SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF PHYSICS

QUESTION BANK

II SEMESTER

PH3226 MEDICAL PHYSICS

Academic Year 2024– 2025

Prepared by

Dr. M. Anbuchezhiyan, Ms. D. Praveena and Dr. S. Padmaja

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DEPARTMENT OF PHYSICS

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SUBJECT : PH3226 - MEDICAL PHYSICS

SEM / YEAR: II SEM / AY-2024-2025

UNIT - I: ELECTROMAGNETIC SPECTRUM AND RADIATIONS

Introduction-properties and classification of electromagnetic radiation-different sources of radiation-radio waves, microwaves, infrared visible, ultra violet radiation, X-rays, gamma rays - production, physical properties and their interaction with tissues.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	What are Electromagnetic Waves?	CO1	BTL 1	Remembering
2.	Write a note on properties of Electromagnetic waves.	CO1	BT L 2	Understanding
3.	How are Electromagnetic waves produced?	CO1	BT L 1	Remembering
4.	What is the wavelength of an infrared light photon that has a frequency of 2×10^{14} Hz?	CO1	BT L 3	Applying
5.	Write a note on ionizing radiation.	CO1	BT L 1	Remembering
6.	What is meant by non-ionizing radiation?	CO1	BT L 2	Understanding
7.	What are the four types of ionizing radiations?	CO1	BT L 1	Remembering
8.	List some therapeutic uses of IR radiations.	CO1	BT L 1	Remembering
9.	Can we use UV radiations for clinical applications? Justify your answer.	CO1	BT L 2	Understanding
10.	Write any four applications of RF waves in medical field	CO1	BT L 2	Understanding
11.	Mention the application of microwaves in medicine.	CO1	BT L 1	Remembering
12.	What are X rays?	CO1	BT L 2	Understanding
13.	Classify the types of X rays based practical applications in medicine.	CO1	BT L 2	Understanding
14.	Define Bremsstrahlung Effect.	CO1	BT L 2	Understanding
15.	List some properties of gamma rays.	CO1	BT L 1	Remembering
16.	Velocity of wave in vacuum is $3x10^8$ m/s. Determine the frequency of gamma rays ($\lambda=1x10^{-4}$ nm).	CO1	BT L 1	Remembering
17.	What are the ways of photon interaction with matter	CO1	BT L 2	Understanding
18.	Write about gamma knife surgery.	CO1	BT L 2	Understanding
19.	What is meant by photo absorption?	CO1	BT L 1	Remembering
20.	What is a photo electron?	CO1	BT L 2	Understanding
21.	Write the three main interaction mechanism of ionizing photons.	CO1	BT L 2	Understanding
22.	Differentiate direct radiation interaction and indirect radiation interaction.	CO1	BT L 2	Understanding

23.	Mention the types of potential radiation injury that occurs to human cell.	CO1	BT L 1	Remembering
24.	Find the frequency and energy of a light photon of wavelength 250 nm.	CO1	BT L 3	Applying

PART – B				
Q. No	**Questions**		**BT Level**	**Competence**
1.	Explain the classification of electromagnetic radiation and their respective wavelength ranges. (16)	CO1	BT L3	Applying
2.	Describe the physical properties of electromagnetic waves in detail. (16)	CO1	BT L3	Applying
3.	(i) Write in detail, the properties of RF waves, IR radiation, UV radiation and Microwaves. (12) (ii) List any two medical applications of UV radiation and IR Radiation. (4)	CO1	BT L3 BT L4	Applying Analyzing
4.	Discuss the production and properties of radio waves in detail with diagrammatic representation. (16)	CO1	BT L3	Applying
5.	With neat diagrammatic representation, explain the production and properties of radio waves. Write few applications of radio waves. (16)	CO1	BT L3	Applying
6.	Explain in detail, the types of infrared radiation and the classification of infrared detector. Give some medicinal applications of infrared radiations. (16)	CO1	BT L2	Understanding
7.	Detail the characteristics of the region of the infrared radiation. Also, list few applications of infrared radiations. (16)	CO1	BT L4	Analyzing
8.	How the microwaves are produced? Explain with the properties and applications of microwaves. (16)	CO	BT L 3	Applying
9.	Explain the interaction of visible light with tissues. (16) Write the significance of visible light in medical imaging. (16)	CO1	BT L3 BTL 2	Applying Understanding
10.	Write a detailed account on ultraviolet radiation and their effects on living tissues. (16)	CO1	BT L3	Applying
11.	How the UV radiations can be classified? Write the therapeutic applications of UV radiations and different UV sources used in it. (16)	CO1	BT L4	Analyzing
12.	Write short note on Ionizing radiations (3) Properties of X-rays (5) Medical applications of X-rays. (8)	CO1	BT L2 BTL 3 BTL 3	Understanding Applying Applying
13.	Discuss in detail about various interactions of ionizing radiation with matter. (16)	CO1	BT L3	Applying
14.	What is Photoelectric effect, Compton effect and pair production. Discuss them in detail? (16)	CO1	BTL3	Applying
15.	(i) What are γ-rays? Explain the characteristics of gamma rays. (13) (ii) The frequency of a γ-ray photon is $2\times \mathbf{10^{18}}$ (Hz). Find the energy, wavelength, and linear momentum of this photon. (3)	CO1	BT L 3 BT L 4	Applying Analyzing

