cohen in 1973 made the first genetically modified organisms in bacteria the first produced bacteria were provided antibiotic resistance to the kanamycin. They inserted the gene responsible for this antibiotic resistance into a plasmid and incorporated the plasmid into the host and it is allowed to integrate. As a result they found that the bacterium was then able to survive in the presence of kanamycin.

Rudolf Jainisch in 1974 introduced the transgenic mice by inserting the foreign DNA into its embryo. Genetically modified mice with genes removed was created in 1989.this was found as the first animal to synthesize transgenic proteins in their milk and these mice were engineered to produce human tissue plasminogen activator a protein that is involved in breaking down the blood clots.

In 1983, the first recombinant plant was developed by Michael, Richard and his colleagues; they infected tobacco with agro bacterium with an antibiotic resistance gene. The plants are then subjected to tissue culture techniques for checking the antibiotic resistance capabilities. In 2000 vitamin a enrich golden rice was the first plant that was developed with increased nutritive value.

Herbert Boyer and Robert Swanson in 1976 produced a human protein called somatostatin in E.coli. Genentech announced the production of genetically engineered human insulin from bacteria named as "humulin" was approved by the food and drug administration in 1982.

In 1987 a strain of pseudomonas became the first genetically modified organisms that were released into the environment for the beneficial effects.

The first antibiotic resistant tobacco plant which was genetically modified crops was produced in 1982 and in 1994 cal gene obtained an approval for the release of genetically modified food that is "flavrsavr" tomato followed by engineer tobacco engineer insect resistant potatoes during the year 1994 and 1995.

Later during 2003 the first genetically modified animal called zebra fish with their respective fluorescent genes were commercialized and aqua Salmon in 2015, the first genetically modified animal was approved for consuming.

Biosensor:

The device that is used for the analytical purposes that detects specific changes in the biological processes there by converting them into electrical signals. They include any kind of biological matter like enzymes, tissues,organ, cells, fluids, antibodies, nucleic acids, etc

The main features of biosensors are caused sensitivity stability and reproducibility. The sample is communicated with the help of an elite that is been checked and the biological response is changed into an electrical signal using a transducer.

The basic principle behind this sensor is that the biological material is deactivated and placed near in contact with the transducer. The electronic stimulus due to the contact of analyst is calculated.thatcan be calculated. In specific cases the device may be connected to the gaseous discharge, electrons, and hydrogen ions. The transducer is a device that can alter and convert them into electrical signals which is then further calculated. There are different types of biosensors namely electrochemical biosensors (amperometric, potentiometric, impedimetric, and voltammetric), physical biosensors,piezoelectric biosensors, thermometer biosensors, optical biosensors, wearable biosensors, enzyme biosensors, DNA biosensors, immune-biosensors, magnet biosensors, resonant biosensors.

The application of biosensors in various fields includes drug discovery, disease detection, micro and macro environmental monitoring, food quality monitoring, water quality management. Specifically they are used in common health care management, metabolites measurement, insulin treatment, in military, agricultural and veterinary applications, detection of crime, medical diagnosis, pharmaceutical manufacturers and organ replacement, etc

Biochip:

Bio chip also called as micro array is a non-electronic device, set of small microarrays that are been placed on a plate that is allowed to perform number of biological reactions in a limited time simultaneously. Every chip can be considered as a micro reactor that is capable of detecting particular molecules like enzymes, proteins, DNA, antibodies, etc. After the biochip gets activated(low- power electromagnetic field through radio signals) they transmits the identification code to the operator through their radio signals which then is received to change into digital form and is exhibited on LCD. The types of microchip includes

- DNA microarray
- Microfluidic chip
- Protein microarray.

Potential applications includes Safe e-commerce systems, forensic investigations, restore the records of medical, cash, passport,etc.,applicable in the medical field such as blood pressure sensor, glucose detector, and oxygen sensors and are widely used for the signal processing.

