# Chapter 11
# Recent Developments in Physics

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## Part – I

## TextBook Evaluation:

## I. Multiple Choice Questions:

**Question** 1.
The particle size of ZnO material is 30 nm. Based on the dimension it is classified as
a) Bulk material
b) Nanomaterial
c) Soft material
d) Magnetic material
**Answer**:
b) Nanomaterial

**Question** 2.
Which one of the following is the natural nanomaterial.
a) Peacock feather
b) Peacock beak
c) Grain of sand
d) Skin of the Whale
**Answer**:
a) Peacock feather

**Question** 3.
The blue print for making ultra-durable synthetic material is mimicked from _____.
a) Lotus leaf
b) Morpho butterfly
c) Parrot fish
d) Peacock feather
**Answer**:
c) Parrot fish

**Question** 4.
The method of making nanomaterial by assembling the atoms is called _____.
a) Top down approach
b) Bottom up approach
c) Cross down approach
d) Diagonal approach

**Answer**:
b) Bottom up approach

**Question** 5.
"Sky wax" is an application of nano product in the field of _____.
a) Medicine
b) Textile
c) Sports
d) Automotive industry
**Answer**:
c) Sports

**Question** 6.
The materials used in Robotics are _____.
a) Aluminium and silver
b) Silver and gold
c) Copper and gold
d) Steel and aluminium
**Answer**:
d) Steel and aluminium

**Question** 7.
The alloys used for muscle wires in Robots are _____.
a) Shape memory alloys
b) Gold copper alloys
c) Gold silver alloys
d) Two-dimensional alloys
**Answer**:
a) Shape memory alloys

**Question** 8.
The technology used for stopping the brain from processing pain is _____.
a) Precision medicine
b) Wireless brain sensor
c) Virtual reality
d) Radiology
**Answer**:
c) Virtual reality

**Question** 9.
The particle which gives mass to protons and neutrons are _____.
a) Higgs particle
b) Einstein particle
c) Nanoparticle
d) Bulk particle

**Answer**:
a) Higgs particle

**Question** 10.
The gravitational waves were theoretically proposed by _____.
a) Conrad Rontgen
b) Marie Curie
c) Albert Einstein
d) Edward Purcell
**Answer**:
c) Albert Einstein

## II. Short Answers Questions:

**Question** 1.
Distinguish between Nanoscience and Nanotechnology.
**Answer**:

| Nanoscience | Nanotechnology |
|---|---|
| 1. Nanoscience is the science of objects with a typical size of 1-100 nm. Nano means one-billionth of a metre that is $10^{-9}$m. | Nanotechnology is a technology involving design, production. |
| 2. If matter is divided into such small objects the mechanical, electrical, optical magnetic and other properties change. | Characterization and application of nano structured materials. |

**Question** 2.
What is the difference between Nano materials and Bulk materials?
**Answer**:

| Nano Materials | Bulk Mateerials |
|---|---|
| 1. Nano materials are particle that have their size in 1-100 nm range atleast in one dimension. | Bulk materials are particle that have their size above lOOnm in all dimensions. |
| 2. We cannot see particles of nanomaterials from the naked eye. | We can see particle of most of the bulk materials from the naked eye. |
| 3. The example of nanomaterials include nano zymes, titanium dioxide, nano particles, graphene, etc. | The example of bulk materials include plaster sand, gravel, cement, ore, slag, salts, etc. |

**Question** 3.
Give any two examples for “Nano” in nature.
**Answer**:
1. Single-strand DNA:
A single strand of DNA, the building block of all living things, is about three nanometers wide.

2. Morpho Butterfly:
The scales on the wings of a morpho butterfly contain nanostructures that change the way light waves interact with each other, giving the wings brilliant metallic blue and green hues. Mimic in laboratories – Manipulation of colours by adjusting the size of nanoparticles with which the materials are made.

**Question** 4.
Mention any two advantages and disadvantages of Robotics.
**Answer**:
Advantage:

1. The robots are much cheaper than humans.
2. Robots never get tired like humans.
3. Stronger and faster than humans.

Disadvantage:

1. Robots have no sense of emotions or conscience.
2. They lack empathy and hence create an emotionless workplace.
3. Unemployment problem will increase.

**Question** 5.
Why steel is preferred in making Robots?
**Answer**:
Steel is several times stronger. In any case, because of the inherent strength of metal, robot bodies are made using a sheet, bar, rod, channel, and other shapes.

