SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

V SEMESTER – MDE

PMD101 – BIOMATERIALS

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Subject: PMD101- Biomaterials

Semester/ Year: V/ III

UNIT I – INTRODUCTION TO BIOMATERIALS					
Definition and classification of bio-materials, Mechanical Properties, Viscoelasticity, Biomaterials performance, Body response to implants, Wound healing, Blood Compatibility, Nano scale phenomena					
PART A					
Q.No	**Questions**		**BT level**	**COs**	**Competence**
1.	Define Biomaterials.		BTL 1	CO1	Remembering
2.	List the properties of biomaterials.		BTL 1	CO1	Remembering
3.	Write some examples of biomaterials used in implants		BTL 1	CO1	Remembering
4.	State the concept of biocompatibility of materials.		BTL 1	CO1	Remembering
5.	Express the relation between stress and strain		BTL 1	CO1	Remembering
6.	Identify the importance of viscoelasticity in the biological systems.		BTL 1	CO1	Remembering
7.	Classify various types of biomaterials.		BTL 2	CO1	Understanding
8.	Differentiate between body response and tissue response to implants.		BTL 2	CO1	Understanding
9.	Summarize the various standards used for biomaterials testing and validation.		BTL 2	CO1	Understanding
10.	Interpret the term biocompatibility with an example.		BTL 2	CO1	Understanding
11.	List the characteristics of biomaterials.		BTL 1	CO1	Remembering
12.	Identify the type of graph used to show the relationship between stress and strain.		BTL 1	CO1	Remembering
13.	Define elastic behavior and name one example of an elastic material.		BTL 1	CO1	Remembering
14.	What are the different ways of wound healing techniques?		BTL 1	CO1	Remembering
15.	List the factors affecting the performance of the implants.		BTL 1	CO1	Remembering
16.	Point out different biological effects of host on implants.		BTL 2	CO1	Understanding
17.	Classify the different processing methods involved in Nano scale phenomena.		BTL 2	CO1	Understanding
18.	Outline the different properties of nano scale particles biological applications		BTL 2	CO1	Understanding
19.	What are the different factors that may affect healing?		BTL 2	CO1	Understanding
20.	Discriminate the methods used to categorize biomaterial surfaces.		BTL 2	CO1	Understanding
21.	Interpret the hardness property of biomaterials.		BTL 2	CO1	Understanding
22.	Differentiate various generations of nanoscale phenomena.		BTL 2	CO1	Understanding
23.	Outline the properties of nanoscale phenomena.		BTL 2	CO1	Understanding
24.	Enlist the top-down methods used for synthesis of nano structured materials.		BTL 1	CO1	Remembering
PART B					
1.	Classify different types of biomaterials and demonstrate their applications in various biomedical fields using a tabular format..	(16)	BTL 3	CO1	Applying
2.	Analyze the historical evolution of biomaterials by	(16)	BTL 4	CO1	Analyzing

	categorizing them based on generations used in implant technology.				
3.	(i) Apply your understanding to list two practical applications of biomaterials in clinical use. (ii) Demonstrate how biocompatibility of an implant can be tested through in vitro or in vivo methods.	(8) (8)	BTL 3	CO1	Applying
4.	Analyze the relationship between stress and strain and explain how they influence the mechanical characteristics of a material.	(16)	BTL 4	CO1	Analyzing
5.	Describe how biomaterials influence the function and performance of implants in the human body.	(16)	BTL 3	CO1	Applying
6.	Illustrate the importance of interfacial phenomena in biomaterials using a neat labelled diagram, and apply this knowledge to explain how it affects implant integration	(16)	BTL 3	CO1	Applying
7.	Classify biomaterials according to their mechanical behavior and demonstrate how these properties determine their suitability for specific biomedical applications.	(16)	BTL 3	CO1	Applying
8.	Analyze various safety and efficacy involved in testing of biomaterials	(16)	BTL 3	CO1	Applying
9.	Categorize different methods used for processing of nano-structured biomaterials.	(16)	BTL 4	CO1	Analyzing
10.	Examine the characteristics of the human system at the chemical level with an illustrative diagram.	(16)	BTL 3	CO1	Applying
11.	Analyze performance and tissue response towards the implants.	(16)	BTL 4	CO1	Analyzing
12.	Distinguish the various characterization techniques involvedin nanoscale phenomena.	(16)	BTL 4	CO1	Analyzing
13.	Analyze the stages of the wound healing process by ordering them sequentially and illustrate the process with a neat, labeled diagram	(16)	BTL 4	CO1	Analyzing
14.	(i) Illustrate the surface improvement of biomaterials (ii) Analyze the sterilization procedures of biomaterials.	(8) (8)	BTL 4	CO1	Analyzing
15.	Examine the key stages involved in gas-phase synthesis of nanomaterials and discuss how each step contributes to material formation.	(16)	BTL 4	CO1	Analyzing
16.	Apply the Transmission electron microscopy method to study the properties of Nano scale phenomena	(16)	BTL 3	CO1	Applying
17.	Examine the environmental safety aspects related to the use of nanomaterials and analyze how these may pose risks to biological systems.	(16)	BTL 4	CO1	Analyzing

