SUMMER– 2017 EXAMINATION

Model Answer **Subject Code:** 17543

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical spelling errors should not be given more Importance, not applicable for subject English and Communication Skills.

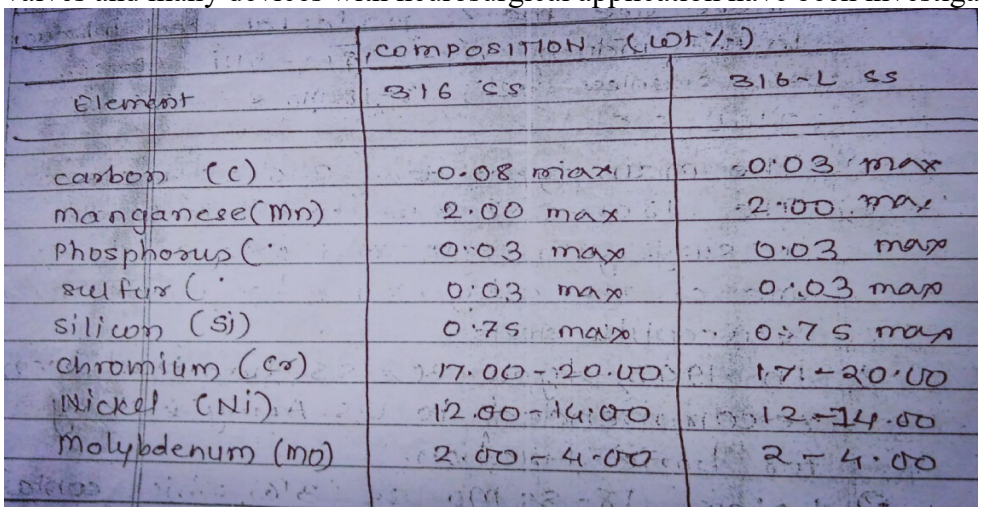
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.	Sub	Answer	Marking

No.	Q. N.		Scheme
Q.1.	(A)	**Attempt any <u>THREE</u>**	**12**
	a)	**List four properties of biomaterials.** **Ans: Properties of biomaterials** 1. It should not irritate the surrounding structure. 2. It should not provoke abnormal inflammatory response. 3. It should not cause any allergic or immunologic reaction. 4. It should not lead to causing cancer. 5. Good corrosion resistance. 6. Excellent fabrication properties & great strength. 7. Good biocompatibility, easy availability, & lower cost. 8. It should have adequate mechanical strength, fatigue, & physical properties. 9. It should be chemically inert & stable.	**04**
	b)	**Give composition & two applications of stainless steel.** **Ans:** **Applications of stainless steel** : 1. Stainless steel ate basically used in orthopedic implants, the major uses include fracture fixation and joint replacement 2. They are used in replacement of hip joints, ankle joints, knee joints, leg lengthening spacers, intramedullary pins, femur shafts, bone plate etc. 3. The uses of these alloys for fabrication of mandibular staple bone plates, heart valves and many devices with neurosurgical application have been investigated	**02**
		 **Table: Composition of stainless steel**	**02**
	c)	**Draw the labelled structure of biological kidney.** **Ans:**	**04**

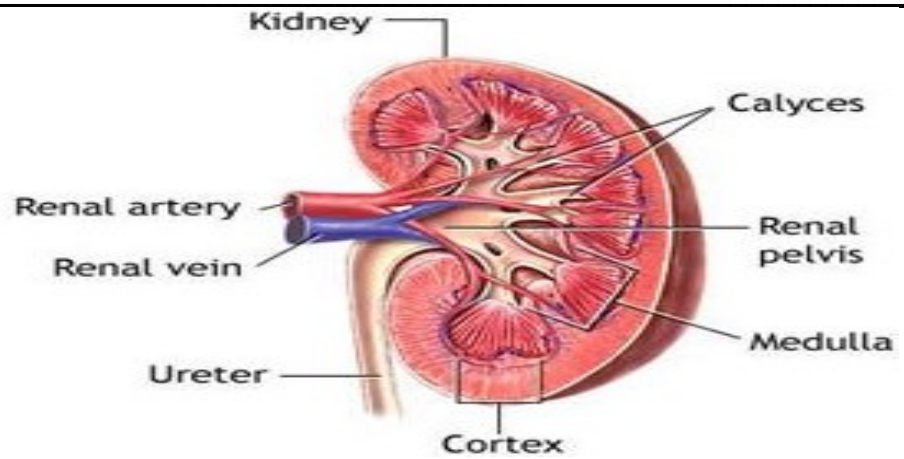


Fig : Structure of Kidney

d) List four mechanical properties of dentine. — **04**

Ans:

Dentine Not as hard as enamel, forms the bulk of the tooth and can be sensitive if the protection of the enamel is lost.

