**Unit -3 lasers**  
What are the two types of emissions in laser technology?

Spontaneous and stimulated emissions.

What is population inversion in the context of lasers?

It is the condition where the number of atoms in an excited state exceeds those in the ground state.

Name one key characteristic of laser light.

Laser light is coherent.

What are the basic requirements for constructing a laser?

Active medium,Pumping, population inversion, and an optical resonant cavity.

What is the active medium in Nd:YAG laser?

Neodymium-doped Yttrium Aluminum Garnet (YAG).

Which gas combination is used in a He-Ne laser?

Helium and Neon.

What type of laser is constructed using GaAs?

Semiconductor laser (Homo junction).

List one application of lasers.

Lasers are used in medical surgeries.

What is stimulated emission?

It is the process where an incoming photon induces an excited atom to emit a photon of the same energy and phase.

What is the role of the optical resonant cavity in lasers?

It amplifies light through repeated reflections and promotes stimulated emission.

What type of pumping is used in a Nd:YAG laser?

Optical pumping.

What is the wavelength of light emitted by a He-Ne laser?

632.8 nm (visible red light).

What is the bandgap energy of GaAs used in semiconductor lasers?

Approximately 1.43 eV.

Which type of laser is widely used in barcode scanners?

He-Ne laser.

Name one industrial application of lasers.

Laser cutting and welding.

How is population inversion achieved in a laser?

By pumping energy into the system to excite more atoms to higher energy states.

What property of lasers makes them suitable for holography?

High coherence.

Fiber Optics

What are the three main parts of an optical fiber?

Core, cladding, and buffer coating.

What is the primary difference between step-index and graded-index fibers?

Step-index fibers have a sudden change in refractive index, while graded-index fibers have a gradual change.

What is the unit of numerical aperture?

Numerical aperture is dimensionless.

What causes attenuation in optical fibers?

Scattering, absorption, and bending losses.

Why are optical fibers preferred in telecommunications?

They have high bandwidth and low signal loss.

What is the acceptance cone in fiber optics?

It is the cone-shaped region within which light can enter the fiber to be guided.

What material is commonly used for making optical fiber cores?

Silica (SiO₂).

What is single-mode fiber used for?

Long-distance, high-speed data transmission.

What type of light source is typically used in fiber optic communication?

Laser diodes or LEDs.

Name an application of fiber optics in medicine.

Endoscopy.

What principle does fiber optics operate on?

Total internal reflection.

What is numerical aperture in fiber optics?

It is a measure of the light-gathering ability of an optical fiber.

What is the acceptance angle in fiber optics?

The maximum angle at which light can enter the fiber and still be guided.

Name one classification of optical fibers based on refractive index.

Step-index and graded-index fibers.

What is one application of optical fibers?

Optical fibers are used in high-speed internet communication.

How does light propagate in graded-index fibers?

By continuously bending along the fiber due to a gradual change in refractive index.

What is the primary use of light wave communication in fiber optics?

Transmitting data over long distances with minimal loss.

**Unit IV: Sensors**

What is a passive sensor?

A sensor that does not require external power to operate.

Give an example of an active sensor.

Radar is an active sensor.

What is the principle of piezoelectric sensors?

They generate an electric charge in response to mechanical stress.

Name one application of quantum sensors.

Quantum sensors are used in gravitational wave detection.

What is the key difference between classical and quantum sensors?

Classical sensors rely on macroscopic phenomena, while quantum sensors exploit quantum mechanical properties like superposition and entanglement.

What is a sensor?

A device that detects and responds to physical or environmental changes.

What is the difference between active and passive sensors?

Active sensors emit energy and detect its reflection, while passive sensors rely on ambient energy.

What is a piezoelectric material?

A material that generates an electric charge when mechanically deformed.

Give an example of a piezoelectric sensor application.

Ultrasound imaging.

What is a thermal sensor?

A sensor that measures temperature using the thermal properties of materials.

Name a commonly used metal-based thermometer.

Platinum Resistance Thermometer (PRT).

What is the main advantage of semiconductor-based thermometers?

High sensitivity to temperature changes.

What property distinguishes quantum sensors from classical sensors?

Quantum sensors leverage phenomena like superposition and entanglement.

What is a common application of quantum sensors?

Precision measurement of magnetic fields (e.g., magnetometers).

What is the role of a sensor in a measurement system?

It converts physical parameters into measurable signals.

What is the output of a piezoelectric force sensor?

An electric charge proportional to the applied force.

What is meant by the sensitivity of a sensor?

The ratio of output signal change to input parameter change.

What is a strain gauge?

A sensor that measures strain in a material by detecting changes in electrical resistance.

What type of signal is generated by a quantum sensor?

A signal based on quantum state measurements.

What are the two primary classifications of sensors?

Active and passive sensors.

What is the working principle of metal-based thermometers?

change in resistance with temperature.

What is a common material used in piezoelectric sensors?

Quartz.

What is an accelerometer used for?

Measuring acceleration or vibration