UNIT II – METALLIC AND CERAMIC MATERIALS					
Metallic implants – Stainless steels, Co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implants – bioinerts, biodegradable or bioresorbable, bioactive ceramics, nanostructured bioceramics					
PART – A					
Q.No	**Questions**		**BT Level**	**COs**	**Competence**
1.	Define corrosion.		BTL 1	CO2	Remembering
2.	Name the technique to improve corrosion resistance in SS		BTL 1	CO2	Remembering
3.	Enumerate the engineering materials used for implants		BTL 1	CO2	Remembering
4.	Give some properties of cobalt (CO).		BTL 1	CO2	Remembering
5.	Name the widely used stainless steel implant materials. Whatare their component elements?		BTL 1	CO2	Remembering
6.	Quote the composition of stainless steels?		BTL 1	CO2	Remembering
7.	Write about the process of forging in Co-Cr alloys		BTL 2	CO2	Understanding
8.	Mention about process of annealing in Ti based implants.		BTL 2	CO2	Understanding
9.	Enumerate four applications of SS implants.		BTL 2	CO2	Understanding
10.	State the phenomenon of Transition Temperature Range (TTR) in shape memory alloys.		BTL 1	CO2	Remembering
11.	Mention the properties of platinum with an application.		BTL 1	CO2	Remembering
12.	List the facial augmentation corrections that can be achieved using HA.		BTL 1	CO2	Remembering
13.	Illustrate the structure of Ti and Ti based alloys.		BTL 2	CO2	Understanding
14.	How does corrosion damage the human body?		BTL 2	CO2	Understanding
15.	Infer the advantages in using titanium as an implant material?		BTL 2	CO2	Understanding
16.	Classify the types of corrosion.		BTL 2	CO2	Understanding
17.	Implement the evaluation procedure for the success rate of ceramic implant.		BTL 2	CO2	Understanding
18.	Outline the drawback of Glass-ceramics based biomaterials.		BTL 2	CO2	Understanding
19.	Mention the design procedure to build the nano structured metallic implant.		BTL 2	CO2	Understanding
20.	Write down the synthesis procedure of nano alumina.		BTL 1	CO2	Remembering
21.	Highlight the significance of passivation.		BTL 2	CO2	Understanding
22.	Distinguish between fibroblast and fiber.		BTL 2	CO2	Understanding
23.	Differentiate between osteoclast and osteoblast.		BTL 2	CO2	Understanding
24.	Define the process of age hardening.		BTL 2	CO2	Understanding
PART B					
1.	Classify the various types of corrosion seen in biomaterials.	(16)	BTL 3	CO2	Applying
2.	Infer and reason the application of NiTi alloy as implants	(16)	BTL 3	CO2	Applying
3.	Integrate an application for ceramics in medical field and explain its characteristics.	(16)	BTL 4	CO2	Analyzing
4.	Analzye the methods of testing corrosion of biomaterials with its biocompatibility using invitro/invivo studies.) .	(16)	BTL 4	CO2	Analyzing
5.	Explain how the biological compatibility of Iron	(16)	BTL 3	CO2	Applying

