SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK

IV SEMESTER – MDE

1910401 – BIOMATERIALS AND ARTIFICIAL ORGANS

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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**		**Competence**
1.	Define Biomaterials.	**BTL 1**		Remembering
2.	List the properties of biomaterials.	**BTL 1**		Remembering
3.	State some examples of biomaterials used in implants	**BTL 1**		Remembering
4.	What is biocompatibility?	**BTL 1**		Remembering
5.	Mention the relation between stress and strain	**BTL 1**		Remembering
6.	What is viscoelasticity?	**BTL 1**		Remembering
7.	Classify various types of biomaterials.	**BTL 2**		Understanding
8.	Discuss how body respond to implants.	**BTL 2**		Understanding
9.	Summarize the various standards used for biomaterials testing and validation.	**BTL 2**		Understanding
10.	Demonstrate the term biocompatibility with an example.	**BTL 2**		Understanding
11.	Applying the materials used, classify biomaterials.	**BTL 3**		Applying
12.	Sketch graphically the relationship between stress and strain.	**BTL 3**		Applying
13.	Using an example explain elastic behaviour of materials.	**BTL 3**		Applying
14.	Analyze different ways of wound healing techniques.	**BTL 4**		Analyzing
15.	Explain various factors affecting performance of the implants.	**BTL 4**		Analyzing
16.	Point out different biological effects of host on implants.	**BTL 4**		Analyzing
17.	Compare the different processing methods involved in Nano scale phenomena.	**BTL 5**		Evaluating
18.	Estimate different properties of nano scale particles.	**BTL 5**		Evaluating
19.	Write different factors that may affect healing.	**BTL 6**		Creating
20.	Develop the methods used to categorize biomaterial surfaces.	**BTL 6**		Creating
PART-B				
1.	Tabulate the classification of biomaterials used for different applications.	**(13)**	**BTL 1**	Remembering
2.	Tabulate the historical developments of biomaterials that are used as implants.	**(13)**	**BTL 1**	Remembering
3.	i. State the applications of biomaterials. ii. How biocompatibility of implants can be tested?	**(5)** **(8)**	**BTL 1**	Remembering
4.	How stress and strain affect the characteristics of a material?	**(13)**	**BTL 1**	Remembering
5.	Describe the impact of biomaterials that are used as implants.	**(13)**	**BTL 2**	Understanding

6.	Mention the significance of interfacial phenomena with neat labelled diagram	**(13)**	**BTL 2**	Understanding
7.	Classify the biomaterials based on their mechanical properties	**(13)**	**BTL 2**	Understanding
8.	Analyze various safety and efficacy involved in testing of biomaterials	**(13)**	**BTL 3**	Applying
9.	Demonstrate the different methods of processing nanostructured materials.	**(13)**	**BTL 3**	Applying
10.	Interpret on the thermal treatment of biomaterials that are used as implants	**(13)**	**BTL 3**	Applying
11.	Analyze performance and tissue response towards the implants.	**(13)**	**BTL 4**	Analyzing
12.	i. Illustrate the surface improvement of biomaterials. ii. Analyze the sterilization procedures of biomaterials.	**(7)** **(6)**	**BTL 4**	Analyzing
13.	Summarize the various characterization techniques involved in nanoscale phenomena.	**(13)**	**BTL 5**	Evaluating
14.	Compile the sequence of local events following implantation in detail ?	**(13)**	**BTL 6**	Creating
	PART-C			
1.	Summarize wound healing process with illustrative diagram.	**(15)**	**BTL 5**	Evaluating
2.	Evaluate the ways to characterize a biomaterial and explain different methods adopted to characterize its physical properties.	**(15)**	**BTL 5**	Evaluating
3.	Examine the characteristics of human system at the chemical level with an illustrative diagram	**(15)**	**BTL 6**	Creating
4.	Describe the characteristics of human system at the cellular level with an illustrative diagram.	**(15)**	**BTL 6**	Creating