16.	Elaborate the production and properties of γ-ray radiations. List the medical applications of γ-rays. (16)	CO1	BT L 3	Applying
17.	Provide an overview of γ-ray interaction with tissues. Explain the advantages and drawbacks of γ-ray interactions on human body. (16)	CO1	BT L 3	Applying

. **UNIT- II: RADIATION SOURCES AND HAZARDS**				
Radiation sources: Gamma chamber - Particle accelerators – Accelerators in medical and industrial applications – safety aspects of accelerators- Radiation hazards: evaluation, control and radiation protection- detection and measurement of contamination on work surface and person - methods of decontamination – planning of medical and industrial radiation installations-radiation scattering-albedo-sky shine.				
	PART A			
Q.No		**CO**	**BT Level**	**Competence**
1.	What are the general sources of radiation?	CO2	BTL 1	Remembering
2.	List some man-made radiation sources.	CO2	BTL 2	Understanding
3.	Define radiation exposure. Give its SI unit.	CO2	BT L 2	Understanding
4.	What are two ways of measuring radiation dose?	CO2	BTL 1	Remembering
5.	Define Absorbed dose.	CO2	BTL 1	Remembering
6.	What is meant by dose equivalent?	CO2	BT L 2	Understanding
7.	What is effective dose?	CO2	BTL 2	Remembering
8.	How is ionizing radiation absorbed in the human body?	CO2	BTL 1	Remembering
9.	Define thermo luminescent dosimetry (TLD)	CO2	BTL 1	Remembering
10.	What is a gamma chamber?	CO2	BT L 2	Understanding
11.	Define particle accelerators.	CO2	BTL 1	Remembering
12.	Mention any two medical applications of accelerators.	CO2	BT L 2	Understanding
13.	What are the primary safety aspects of using accelerators?	CO2	BT L 2	Understanding
14.	Write about radiation hazards?	CO2	BT L 2	Understanding
15.	What do you infer from radiation protection?	CO2	BTL 1	Remembering
16.	Differentiate particle radiation and electromagnetic radiation.	CO2	BTL 2	Understanding
17.	Mention two methods of detecting contamination on a work surface.	CO2	BTL 1	Remembering
18.	What is radiation decontamination?	CO2	BTL 1	Remembering
19.	Name any two key considerations in planning a medical radiation installation.	CO2	BTL 2	Understanding
20.	What do you mean by the term KERMA?	CO2	BTL 1	Remembering
21.	What are dosimeters?	CO2	BTL 2	Understanding

22.	Define “sky shine radiation”.	CO2	BTL 1	Remembering
23.	What is the result of radiation scattering in medical devices?	CO2	BTL 1	Remembering
24.	Write the effect of albedo in humans.	CO2	BTL 2	Understanding