	and Cobalt affects their use in fabricating biomaterials.				
6.	Analyze the mechanical behavior of titanium-based alloys by discussing their composition, fabrication techniques, and performance in biomedical applications.	(16)	BTL 4	CO2	Analyzing
7.	Analyze the key properties of biomedical ceramics and evaluate their advantages and limitations in clinical or implant-related applications.	(16)	BTL 4	CO2	Analyzing
8.	Interpret the characteristics features of metals and its applications as implants.	(16)	BTL 3	CO2	Applying
9.	Using the key characteristics of different alloys, tabulate the various biomedical applications of metallic implants.	(16)	BTL 3	CO2	Applying
10.	Examine the use of ceramics in medical applications withexamples.	(16)	BTL 3	CO2	Applying
11.	Explain the process of corrosion rate measurement for studying the properties of biomaterials.	(16)	BTL 4	CO2	Analyzing
12.	Analyze the effect of corrosion products on implants and biological tissues	(16)	BTL 4	CO2	Analyzing
13.	Identify the process of metallic corrosion related to biomaterials.	(16)	BTL 4	CO2	Analyzing
14.	Outline the biological tolerance of metals such as Nickel, Manganese, Titanium used as implants.	(16)	BTL 3	CO2	Applying
15.	Categorize the methods available for Nano ceramic synthesis	(16)	BTL 4	CO2	Analyzing
16.	Illustrate the structural importance of bioactive glass	(16)	BTL 3	CO2	Applying
17.	Classify common bioceramic implants by their interaction with body tissues, and identify one suitable medical application for each type.	(16)	BTL 3	CO2	Applying

UNIT III – POLYMERIC IMPLANT MATERIALS				
Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers,Biopolymers: Collagen, Elastin and chitin, Medical Textiles, Case study of organ regeneration				
PART – A				
Q.No	**Questions**	**BT Level**	**COs**	**Competence**
1.	List the factors that influence the properties of polymers.	BTL 1	CO3	Remembering
2.	What is Collagen?	BTL 1	CO3	Remembering
3.	Define Polymer.	BTL 1	CO3	Remembering
4.	Identify the material used for designing contact lens.	BTL 1	CO3	Remembering
5.	State the methods of polymerisation.	BTL 1	CO3	Remembering
6.	What are PLA composites?	BTL 1	CO3	Remembering
7.	Give details about wound dressings.	BTL 2	CO3	Understanding
8.	Sketch the structure of Chitosan.	BTL 2	CO3	Understanding
9.	What is meant by Medical textiles?	BTL 2	CO3	Understanding
10.	Define the term polymerization.	BTL 2	CO3	Understanding
11.	Interpret the applications of different types of polymers.	BTL 1	CO3	Remembering
12.	Identify a polymer suitable for dental applications.	BTL 1	CO3	Remembering
13.	List the steps involved in condensation and addition polymerization.	BTL 1	CO3	Remembering
14.	Point out different applications of medical textiles.	BTL 1	CO3	Remembering
15.	Define elastin and list its basic structural features and properties.	BTL 1	CO3	Remembering