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**	**Competence**
1.	Define corrosion.	**BTL 1**	Remembering
2.	State the technique to improve corrosion resistance in SS	**BTL 1**	Remembering
3.	Enumerate the engineering materials used for implants	**BTL 1**	Remembering
4.	Give some properties of cobalt (CO).	**BTL 1**	Remembering
5.	Name the widely used stainless steel implant materials. What are their component elements?	**BTL 1**	Remembering
6.	Quote the composition of stainless steels?	**BTL 1**	Remembering
7.	Write about the process of forging in Co-Cr alloys	**BTL 2**	Understanding
8.	Explain about process of annealing in Ti based implants	**BTL 2**	Understanding
9.	Enumerate four applications of SS implants.	**BTL 2**	Understanding
10.	State the phenomenon of Transition Temperature Range (TTR) in shape memory alloys.	**BTL 2**	Understanding

11.	Mention the properties of platinum with an application.		**BTL 3**	Applying
12.	Manipulate the facial augmentation corrections that can be achieved using HA.		**BTL 3**	Applying
13.	Sketch the structure of Ti and Ti based alloys.		**BTL 3**	Applying
14.	Categorize the ways, corrosion attacks the surrounding tissue		**BTL 4**	Analyzing
15.	Infer the advantages in using titanium as an implant material?		**BTL 4**	Analyzing
16.	Classify the types of corrosion		**BTL 4**	Analyzing
17.	How the success rate of ceramic implant evaluated?		**BTL 5**	Evaluating
18.	Estimate the drawback of Glass-ceramics based biomaterials		**BTL 5**	Evaluating
19.	Formulate how nano structured metallic implant is designed.		**BTL 6**	Creating
20.	Design the synthesis procedure of nano alumina.		**BTL 6**	Creating
PART – B				
1.	What is stainless steel? Mention the composition, fabrication of stainless steel. Also state its medical applications.	**(13)**	**BTL 1**	Remembering
2.	Define NITINOL. Mention the significance of other metals used as biomaterials implants	**(13)**	**BTL 1**	Remembering
3.	List different mechanical properties and applications of Co-Cr based alloys.	**(13)**	**BTL 1**	Remembering
4.	Summarize the biological tolerance for Chromium, Molybdenum metals used as implants	**(13)**	**BTL 1**	Remembering
5.	Summarise the biological tolerance of Iron and Cobalt metals used for fabrication of biomaterials.	**(13)**	**BTL 2**	Understanding
6.	Write an essay about Ti- based alloys with its mechanical properties, composition and fabrication process.	**(13)**	**BTL 2**	Understanding
7.	Describe the properties, merits and demerits of ceramics.	**(13)**	**BTL 2**	Understanding
8.	Interpret the characteristic features of metals and its applications as implants.	**(13)**	**BTL 3**	Applying
9.	Using the key characteristics of different alloys, tabulate the various biomedical applications of metallic implants.	**(13)**	**BTL 3**	Applying
10.	Examine the use of ceramics in medical applications with examples.	**(13)**	**BTL 3**	Applying
11.	Explain the process of corrosion rate measurement for studying the properties of biomaterials.	**(13)**	**BTL 4**	Analyzing
12.	Analyze the effect of corrosion products on implants and biological tissues.	**(13)**	**BTL 4**	Analyzing
13.	Evaluate the process of metallic corrosion related to biomaterials.	**(13)**	**BTL 5**	Evaluating
14.	Formulate the biological tolerance of metals such as Nickel, Manganese, Titanium used as implants.	**(13)**	**BTL 6**	Creating
PART – C				
1.	Summarise the various types of corrosion seen in biomaterials.	**(15)**	**BTL 5**	Evaluating
2.	Support why NiTi alloy has been proposed to be used for different applications?	**(15)**	**BTL 5**	Evaluating
3.	Develop an application for ceramics in medical field and explain its characteristics.	**(15)**	**BTL 6**	Creating
4.	Compile the methods of testing corrosion of biomaterials with its biocompatibility using invitro/invivo studies.) .	**(15)**	**BTL 6**	Creating