**Question** 6.
What are black holes?
**Answer**:

1. Black holes are the end-stage of stars which are the highly dense massive objects. Its mass ranges from 20 times mass of the sun to 1 million times mass of the sun.
2. It has very strong gravitational force such that no particle or even light can escape from it.
3. The existence of black holes is studied when the stars orbiting the black hole behave differently from the other stars. Every galaxy has a black hole at its center.

**Question** 7.
What are sub atomic particles?
**Answer**:

1. The three main subatomic particles that form an atom are protons, neutrons, and electrons.
2. Subatomic particles are particles that are smaller than the atom, proton and neutron are made up of quarks which is interact through gluons.
3. A subatomic particle having two types of particles, they are elementary particles and composite particles.

## III. Long Answer Questions:

**Question** 1.
Discuss the applications of Nanomaterials in various fields.
**Answer**:

(i) Automotive industry:

- Lightweight construction
- Painting (fillers, base coat, clear coat)
- Catalysts
- Tires (fillers)
- Sensors
- Coatings for window screen and car bodies

(ii) Chemical industry:

- Fillers for paint systems
- Coating systems based on nanocomposites
- Impregnation of papers
- Switchable adhesives
- Magnetic fluids

(iii) Engineering

- Wear protection for tools and machines (anti blocking coatings, scratch resistant coatings on plastic parts, etc.)
- Lubricant – free bearings

(iv) Electronic industry

- Data memory
- Displays
- Laser diodes

- Glass fibres
- Optical switches
- Filters (IR-blocking)
- Conductive, antistatic coatings

(v) Construction:

- Construction materials
- Thermal insulation
- Flame retardants
- Surface – functionalised building materials for wood, floors, stone, facades, tiles, roof tiles, etc.
- Facade coatings
- Groove mortar

(vi) Medicine:

- Drug delivery systems
- Contrast medium
- Prostheses and implants
- Agents in cancer therapy
- Active agents
- Medical rapid tests
- Antimicrobial agents and coatings

(vii) Textile / fabrics / non – wovens:

- Surface – processed textiles
- Smart clothes

(viii) Energy:

- Fuel cells
- Solar cells
- Batteries
- Capacitors

(ix) Cosmetics:

- Sun protection
- Lipsticks
- Skin creams
- Tooth paste

(x) Food and drinks:

- Package materials
- Additives
- Storage life sensors
- Clarification of fruit juices

(xi) Household:

- Ceramic coatings for irons
- Odors catalyst
- Cleaner for glass, ceramic, floor, windows

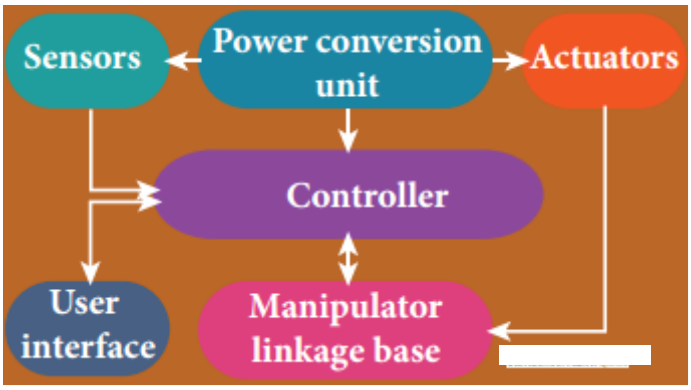
(xii) Sports / outdoor:

- Ski wax
- Antifogging of glasses/goggles
- Antifouling coatings for ships/boats
- Reinforced tennis rackets and balls.

**Question** 2.
What are the possible harmful effects of the usage of Nanoparticles? Why?
**Answer**:

1. The research on the harmful impact of the application of nanotechnology is also equally important and fast developing.
2. The major concern here is that the nanoparticles have the dimensions same as biological molecules such as protein.
3. They may easily get absorbed onto the surface of living organisms and they might enter the tissues and fluids of the body.
4. The interaction with living systems is also affected by the dimensions of the nanoparticles.
5. For instance, nanoparticles of a few nanometers size may reach well inside biomolecules.
6. It is also possible for the inhaled nanoparticles to reach the blood to reach other sites such as the liver, heart, or blood cells.
7. Researchers are trying to understand the response of living organisms to the presence of nanoparticles of varying size, shape, chemical composition, and surface characteristics.

**Question** 3.
Discuss the functions of key components in Robots?
**Answer**:




Power conversion unit:
Robots are powered by batteries, solar power, and hydraulics.