NANOTECHNOLOGY:

The technology that does not exist but your existence has made development and are developing. They hold the supreme power to reduce the overall medical costs and overcomes especially through their efficiency in disease detection, drug discovery and drug delivery simply nanotechnology is the study that predominantly deals and it is related to the small, a very tiny particles.1 micrometer is equal to 1 millionth of a meter (i.e.) 1000 nanometer. At present in our day to day life we use many nanoparticle products such as Sunscreen-that blocks UV radiation; Clothing-nanoparticles of silica that creates fabrics that repel water and other liquids; Furniture

they are made of carbon nanofibers which are less flammable and other adhesives

Even our human body is formed of nanoparticles like RBC's which is 2.5 microns in diameter, the width of the DNA molecule is about to 2nm,the width of human hair is about 80-100 microns.

Nanoprobe technology:

The early detection assay (i.e.) the bio-barcode technology developed by nanosphere is about 1, 00,000 times more sensitive than any other tests available for detecting ADDI(Alzheimer's disease, prostate cancer and other diseases). This technology involves the application of gold nanoparticle probes with antibodies to the target protein that is attached to the polymeric surface along with this; they carry a specific covalently attached oligonucleotide and complementary oligonucleotide.When probe gets attached to the target protein the bio-barcode that is serving as a protein markers is washed away due to the nanoprobe contain many oligonucleotides bound per protein where the amplification takes place which is related to the protein.

Lab on a chip:

Lab on a chip technique seems to be a best example in the field of medicine especially in the drug research and diagnostics.This chip contains 15,000 different oligonucleotide probes that have the ability to detect various genetic variations in the cytochrome genes.Amplichip CYP450 was the first Food and Drug Administration approved technology that involves microarray based test that have the ability to determine cytochrome p4502D6 and 2C19.These two genes have the ability to influence the drug efficacy and reactions.Researchers stated that,with this technique it might be possible to prevent the selection of therapies.

Quantum dots:

The use of fluorescent dyes to tag cells and cellular components is important mechanism in medical. They are smaller sized semiconductors that act as light emitting diode for bio-imaging due to their smallest size they act and functions as cell and even molecules that do not have effects on others cells.A variety of target molecules like monoclonal antibodies are attached to the polymer coated quantum dots making them to attach with specific biomarkers.Various pharmaceutical companies in collaboration with quantum Dot Corporation apply these semiconductors in high content drug screening.Successful outcomes include labelling HER2 breast cancer marker with the help of nanodots.

Reformulated drugs:

Nanocrystal technology is a nanoparticulate drug developed by a neuroscience based biotechnology company.This technology enables the formulation and improving the activity and end product characteristics.The simplest form of delivering drugs involves the reformulation of drugs in their nanoparticle form by reducing the size of the drug to about 200 nm,enhances the total surface area (enlarge)and thereby the relative insolubility of the drug is also overcomed.A new formulated drug called “sirolimus” tablet has been approved and is in use from early 20's.

Drug discovery:

Bio-Nano tubules also called as smart bio- Nano tubules are lipid protein tubes that have 16nm diameter of inner space which is used for the drug or gene delivery applications by the control the state of liquid and protein content it is possible to switch between two faces of nanotubes with other open ends are closed ends with leopard cabs this process stands as the base for chemical,drug encapsulation and release.

Researches explained that drugs could be delivered by smart bio Nano tubules in in a manner specific to the cancer cells thereby reducing the side effect of chemotherapy treatments.Also they stated that any drug that is capable of entering into the nanotubes without destroying them into the target cell could be delivered.For example-sirolimus and paxlitaxel.

Cancer therapy:

The basic concept of these therapies are to destroy the tumor tissue and inhibit or destroy the cancer cells growth.The applications of nanoparticles in Cancer therapy includes,

Photo-thermal therapy -this therapy involves the use of nanoparticles such as gold nanoparticles and NIR along with thiol and amine groups.Colloidal gold can absorb light at specific wavelength which then makes them useful for the hyperthermic cancer treatment and it related applications. This is also done to reduce the heat that is normally caused during the therapies.Paclitaxel can be given when the membrane is being destroyed by the heat that is generated by the gold nanoparticles under laser irradiation to provide the anticancer effect. Some examples of photo-thermal therapy and immunotherapy molecules are Prussian blue nanoparticles, polyethylene glycoxylated single wall nanotubes, gold nanostars are involved in tumors such as neuroblastoma,

breast tumor, bladder tumor, colorectal cancer.etc.,

Photodynamic therapy- this non-invasive and cytotoxic therapy is a form of light therapy that uses light molecular oxygen and photosensitive agents to kill the cancer cells. Ferroptosis along with the nano drug increases the anticancer action by and it promotes the production of ROS.