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**		**Competence**
1.	List the factors that influence the properties of polymers.	**BTL 1**		Remembering
2.	What is Collagen?	**BTL 1**		Remembering
3.	Define Polymer.	**BTL 1**		Remembering
4.	Identify the material used for designing contact lens.	**BTL 1**		Remembering
5.	State the methods of polymerisation.	**BTL 1**		Remembering
6.	What are PLA composites?	**BTL 1**		Remembering
7.	Give details about wound dressings.	**BTL 2**		Understanding
8.	Illustrate the structure of Chitosan?	**BTL 2**		Understanding
9.	Explain Medical textiles?	**BTL 2**		Understanding
10.	Define polymerisation.	**BTL 2**		Understanding
11.	Interpret the applications of different types of polymers.	**BTL 3**		Applying
12.	Choose the polymer that can be used for dental applications.	**BTL 3**		Applying
13.	Mention the steps involved in condensation and addition polymerisation.	**BTL 3**		Applying
14.	Point out different applications of medical textiles.	**BTL 4**		Analyzing
15.	Analyze the structure and properties of Elastin?	**BTL 4**		Analyzing
16.	Categorise Polymers.	**BTL 4**		Analyzing
17.	Evaluate the criteria and requirements needed for a polymer.	**BTL 5**		Evaluating
18.	How polymers is used as biomaterials?	**BTL 5**		Evaluating
19.	Organise how biodegradable polymers are developed.	**BTL 6**		Creating
20.	Design a polymer that can be used for wound healing.	**BTL 6**		Creating
PART – B				
1.	What is polymerisation? How polymerisation is achieved?	**(13)**	**BTL 1**	Remembering
2.	List the properties of polymers. Also explain different factors that influence the properties of polymers.	**(13)**	**BTL 1**	Remembering
3.	Define biopolymer. Give some examples. Mention the characteristics of biopolymers.	**(13)**	**BTL 1**	Remembering
4.	Tabulate how polymers is used as biomaterials.	**(13)**	**BTL 1**	Remembering
5.	Explain how polymer nanofibers are used in wound dressing.	**(13)**	**BTL 2**	Understanding
6.	Discuss the properties of medical textiles and express its application in the field of medical applications.	**(13)**	**BTL 2**	Understanding
7.	Describe in detail about collagen and elastin.	**(13)**	**BTL 2**	Understanding
8.	Sketch the structure of PLA, PGA, PLGA and metion its application.	**(13)**	**BTL 3**	Applying
9.	Examine the biomedical applications of polymer nanofibers and explain them.	**(13)**	**BTL 3**	Applying
10.	Using a technique of electrospinning, discuss how processing of polymer is carried out.	**(13)**	**BTL 3**	Applying
11.	Compare and contrast the types of synthetic polymers.	**(13)**	**BTL 4**	Analyzing

12.	Classify the polymeric biomaterials and analyze its characteristics, merits and demerits.	**(13)**	**BTL 4**	Analyzing
13.	Appraise different characteristics of naturally derived polymers.	**(13)**	**BTL 5**	Evaluating
14.	Design a study to appraise organ regeneration.	**(13)**	**BTL 6**	Creating
	PART – C			
1.	Justify that the use of natural polymers are advantageous over metallicimplants.	**(15)**	**BTL 5**	Evaluating
2.	Predict the various stages involved in organ regeneration.	**(15)**	**BTL 5**	Evaluating
3.	Develop a model to show how smart polymers are used as biomaterials.	**(15)**	**BTL 6**	Creating
4.	Formulate a drug delivery system having influenced by the biodegradation on properties of biodegradable polymers.	**(15)**	**BTL 6**	Creating