PART B				
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Explain the working principle and applications of gamma chamber. (16)	CO2	BTL 3	Applying
2.	Elaborate the principle, working and applications of gamma chamber with diagrammatic representation. (16)	CO2	BTL 3	Applying
3.	(i) Explain any two types of particle accelerators with schematic diagrams. (13) (ii) Write the medical and industrial applications (3)	CO2	BTL 3 BTL 2	Applying Understanding
4.	Write short notes on the following (i) Betatron (8) (ii) Cyclotron (8)	CO2	BTL 3	Applying
5.	Explain the various components of a linear accelerator with block diagram. (13)	CO2	BTL 3	Applying
6.	Detail on radiation hazards, how to protect from hazards and how to control the ionizing radiation. (13)	CO2	BTL 3	Applying
7.	Elaborate on various radiation doses. Also give a summary on long term risks in different doses of radiations. (13)	CO2	BTL 3	Applying
8.	Write short notes on (i) Absorbed dose (6) (ii) Equivalent dose (5) (iii) Effective dose. (5)	CO2	BTL 3	Applying
9.	Explain in detail the delayed effects of radiation. (16)	CO2	BTL 3	Applying
10.	(i) Differentiate particle radiation and electromagnetic radiation. (10) (ii) Give a short note on the various protective equipment for radiation. (6)	CO2	BTL 3	Applying
11.	Enumerate the different surface contamination methods due to radiations in work surface and person. What are the methods to identify and control the contaminations. (16)	CO2	BTL 3	Applying
12.	(i) Discuss the surface contaminations due to radiations. (10) (ii) Detail the methods to identify and control the contaminations. (6)	CO2	BTL 3	Applying
13.	Discuss the steps involved in planning radiation installations for medical and industrial use. (16)	CO2	BTL 3	Applying
14.	Write short notes on (i) Medical and industrial radiation installations (8) (ii) Methods of decontamination. (8)	CO2	BTL 4	Analyzing
15.	Explain the concept of radiation scattering and its significance in radiation safety. (16)	CO2	BTL 3	Applying

16.	Discuss on the construction and working of Geiger Muller counter which measures the scattered radiations. Write its advantages in medical field. (16)	CO2	BTL 3	Applying
17.	(i)With diagrammatic representation, explain the equipment which is used to measure the harmful scattering radiations. (13) (ii) Write the applications and advantages. (3)	CO2	BTL 3	Applying

	UNIT- III: MEDIPHOTONICS AND MEDICAL ULTRASOUND			
	Lasers in medicine - applications of ultrafast pulsed lasers - lasers in dermatology -oncology and cell biology - lasers in blood flow measurement - ultrasound production-Bioacoustics-acoustical characteristics of human body - ultrasonic dosimetry-destructive and non-destructive tests - high power ultrasound in therapy.			
	PART A			
Q.No		**CO**	**BT Level**	**Competence**
1.	What are the properties of light?	CO3	BTL1	Remembering
2.	Compare characteristic of laser beam over conventional source.	CO3	BTL1	Remembering
3.	What is the clinical significance of Laser beam?	CO3	BTL2	Understanding
4.	Define the term laser speckles.	CO3	BTL2	Understanding
5.	List the medical applications of ultrafast pulsed laser.	CO3	BTL1	Remembering
6.	Mention the factors which will contribute for penetration of laser in dermatological applications.	CO3	BTL2	Understanding
7.	Based on the penetration depth of lasers, classify the treatments in dermatology.	CO3	BTL1	Remembering
8.	What is meant by “skin cooling”.	CO3	BTL2	Understanding
9.	Mention some of the lasers that can be used for cancer treatment.	CO3	BTL1	Remembering
10.	What is photodynamic therapy?	CO3	BTL1	Remembering
11.	Can all type of cancers be cured using laser? Justify your answer.	CO3	BTL2	Understanding
12.	Write the limitations of using laser in oncology.	CO3	BTL1	Remembering
13.	Write down the basic effects on laser on tissues.	CO3	BTL2	Understanding
14.	What is the main application of mechanical effect of laser in tissue engineering?	CO3	BTL2	Understanding
15.	What is meant by photo ablation?	CO3	BTL2	Understanding
16.	Write the formula to find the blood flow.	CO3	BTL2	Understanding
17.	Define the term impedance in ultrasonic interaction with materials.	CO3	BTL1	Remembering
18.	What will the wavelength of 10 MHz frequency ultrasound,when travelling in blood medium?Given density and velocity of ultrasound in blood is 1,058 kg/m^3 and 1.56mm/μm respectively.	CO3	BTL2	Understanding
19.	What are the ways to produce ultrasound for therapeutic applications?	CO3	BTL1	Understanding