16.	Categories polymers into various different classes based on application.		BTL 2	CO3	Understanding
17.	Mention the criteria and requirements needed for a polymer.		BTL 2	CO3	Understanding
18.	Classify the use of polymers as biomaterials.		BTL 2	CO3	Understanding
19.	Interpret the method or strategy used in the development of biodegradable polymers.		BTL 2	CO3	Understanding
20.	Mention the type of biomaterial suitable for promoting effective wound healing.		BTL 2	CO3	Understanding
21.	Enlist the demerits of drawing methods used for processing polymer nanofibers.		BTL 2	CO3	Understanding
22.	Outline the schematic of polymer nanofiber processing by template method.		BTL 2	CO3	Understanding
23.	Identify the importance of phase separation method.		BTL 2	CO3	Understanding
24.	Differentiate between decalcification and deproteination		BTL 2	CO3	Understanding
	PART B				
1.	Distinguish between the natural polymers over the metallic implants.	(16)	BTL 4	CO3	Analyzing
2.	Identify the key properties of polymers and illustrate how different factors such as temperature, molecular weight, and crystallinity influence these properties..	(16)	BTL 3	CO3	Applying
3.	Define biopolymers, identify suitable examples, and describe their common characteristics relevant to biomedical use.	(16)	BTL 3	CO3	Applying
4.	Integrate the various stages involved in organ regeneration.	(16)	BTL 4	CO3	Analyzing
5.	Explain how polymer nanofibers are used in wound dressing.	(16)	BTL 3	CO3	Applying
6.	Illustrate the properties of medical textiles and express its application in the field of medical applications.	(16)	BTL 3	CO3	Applying
7.	Structure a model to show how smart polymers are used as biomaterials.	(16)	BTL 4	CO3	Analyzing
8.	Discriminate the structures of PLA, PGA, PLGA and metion itsapplication.	(16)	BTL 4	CO3	Analyzing
9.	Examine the biomedical applications of polymer nanofibersand explain them.	(16)	BTL 3	CO3	Applying
10.	Using a technique of electrospinning, discuss how processingof polymer is carried out.	(16)	BTL 3	CO3	Applying
11.	Compare and contrast the types of synthetic polymers.	(16)	BTL 4	CO3	Analyzing
12.	Classify the polymeric biomaterials and analyze its characteristics,merits and demerits.	(16)	BTL 4	CO3	Analyzing
13.	Identify different characteristics of naturally derived polymers.	(16)	BTL 4	CO3	Analyzing
14.	Implement a drug delivery system having influenced by the biodegradation on properties of biodegradable polymers.	(16)	BTL 3	CO3	Applying
15.	Highlight the role and significance of tissue scaffolds in supporting cell growth and regeneration within the field of tissue engineering.	(16)	BTL 3	CO3	Applying
16.	Analyze medical prostheses using polymer nanofibers.	(16)	BTL 4	CO3	Analyzing
17.	Contrast the different self assembly methods to	(16)	BTL 4	CO3	Analyzing

	process polymer nano fibers.				

UNIT IV – TISSUE REPLACEMENT IMPLANTS				
Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.				
PART – A				
Q.No	**Questions**	**BT Level**	**COs**	**Competence**
1.	What is meant by the term *extracellular matrix (ECM)*?	BTL 1	CO4	Remembering
2.	Identify two medical uses of small intestinal submucosa (SIS).	BTL 1	CO4	Remembering
3.	List two commonly used decellularized matrix biomaterials.	BTL 1	CO4	Remembering
4.	Mention any two clinical applications of soft tissue replacement.	BTL 1	CO4	Remembering
5.	What is the purpose of sutures in surgery?	BTL 1	CO4	Remembering
6.	List any two examples of surgical adhesive materials.	BTL 1	CO4	Remembering
7.	Why decellularized matrix materials are important in soft tissue reconstruction?	BTL 2	CO4	Understanding
8.	Outline the contribution of small intestinal submucosa (SIS) to the process of tissue regeneration.	BTL 2	CO4	Understanding
9.	Mention the importance of using biocompatible sutures to enhance the tissue healing process.	BTL 2	CO4	Understanding
10.	Interpret how percutaneous implants improve the success and efficiency of clinical treatments.	BTL 2	CO4	Understanding
11.	Name two biomaterials used in percutaneous implant devices.	BTL 1	CO4	Remembering
12.	Define the term *maxillofacial augmentation*.	BTL 1	CO4	Remembering
13.	What is meant by hard tissue replacement implants?	BTL 1	CO4	Remembering
14.	Give two examples of joints commonly replaced using implants.	BTL 1	CO4	Remembering
15.	Name two polymers used for soft or hard tissue scaffolds.	BTL 1	CO4	Remembering
16.	Classify common biomaterials used in hard tissue replacements based on their type (metal, ceramic, polymer).	BTL 2	CO4	Understanding
17.	Interpret the significance of using nanotechnology in developing biomaterials for regenerative medicine.	BTL 2	CO4	Understanding
18.	Contrast the function of vascular grafts in cardiovascular treatments.	BTL 2	CO4	Understanding
19.	How nanoscale features improve the performance of biomedical scaffolds?	BTL 2	CO4	Understanding
20.	Infer the benefits of using biocompatible materials in joint replacements.	BTL 2	CO4	Understanding
21.	Enlist the need for joint replacement implants in orthopedic surgery.	BTL 2	CO4	Understanding
22.	Highlight the application of ECM-derived materials in procedures like maxillofacial reconstruction.	BTL 2	CO4	Understanding
23.	Outline the importance of skin–implant interface in ensuring implant stability.	BTL 2	CO4	Understanding
24.	Interpret the risks associated with infections around percutaneous implants.	BTL 2	CO4	Understanding