UNIT IV- ARTIFICIAL ORGANS AND TRANSPLANT			
Artificial Organs: Introduction, outlook for organ replacements, design consideration, evaluation process Transplants: Overview, immunological considerations, blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Tabulate the immune response to transplantation.	**BTL 1**	Remembering
2.	Write the challenges behind organ replacement.	**BTL 1**	Remembering
3.	Name the types of grafts.	**BTL 1**	Remembering
4.	Identify the common orthopedic biomaterials.	**BTL 1**	Remembering
5.	Define bioartificial organ?	**BTL 1**	Remembering
6.	List the functions of kidney.	**BTL 1**	Remembering
7.	Discuss what does renal failure refers to?	**BTL 2**	Understanding
8.	What do you understand from the word transplant?	**BTL 2**	Understanding
9.	How blood types are classified?	**BTL 2**	Understanding
10.	Define blood transfusion? What are the types of blood transfusion?	**BTL 2**	Understanding
11.	Interpret when corneal transplant is to be made.	**BTL 3**	Applying
12.	List the causes of liver failure.	**BTL 3**	Applying
13.	Relate lung transplantation with heart lung transplantation.	**BTL 3**	Applying
14.	How do bioartificial organs classified?	**BTL 4**	Analyzing
15.	Categorise the different generation of organ replacement.	**BTL 4**	Analyzing
16.	Point out the different phases of organ replacement.	**BTL 4**	Analyzing
17.	Predict different technologies for replacing organs.	**BTL 5**	Evaluating
18.	Estimate the side effects of conditioning process carried out during the stem cell transplant process.	**BTL 5**	Evaluating
19.	Substitute a name for the process where healthy blood-forming stem cells is infused into a body. Also state the types of donors this method may have.	**BTL 6**	Creating
20.	Compose a name to a process when the recipient's immune system attacks the donated graft and begins destroying the transplanted tissue or organ.	**BTL 6**	Creating

PART – B				
1.	List the various applications of hybrid artificial organs.	**(13)**	**BTL 1**	Remembering
2.	When do a bone marrow transplant to be carried out? What would be the procedure followed?	**(13)**	**BTL 1**	Remembering
3.	What does a transplant refers to? What are the types of transplants available? State the general procedure followed during a transplant process.	**(13)**	**BTL 1**	Remembering
4.	i. Describe about heart transplant and lung transplant process. ii. Elaborate when a heart-lung transplant is carried out and also explain the procedure followed for doing the same.	**(6)** **(7)**	**BTL 1**	Remembering
5.	Discuss in detail about the design consideration that is to be followed during organ replacement.	**(13)**	**BTL 2**	Understanding
6.	Elaborate the process of bone marrow transplant.	**(13)**	**BTL 2**	Understanding
7.	Explain keratoplasty in detail. Also describe its procedure and risk factor. Also state when this transplant is to be done.	**(13)**	**BTL 2**	Understanding
8.	Sketch the different generations of organ replacement and elaborate the same.	**(13)**	**BTL 3**	Applying
9.	Using the technological advancements, explain how organ functions can be replaced by using transplants.	**(13)**	**BTL 3**	Applying
10.	Report and elaborate the different rejection mechanism when a transplantation is carried out.	**(13)**	**BTL 3**	Applying
11.	Criticize the different ways of organ replacement techniques.	**(13)**	**BTL 4**	Analyzing
12.	Compare and contrast the types of bioartificial organs.	**(13)**	**BTL 4**	Analyzing
13.	Summarise the process of renal replacement therapy.	**(13)**	**BTL 5**	Evaluating
14.	Model a artificial hip joint with a suitable biomaterial such that it can be used in hip replacement.	**(13)**	**BTL 6**	Creating
PART – C				
1.	Evaluate different phases of evaluation process involved in organ replacement.	**(15)**	**BTL 5**	Evaluating
2.	Predict the risk factors and complications of blood transfusions.	**(15)**	**BTL 5**	Evaluating
3.	Anticipate the working of a heart-lung machine.	**(15)**	**BTL 6**	Creating
4.	Develop a model which helps in understanding the permanent organ replacement.	**(15)**	**BTL 6**	Creating