20.	Why coupling medium gel is used during ultrasound scan?	CO3	BTL2	Applying
21.	Write the range of ultrasonic dosimetry for acute condition and chronic condition.	CO3	BTL 1	Remembering
22.	Differentiate therapeutic ultrasound and non therapeutic ultrasound.	CO3	BTL2	Remembering
23.	Calculate the frequency of an ultrasound signal in tissue if its velocity is1500m/s and the wavelength is 7.6×10^{-3} cm.	CO3	BTL2	Remembering
24.	Calculate the maximal audio frequency of a Doppler ultrasonic blood flow meter that has a carrier frequency of 8MHz, a transducer angle o f 30° , a blood velocity of 150 cm/s. and an acoustic velocity of 1350m/s	CO3	BTL2	Remembering

	PART – B			
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Write a detailed account on the use of lasers in dermatology. (16)	CO3	BTL3	Applying
2.	How laser is used to treat the skin related problems. Explain in detail. (16)	CO3	BTL3	Applying
3.	Explain with diagrammatic representation of any three-cell biology-oriented treatments using laser. (16)	CO3	BTL3	Applying
4.	Detail the use of laser in cell biology. (16)	CO3	BTL3	Applying
5.	What is photo dynamic therapy? Explain in detail. (16)	CO3	BTL3	Applying
6.	Give a detail account of therapeutic cancer treatment using laser. List the various types of oncological treatment using laser therapy. (16)	CO3	BTL4	Analyzing
7.	With neat diagrammatic representation, explain the laser doppler blood flow meter. Write the advantages and limitations for the same. (16)	CO3	BTL3	Applying
8.	Discuss in detail, the working of laser Doppler blood flow meter, its advantages and disadvantages. (16)	CO3	BTL3	Applying
9.	Explain the principles and methods of blood flow measurement using lasers. (16)	CO3	BTL3	Applying
10.	Discuss in detail, the two types of biological effects of ultrasound in human body. (16)	CO3	BTL3	Applying
11.	Give short notes on Thermal effect of ultrasound (8) Non-thermal effect of ultrasound (8)	CO3	BTL3	Applying
12.	Describe the acoustical characteristics of human body and their significance in ultrasound applications. (16)	CO3	BTL3	Applying
13.	Explain the three techniques used in ultrasound therapeutic applications with diagrammatic applications. (16)	CO3	BTL3	Applying
14.	Explain with necessary examples the usage of Ultrafast lasers in medicine. (16)	CO3	BTL3	Applying
15.	Explain the therapeutic applications of high-power ultrasound, its advantages and limitations. (16)	CO3	BTL3	Applying

16.	How ultrasound can be used in destructive and non-destructive testing of medical applications. (16)	CO3	BTL3	Applying
17.	Compare and contrast, destructive and non-destructive testing techniques in ultrasound. (16)	CO3	BTL4	Analyzing

UNIT- IV: PHYSICS OF MEDICAL RADIOGRAPHY				
Physics of X-ray production- endoscopes - nuclear imaging techniques- nanotech based imaging techniques: Magnetic resonance imaging (MRI) - Computed tomography (CT) - Positron emission tomography (PET) - Single photon emission computed tomography (SPECT)- Fluorescence imaging.				
PART – A				
Q.No		**CO**	**BT Level**	**Competence**
1.	What is the principle behind X-ray production?	CO4	BTL1	Remembering
2.	Define Bremsstrahlung and characteristic radiation in X-ray production.	CO4	BTL1	Remembering
3.	What are the units of radiation?	CO4	BTL1	Remembering
4.	List the nature of X-rays.	CO4	BTL2	Understanding
5.	What is the need of cooling system in X- ray tube?	CO4	BTL2	Understanding
6.	What is Xeroradiography?	CO4	BTL1	Remembering
7.	What is endoscope?	CO4	BTL2	Understanding
8.	List the different types of endoscopic techniques?	CO4	BTL1	Analyzing
9.	What is “Capsule Endoscopy”?	CO4	BTL2	Understanding
10.	What is the principle behind nuclear imaging technique.	CO4	BTL1	Remembering
11.	Write the difference between nuclear imaging technique and other imaging technique.	CO4	BTL2	Understanding
12.	What is the main radioactive material used in nuclear imaging technique.	CO4	BTL1	Remembering
13.	What is the principle behind Magnetic Imaging Technique (MRI)?	CO4	BTL2	Applying
14.	Write few advantages and disadvantages of MRI.	CO4	BTL2	Applying
15.	Why super conducting magnets are used in MRI?	CO4	BTL2	Applying
16.	What is the principle used in Computer Tomography?	CO4	BTL1	Understanding
17.	What are the disadvantages of first-generation CT?	CO4	BTL2	Applying
18.	Differentiate X-rays and CT images?	CO4	BTL2	Applying
19.	Write the principle of Positron Emission Tomography.	CO4	BTL 1	Understanding
20.	Write the advantages of PET scan.	CO4	BTL 1	Remembering
21.	What is the role of nanotechnology in imaging techniques?	CO4	BTL 2	Applying
22.	What is nuclear medicine?	CO4	BTL2	Applying