Actuators:

1. Converts energy into movement.
2. The majority of the actuators produce rotational (or) linear motion.

Most robots are composed of 3 main parts.

The Controller:

1. This is also known as the "brain" which is run by a computer program.
2. It gives commands for the moving parts to perform the job.

Most robots are composed of 3 main parts.

Mechanical parts:

1. Motors
2. Pistons
3. Grippers
4. Wheels and gears that make the robot move, grab, turn and lift.

Sensors:

1. To tell the robot about its surroundings.
2. It helps to determine the sizes and shapes of the objects around, the distance between the objects, and the directions as well.

**Question** 4.
Elaborate any two types of Robots with relevant examples.
**Answer**:
(i) Human-Robot: Certain robots are made to resemble humans in appearance and replicate human activities like walking, lifting, and sensing, etc.

1. Power conversion unit: Robots are powered by batteries, solar power, and hydraulics.
2. Actuators: Converts energy into movement. The majority of the actuators produce rotational or linear motion.
3. Electric motors: They are used to actuate the parts of the robots like wheels, arms, fingers,
   legs, sensors, camera, weapon systems etc. Different types of electric motors are used. The most often used ones are AC motor, Brushed DC motor, Brushless DC motor, Geared DC motor, etc.
4. Pneumatic Air Muscles: They are devices that can contract and expand when air is pumped inside. It can replicate the function of a human muscle. The contract almost 40% when the air is sucked inside them.
5. Muscle wires: They are thin strands of wire made of shape memory alloys. They can contract by 5% when an electric current is passed through them.
6. Piezo Motors and Ultrasonic Motors: Basically, we use it for industrial robots.
7. Sensors: Generally used in task environments as it provides information of real-time knowledge.
8. Robot locomotion: Provides the types of movements to a robot.
   The different types are:
   - Legged
   - Wheeled
   - Combination of Legged and Wheeled Locomotion
   - Tracked slip/skid.

(ii) Industrial Robots:
Six main types of industrial robots:

1. Cartesian
2. SCARA (Selective Compliance Assembly Robot Arm)
3. Cylindrical
4. Delta
5. Polar
6. Vertically articulated

Six-axis robots are ideal for:

1. Arc Welding
2. Spot Welding
3. Material Handling
4. Machine Tending
5. Other Applications

**Question** 5.
Comment on the recent advancement in medical diagnosis and therapy.
**Answer**:
The recent advancement in medical diagnosis and therapy:

1. Virtual reality
2. Precision medicine
3. Health wearables
4. Artificial organs
5. 3 – D printing
6. Wireless brain sensors
7. Robotic surgery
8. Smart inhalers

1. Virtual reality:
Medical virtual reality is effectively used to stop the brain from processing pain and cure soreness in the hospitalized patients. Virtual reality has enhanced surgeries by the use of 3D models by surgeons to plan operations. It helps in the treatment of Autism, Memory loss, and Mental illness.

2. Precision medicine:
Precision medicine is an emerging approach for disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle for each person. In this medical model, it is possible to customise healthcare, with medical decisions, treatments, practices, or products which are tailored to the individual patient.

3. Health wearables:
A health wearable is a device used for tracking a wearer's vital signs or health and fitness-related data, location, etc. Medical wearables with artificial intelligence and big data provide an added value to healthcare with a focus on diagnosis, treatment, patient monitoring, and prevention.

Note Big Data: Extremely large data sets that may be analysed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.

4. Artificial organs:
An artificial organ is an engineered device or tissue that is implanted or integrated into a human. It is possible to interface it with living tissue or to replace a natural organ. It duplicates or augments a specific function or functions of human organs so that the patient may return to normal life as soon as possible.

5. 3D printing:
Advanced 3D printer systems and materials assist physicians in a range of operations in the medical field from audiology, dentistry, orthopedics, and other applications.

6. Wireless brain sensors:
Wireless brain sensors monitor intracranial pressure and temperature and then are absorbed by the body. Hence there is no need for surgery to remove these devices.

7. Robotic surgery:
Robotic surgery is a type of surgical procedure that is done using robotic systems.

Robotically-assisted surgery helps to overcome the limitations of pre – existing minimally invasive surgical procedures and to enhance the capabilities of surgeons performing open surgery.

8. Smart inhalers:
Inhalers are the main treatment option for asthma. Smart inhalers are designed with health systems and patients in mind so that they can offer maximum benefit. Smart inhalers use Bluetooth technology to detect inhaler use, remind patients when to take their medication, and gather data to help guide care.