PART B					
1.	Examine the structural components of decellularized matrices and their functional relevance in soft tissue engineering.	(16)	BTL 4	CO4	Analyzing
2.	Compare the biological role of natural extracellular matrix with engineered scaffolds in tissue healing.	(16)	BTL 4	CO4	Analyzing
3.	Distinguish between the clinical outcomes of using soft tissue replacements versus traditional grafts.	(16)	BTL 4	CO4	Analyzing
4.	Analyze how small intestinal submucosa (SIS) differs from synthetic grafts in promoting tissue repair	(16)	BTL 4	CO4	Analyzing
5.	Analyze how material properties influence the selection of implants for soft tissue reconstruction.	(16)	BTL 4	CO4	Analyzing
6.	Explain the application of surgical adhesives in managing incisions or tissue trauma.	(16)	BTL 3	CO4	Applying
7.	Identify and explain the clinical use of surgical adhesives in managing tissue trauma or incisions.	(16)	BTL 3	CO4	Applying
8.	Describe how surface design influences the performance of percutaneous implants in tissue integration.	(16)	BTL 3	CO4	Applying
9.	Apply the concept of biomaterial-tissue interaction to explain the role of skin implants in facial reconstruction or cosmetic procedures.	(16)	BTL 3	CO4	Applying
10.	Examine how the design and surface characteristics of percutaneous implants affect long-term tissue integration.	(16)	BTL 3	CO4	Applying
11.	Analyze the structural and functional considerations involved in selecting biomaterials for maxillofacial augmentation.	(16)	BTL 4	CO4	Analyzing
12.	Differentiate between the types of joint replacement implants used for hip and knee applications.	(16)	BTL 4	CO4	Analyzing
13.	Compare the performance of biological vs. synthetic vascular grafts in terms of compatibility and long-term patency.	(16)	BTL 4	CO4	Analyzing
14.	Apply your understanding to suggest suitable suture materials for internal organ repair and justify the choice.	(16)	BTL 3	CO4	Applying
15.	Use a case scenario to show how surgical tapes are applied post-operatively to aid in healing and minimize scarring.	(16)	BTL 3	CO4	Applying
16.	Explain how small intestinal submucosa (SIS) is used in clinical soft tissue repair procedures.	(16)	BTL 3	CO4	Applying
17.	Examine the challenges associated with vascular graft integration in complex surgical environments.	(16)	BTL 3	CO4	Applying