23.	What is fluorescence imaging?	CO4	BTL 1	Remembering
24.	Why image reconstruction is important in SPECT?	CO4	BTL 2	Understanding

PART B				
Q.No	**Questions**	**CO**		**Competence**
1.	Explain in detail, the physics of X-ray production including Bremsstrahlung and characteristic X-rays. (16)	CO4	BTL 3	Applying
2.	(i) Discuss the ways of producing X-rays with diagrammatic representations. (13) (ii) Write few applications of X-rays in medical radiation. (3)	CO4	BTL 3	Applying
3.	Write short note on (i) Bremsstrahlung radiation (8) (ii) Characteristic radiation (8)	CO4	BTL 3	Applying
4.	With neat sketch, describe the medical endoscopy. Write the different types of endoscopic technique for various organ. (16)	CO4	BTL 3	Applying
5.	Describe the construction and working of an endoscope, highlighting its applications in different organ imaging. (16)	CO4	BTL 3	Applying
6.	Write a detailed account of nuclear imaging techniques, focussing on their principles and applications. (16)	CO4	BTL 3	Applying
7.	How nuclear imaging different from diagnostic radiology? Explain in detail. (16)	CO4	**BTL 4**	Analyzing
8.	Explain the working principle of Magnetic Resonance Imaging (MRI). (16)	CO4	BTL 3	Applying
9.	With neat diagrammatic representation, explain the principle, mechanism and various components of MRI machine. (16)	CO4	BTL 3	Applying
10.	(i) Write the principle of MRI. (3) (ii) Draw the block diagram of MRI machine and explain the various components used in it. (13)	CO4	BTL 3	Applying
11.	Discuss the different types of detectors used in Computed Tomography. (16)	CO4	BTL 3	Applying
12.	Explain the construction and working of Technetium -99m generator with neat diagram. (16)	CO4	BTL 3	Applying
13.	Provide an overview of computed tomography (CT), including its principle, working and clinical status. (16)	CO4	BTL 3	Applying
14.	Explain the 4^{th} generation Computer Tomography imaging with its diagrammatic representation. (16)	CO4	BTL 3	Applying
15.	Write a short note on (i) Sprial Helical CT (8) (ii) Multiple slice CT (8)	CO4	BTL 3	Applying

16.	Compare the principle and working of PET and SPECT with neat diagram. (16)	CO4	BTL 3	Applying
17.	Describe the principle and clinical applications of Single Photon Emission Tomography. Why it is different from other imaging techniques. (16)	CO4	BTL 3	Applying