Chemotherapy-nanoparticles play a crucial role in delivering the drugs to the target site and providing a platform for their multi-functioning. Nanoparticles can increase the penetration and accumulation of the drug in the tumor cells and tissues, thereby improving the antitumor activity compared to the other drugs.These characters make them suitable for chemotherapy in the cases of lung cancer.

Medical imaging has improved significantly in the reason days where nanoparticles play an important part in medical imaging in the cases of **magnetic resonance imaging**. This magnetic resonance imaging is an imaging technique that provides different parametric information. In order to minimize the side effects due this imaging,recent advances in nanoparticles have showed their potential to use as contrast agents contrasting agents such as;
Gadolinium is a contrast agent that is used for the diagnostic in MRI in which when they are exposed to zinc ions(Zn^{2+}),relativity increases thereby multiple applications are possible. They are used as biomarkers for insulin secretion in beta cells since zinc ions (Zn^{2+}) are important in the biological processes involving the enzyme catalyst reactions. It is also possible to detect excess collagen along with gd nanoparticle-based contrasting agents in MRI.

Dendrimers are also used in the medical imaging due to their various properties such as rigidity, use of surface modifications, they have a various applications like cell tracking, blood pool imaging, tumor targeted theranostics,lymph node imaging. Also nanoparticles such as carbon (C^{13}), nanodiamonds, carbon nanotubes, graphene manganese, silicon, peptides are also used for better imaging in the magnetic resonance imaging.
Immunotherapy-normal cells producenanosized particles called exosomes.They communicate between the cells and with the environment through cargo transfer.Through the exosomes that is known as tumor derived exosomes,they provide antitumor effect and affect the tumor microenvironment.

Computed tomography is an instrument that uses x-ray as a source and detector to form and images it is generally used to provide 3D anatomical information of tissues and organs such as cardiovascular tracts, gastrointestinal tract, liver and lungs.One such drawback of CT is they lack sensitivity when exposed to contrasting agents and this remains a step behind from MRI.Futuristic approach of nanotechnology includes that they could be designed in such a way to encapsulate and then to deliver the drug or gene in the specific site of the body. The potential applications of nanotechnology include markers for identification of variety of complications like cancer, neurodegenerative diseases, infectious diseases, cardiac diseases and pulmonary diseases.

COMPUTATIONAL BOENGNEERING:

Computational bioengineering generally deals with the science of approaches in a computational method to biology and medical problems that range from molecular modeling to the healthcare informatics. They include biomechanics, bioimaging in a computational basis. Computational methods and its understanding can lead to a clear idea on phenomena such as fluid flow in blood vessels; mechanics of cartilage compression and in the processing of medical images. This form of study includes mathematical, statistical, biological, physical and chemical principles and applications.An engineering approach to life science suggests synthetic biology than the systematic biology. synthetic biology is simply a step forward engineering process with a moto to design specification, biological parts, and mechanism sticks approaches whereas system biology is a reverse engineering that is concerned on the feedback dynamics and adaptations. For clear biological understanding and applications synthetic biologist build and systemic biologist model.

Software's that are used for the computational studies

- **NET bio**-helps developers in researches and scientist to their framework
- **AMPHORA** for metagenomics analysis software
- **Anduril** for component based workflow framework for data analysis
- **Ascalaph** designer for computer program of molecular modeling for molecular designs
- **Autodock** for automated docking tools
- **BIO tool** for genome automatic
- **Bioclipse** for chemo and bioinformatics based platform

- **Biojava** to study the functions for manipulating sequences protein structures annotation systems and simple statistical
- **BioPHP** for PHP language tool kit for DNA and protein sequence, analysis, alignment, database parsing and bioinformatics tool
- **biopython** a python language toolkit
- **BLAST** for algorithm and program for comparing the primary biological sequence and its information including DNA and protein
- **GALAXY** for scientific workflow and data integration system
- **Gene pattern** for scientific workflow system providing number of genomic analysis tools
- **SOAP suite** for assembling alignment and analysis of short read next generation sequencing data
- **Taverna workbench** is a tool to design and execute workflows
- **UGENE** is an integrated bioinformatic tool that is written in C++
- **unipept** for metaproteomics biodiversity analysis gene panel a web tool to generate list of teams based on the specific conditions and phenotypes

BIONFORMATICS AND COMPUTATIONAL BIOLOGY:

Biostatistics and computational biology is similar terms but are different from each other. **Bioinformatics** refers to the study that includes large set of biological data, statistics and finally that result in an in-depth study, examples of bioinformatics studies includes comparative study of the chemical composition of proteins that clears the pathway for improving personalized medicine and to predict the function of protein from the data sequence and by structural information.