UNIT V – APPLICATIONS OF NANO BIOMATERIALS					
Applications of nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs - Bioimaging/Biosensor-Molecular Imaging- challenges and future perspective.					
PART – A					
Q.No	**Questions**		**BT Level**	**COs**	**Competence**
1.	Define nanoantibiotics.		BTL 1	CO5	Remembering
2.	State two applications of biochips.		BTL 1	CO5	Remembering
3.	List any two examples of bioimaging techniques.		BTL 1	CO5	Remembering
4.	State any two uses of biosensors in healthcare.		BTL 1	CO5	Remembering
5.	What is meant by molecular imaging?		BTL 1	CO5	Remembering
6.	Mention any two challenges in the application of nanomedicine.		BTL 1	CO5	Remembering
7.	Interpret how bioimaging assists in early disease diagnosis.		BTL 2	CO5	Understanding
8.	Outline the principle of molecular imaging in healthcare.		BTL 2	CO5	Understanding
9.	Point out the benefits of integrating biosensors with imaging systems.		BTL 2	CO5	Understanding
10.	Highlight the challenge faced in developing clinical nanodiagnostic tools.		BTL 2	CO5	Understanding
11.	List two future prospects of nanotechnology in biomedical fields.		BTL 1	CO5	Remembering
12.	State two limitations in the current use of nanomedicines.		BTL 1	CO5	Remembering
13.	Name two techniques used in bioimaging.		BTL 1	CO5	Remembering
14.	Mention two limitations in the use of molecular imaging techniques.		BTL 2	CO5	Understanding
15.	Intrepret the future potential of BioNEMs in targeted drug delivery.		BTL 2	CO5	Understanding
16.	Summarize two advancements expected in biosensor technology.		BTL 2	CO5	Understanding
17.	How nanoantibiotics help in overcoming antibiotic resistance?		BTL 2	CO5	Understanding
18.	Define the term nanomedicine with an example.		BTL 1	CO5	Remembering
19.	Infer the role of nanomedicine in targeted drug delivery.		BTL 2	CO5	Understanding
20.	Mention the function of nanoantibiotics in treating bacterial infections.		BTL 2	CO5	Understanding
21.	Identify one key advantage of using nanomedicines over conventional drugs		BTL 2	CO5	Understanding
22.	Interpret the use of biochips in disease diagnosis		BTL 2	CO5	Understanding
23.	How is biomimetics defined in biomedical engineering?		BTL 1	CO5	Remembering
24.	Name any two tools used in molecular imaging.		BTL 1	CO5	Remembering
PART B					
1.	Illustrate how nanoantibiotics can be applied in treating antibiotic-resistant infections.	(16)	BTL 3	CO5	Applying
2.	Describe the concept of nanomedicine in the treatment of site-specific cancer therapy.	(16)	BTL 3	CO5	Applying
3.	Describe how biosensors can monitor glucose levels in diabetic patients.	(16)	BTL 3	CO5	Applying
4.	Explain how biomimetic scaffolds are used in regenerative tissue engineering.	(16)	BTL 3	CO5	Applying
5.	Compare nanoantibiotics with conventional antibiotics in terms of mechanism and effectiveness.	(16)	BTL 4	CO5	Analyzing
6.	Analyze the advantages and limitations of	(16)	BTL 4	CO5	Analyzing

	nanomedicines in personalized medicine.				
7.	Apply the concept of BioNEMs in the development of nanoscale surgical tools.	(16)	BTL 3	CO5	Applying
8.	Apply the principles of BioNEMs to explain their role in minimally invasive surgeries.	(16)	BTL 3	CO5	Applying
9.	Apply the concept of nanotechnology in enhancing the performance of bioimaging techniques.	(16)	BTL 3	CO5	Applying
10.	Suggest practical solutions to overcome current challenges in the clinical use of nanomedicine.	(16)	BTL 3	CO5	Applying
11.	Differentiate between DNA and protein biochips based on structure and application.	(16)	BTL 4	CO5	Analyzing
12.	Analyze two major challenges in the clinical translation of nanomedicine-based therapies.	(16)	BTL 4	CO5	Analyzing
13.	Compare traditional imaging techniques with molecular imaging in terms of resolution and specificity.	(16)	BTL 4	CO5	Analyzing
14.	Examine how future innovations in bioimaging could improve the accuracy of non-invasive diagnostics.	(16)	BTL 4	CO5	Analyzing
15.	Explain how future advancements in biosensors could transform real-time health monitoring.	(16)	BTL 3	CO5	Applying
16.	Evaluate how bioimaging contributes to personalized medicine through real-time monitoring.	(16)	BTL 4	CO5	Analyzing
17.	Examine how biomimetics enhances the functionality of artificial implants.	(16)	BTL 4	CO5	Analyzing