UNIT- V: NANOPHYSICS IN BIOMEDICAL APPLICATIONS				
Molecular Engineering - Nanoscale structures as Biological tags - nanoparticles and microorganisms - nano materials in bone substitutes and dentistry- metallic, ceramic and polymeric implant materials – nanoparticles in cosmetics - drug delivery and applications.				
	PART – A			
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	What are quantum dots?	CO5	BTL 1	Remembering
2.	List two applications of quantum dots in biomedical research.	CO5	BTL 2	Understanding
3.	What is molecular engineering?	CO5	BTL 1	Remembering
4.	Define nanoscale structures as biological tags.	CO5	BTL 2	Understanding
5.	What are nano materials?	CO5	BTL 1	Remembering
6.	How do nanoparticles interact with microorganisms?	CO5	BTL 1	Remembering
7.	Name two applications of nanoparticles in antimicrobial treatments.	CO5	BTL 2	Understanding
8.	Mention the different bonds which determine the properties of a biomaterial.	CO5	BTL 2	Understanding
9.	Name few biopolymers used in biomedical applications.	CO5	BTL 2	Understanding
10.	Give few examples for a polymeric implant material.	CO5	BTL 2	Understanding
11.	What is the role of metallic implant materials in human body?	CO5	BTL 1	Remembering
12.	State the uses of nanoparticles in cosmetics.	CO5	BTL 2	Understanding
13.	Do we have nanoparticles in sunscreen? Justify.	CO5	BTL 1	Remembering
14.	What are the materials used in dental implants?	CO5	BTL 1	Remembering
15.	Write the importance of ceramic in orthopedic applications.	CO5	BTL 2	Understanding
16.	Give the importance of collagen in cosmetics surgery.	CO5	BTL 2	Understanding
17.	Write the examples for polymers present in human body.	CO5	BTL 2	Understanding
18.	What is biodegradation?	CO5	BTL 1	Remembering
19.	Mention the materials used in artificial heart valve preparation.	CO5	BTL 2	Understanding
20.	List out biomedical applications of Ti based alloys.	CO5	BTL 2	Understanding
21.	Mention any three internal fixation devices.	CO5	BTL 2	Understanding
22.	How do nanoparticles improve targeted drug delivery?	CO5	BTL 1	Remembering

23.	What is the significance of gold nanoparticles in cancer therapy?	CO5	BTL 1	Remembering
24.	What is carbon nano tube(CNT)? How it is used in medicinal field?	CO5	BTL 1	Remembering

	PART B			
Q.No	Questions	CO	BT LEVEL	**Competence**
1.	What are quantum dots? List out the physical properties of semiconductor quantum dots? (16)	CO5	BTL2	Understanding
2.	Discuss in details how quantum dots are used as biological tag. (16)	CO5	BTL4	Analysing
3.	(i) Discuss the interaction of nanoparticles with microorganisms and their antimicrobial properties. (ii) Explain the mechanisms by which nanoparticles can be used to control microbial infections.	CO5	BTL4	Analysing
4.	Classify biomaterials based on carbon atoms as a backbone and explain its characters and importance in biomedical applications. (16)	CO5	BTL3	Applying
5.	Explain in detail about ceramic material characters and its applications in biomedical field. (16)	CO5	BTL3	Applying
6.	Compare metallic, ceramic, and polymeric implant materials in terms of properties, biocompatibility, and applications. (16)	CO5	BTL3	Applying
7.	Discuss the challenges and advancements in the development of polymeric biomaterials for medical implants. (16)	CO5	BTL4	Analysing
8.	Describe the characteristic feature of metals and its application as implants. (16)	CO5	BTL4	Analysing
9.	Explain in detail about orthopedic implant. (16)	CO5	BTL3	Applying
10.	Explain in detail about dental implants. (16)	CO5	BTL3	Applying
11.	Describe on natural polymers and how its advantageous over metallic implants. (16)	CO5	BTL4	Analysing
12.	Explain the role of nanoparticles in cosmetic formulations, such as sunscreens, anti-aging creams and drug-infused skin care.	CO5	BTL3	Applying
13.	Write short notes on (i) Orthopedic implant (6) (ii) Dental implant (5) Polymeric implant (5)	CO5	BTL4	Analysing
14.	Explain the principles of nanoparticle-based drug delivery systems and their advantages over conventional drug delivery methods. (16)	CO5	BTL3	Applying
15.	Discuss the role of liposomes, dendrimers, and micelles in targeted drug delivery applications. (16)	CO5	BTL4	Analysing
16.	Describe the use of quantum dots in biomedical imaging and disease diagnosis. (16)	CO5	BTL4	Analysing
17.	Explain the role of gold and silver nanoparticles in cancer therapy and targeted drug delivery. (16)	CO5	BTL4	Analysing