UNIT V – IMPLANTABLE MEDICAL DEVICES AND ORGANS			
Gastrointestinal System, Dentistry, Maxillofacial and craniofacial replacement, soft tissue repair, replacement and augmentation, recent advancement and future directions			
PART –A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Write the applications of soft tissue augmentation.	**BTL 1**	Remembering
2.	Define craniofacial replacement.	**BTL 1**	Remembering

3.	Name the major components of gastrointestinal system.	**BTL 1**	Remembering
4.	Identify the aim of performing maxillofacial replacement.	**BTL 1**	Remembering
5.	Quote dental implant?	**BTL 1**	Remembering
6.	List the characteristics of sutures.	**BTL 1**	Remembering
7.	How the maxillofacial protheses classified?	**BTL 2**	Understanding
8.	What do you understand from the term augmentation?	**BTL 2**	Understanding
9.	Write about dental implants.	**BTL 2**	Understanding
10.	Discuss some of the recent advancement in designing the implantable devices.	**BTL 2**	Understanding
11.	Illustrate the surgical procedure of dental implant.	**BTL 3**	Applying
12.	Using the maxillofacial replacement, which parts of the body is being corrected.	**BTL 3**	Applying
13.	Show the difference between soft tissue and hard tissue.	**BTL 3**	Applying
14.	Why tissue engineered GI tract replacement is advisable?	**BTL 4**	Analyzing
15.	Point out the risk factors that may affect the results of craniofacial reconstruction?	**BTL 4**	Analyzing
16.	Differentiate dental implants from dentures.	**BTL 4**	Analyzing
17.	Predict the necessity of craniofacial reconstruction.	**BTL 5**	Evaluating
18.	Summarize the function of soft tissue augmentation.	**BTL 5**	Evaluating
19.	Suggest a way to design a implantable lens.	**BTL 6**	Creating
20.	Devise a method to design a heart valve.	**BTL 6**	Creating

PART – B

1.	Highlight the different types of prostheses that comes and maxillofacial replacement and explain the same.	**(13)**	**BTL 1**	Remembering
2.	What is implantable device? Give some examples of implantable medical devices and explain their purpose.	**(13)**	**BTL 1**	Remembering
3.	List the biomaterials that can be used in dentistry? Also describe the implantable devices related to dentistry.	**(13)**	**BTL 1**	Remembering
4.	Define craniofacial replacement. Where is this procedure followed and how it is carried out?	**(13)**	**BTL 1**	Remembering
5.	Explain the various considerations that are to be considered during the GI tract replacement.	**(13)**	**BTL 2**	Understanding
6.	Briefly describe the various artificial organs related to GI system that can be implanted into a human body.	**(13)**	**BTL 2**	Understanding
7.	Discuss in detail about different percutaneous implants.	**(13)**	**BTL 2**	Understanding
8.	Using the design consideration, how permanent skin control substitute is made.	**(13)**	**BTL 3**	Applying
9.	Interpret the pros and cons of different types of suture materials.	**(13)**	**BTL 3**	Applying
10.	With the help of technological advancements, describe the recent advancement in the soft tissue repair technique.	**(13)**	**BTL 3**	Applying
11.	Classify biomaterials for different maxillofacial prostheses and explain its applications.	**(13)**	**BTL 4**	Analyzing
12.	Compare and contrast replacement and augmentation techniques.	**(13)**	**BTL 4**	Analyzing
13.	Differentiate the different maxillofacial and craniofacial organs by evaluating their different replacement techniques.	**(13)**	**BTL 5**	Evaluating

14.	Formulate the steps to be followed when plastic surgery is being carried out.	**(13)**	**BTL 6**	Creating
PART – C				
1.	Evaluate the biomaterials design controls using different	**(15)**	**BTL 5**	Evaluating
2.	How to choose a best biomaterial in application of skin replacement and explain in detail.	**(15)**	**BTL 5**	Evaluating
3.	Develop a dental implant system by stating the materials used and it compatibility .	**(15)**	**BTL 6**	Creating
4.	Prepare a biocompatibility assessment for biomaterials in medical devices.	**(15)**	**BTL 6**	Creating