Applications of bioinformatics include microbial genome applications,molecular medicine, personalized medicine, gene therapy, drug development, evolutionary studies, biotechnology, crop improvement, artificial intelligence, machine learning animal behavioral studies, forensic analysis, bioweapon creation and improvement of nutritional quality. They include the branch of studies like genetics, genomics, proteomics, metagenomics, transcriptomics, phylogenetics, system biology, structural analysis, molecular modeling pathway analysis.

Computational biology is concerned with the solution to the problems that have been raised from the bioinformatics studies. Examples include analyzing how proteins interact with each other through protein folding, movement and interaction.

Applications of computational biology includes stochastic models, system biology, molecular medicine, metabolic pathway studies, cellular biology, biochemical studies, radiotherapy, deep learning, neural networks, oncology, animal physiology, advanced mathematics, genomic trends and genetic analysis. They include various branch of study like computational bioengineering, computational biomechanics, computational bioimaging, mathematical biology, theoretical biology.

Synthetic biology involves promoters, inducers, transcriptional factors→circuit, feedback→devices
Systematic biology involves cell organelles→ pathways and networks→ modules→ bio-molecules

COMPARISON BETWEEN BIOLOGICAL SYSTEMS AND ENGINEERED SYSTEMS

1. Human eye versus camera lenses

- Both focus on inverted images and to the light-sensitive surfaces
- In the case of camera, it focuses on the film of the sensor chip and in eye,it is focused on retina
- Aperture in camera is used to focus light on the film while in the eye pupil act as a focusing agent on retina
- Both can adjust quantity of in light that is being entered. In a camera it is done with the help of diaphragm, while in our eye it is done by iris
- Retina is the sensory layer that lines very back of our eyes it acts like a need sensory chip in a digital camera
- Retina has numerous photoreceptor nerve cells that helps to change the light rays into electrical impulse and send them through the optic nerve and to the brain where an image is finally received and perceived

2. FLYING BIRD AND AIRCRAFT

- Trying to navigate in air by imitating the bird is very common and they build wings to strap on to their arms or machines with flapping wings are calledornithopters. The trouble is, it works better at bird scale but not enough to lift a man or a machine off the ground.
- In 1784, a few aeronauts made it with uncontrolled flight lighter air balloons filled with hot air
- In the 19th century an English baronet from the gloomy moon of Yorkshire came up with a flying machine with fixed wings and movable control surfaces.
- This stood as the fundamental concept of airplane.
- George Cayley built the first true airplane- a kite mounted on a stick with the movable tale, it was crude but it proved that the idea works and from that the very first glider evolved.
- The amazing machine that have taken us to space at speed faster than sound.

3. WRIGHT BROTHERS AND FIRST AIRPLANES:

- Wright brothers were the first to invent aircraft controls that made fixed wing powered flight possible.
- Wright brothers gained mechanical skills essential and noticed that the birds soared into the wings and that the air flowing over the curves of age of their wings created to lift. In order to turn, birds under some conformational change.
- Wrights designed their own glider by concentrating much and majorly on how it turns out and that small birds don't change the shape of the wings when flying rather they change the speed of a flapping wings, for example to start a left turn the right wing is slapped more vigorously to turned right the speed of flapping the same to the other wing to fly straight both wings of clapped at the same speed. This is the principle behind the airplane invention

II. Conclusion

A clear and well understanding and applicable knowledge in life science paves way for various field of research in which many such current issues could be solved or altered by the application of technology. An engineer catalyses the rate of betterment of all well being. Through various technologies it is now possible to combat every fault and is capable of fixing with potential and continuous efforts, ideas and strategies.

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