	Density (g/cm^3)	**Compressive Strength (MPa)**	**Young's Modulus (GPa)**	**Thermal Conductivity (W/mk)**
Dentine	1.9	138	13.5	0.59

Fig: Mechanical properties of dentine

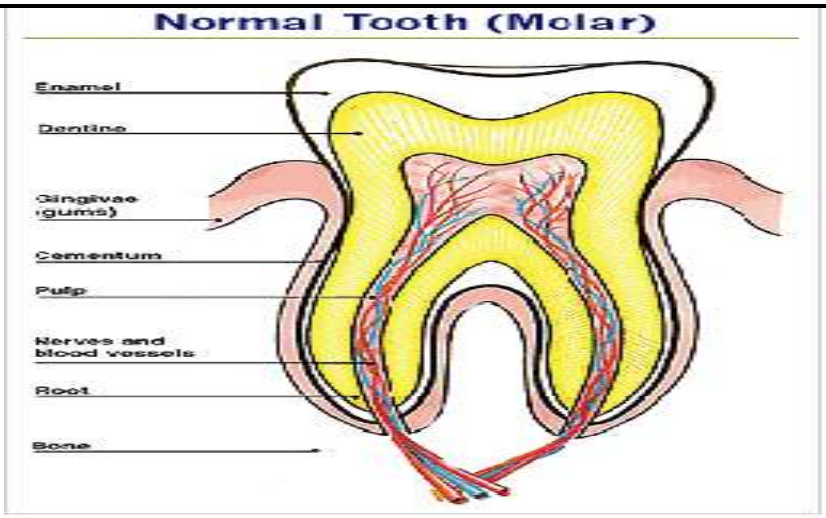
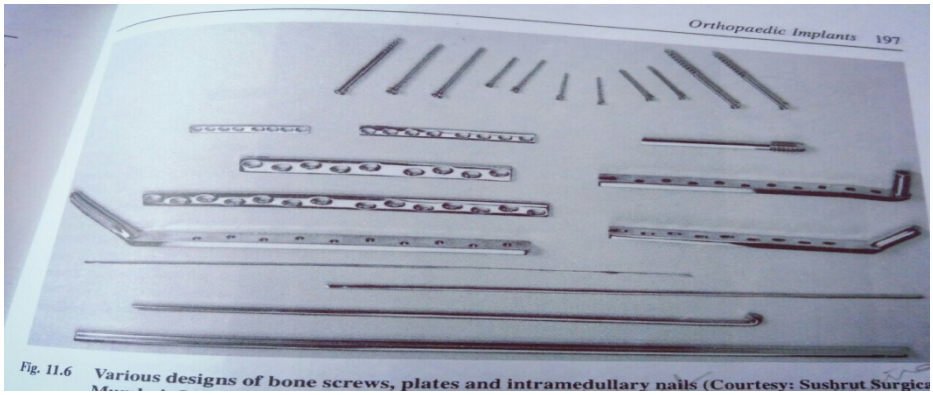
(B) Attempt any <u>ONE</u> — **06**

a) State the composition of teeth. Draw schematic neat labelled diagram of tooth. — **03**

Ans:

Constituents[a]	*Dentine*	*Enamel*
Ca^{2+}	27.0	36.0
PO_4^{3-} as P	13.0	17.7
Na^+	0.3	0.5
K^+	0.05	0.08
Mg^{2+}	1.1	0.44
CO_3^{2-}	4.5	2.3
F^-	0.05	0.01
Cl^-	0.01	0.30
$P_2O_7^{4-}$	0.08	0.022
Ash[b]	70	97.0
Organic	20	1.0
H_2O[c]	10	1.55

Table : Composition of Teeth

		 **Fig: Tooth**	**03**
	b)	**Draw & describe neat sketches of different devices used to assist healing of broken bone.** **Ans:**  **Fig: Bone screws, plates and nails** The purpose of temporary fixation devices is to stabilize fractured bone until natural healing processes have restored sufficient strength so that the implant can be removed. These devices include pins, nails, wires, screws, plates, and intramedullary devices. For example: Bone plates are used for joining bone fragments together during healing of load-bearing bones. The plate provides rigidity for the fixation of the fracture. Screws are used with the plates to secure them to the bone. The advantage of an intramedullary device is that it can be nailed through a small incision. Plates of various sizes and shapes are available for the implantation in femoral and tibial part.	**03** **03**
2.		**Attempt any <u>FOUR</u>**	**16**
	a)	**State the Hooks law & Poisson's ratio.** **Ans:** 1. **Hooks law:** Deformations of metals initially result in stretching of the bonds that hold atoms together. This generates a linear response between stress & strain, i.e. it obeys Hooks law, which states that force is proportional to the displacement. 2. **Poisson's ratio:** It can be shown that Young's modulus is related to shear (G) and bulk (K) moduli for isotropic material through poissons ratio ($V = - \varepsilon_x / \varepsilon_z = - \varepsilon_y / \varepsilon_z$) for cubic materials.	**02** **02**

b) Give composition & two properties of Cr alloy. — 02

Ans:

Table 3.5 The compositions of cobalt-chromium alloys used in dentistry and surgery*

Type	F75 (Cast)	F90 (Wrought)	F562 (Wrought)	F563 (Wrought)
Element	%	%	%	%
Manganese	1.00 max	1.0 to 2.0	0.15	1.0 max
Silicon	1.0 max	0.4 max	0.15 max	0.5 max
Chromium	27-30	19-21	19-21	18-22
Nickel	2.5 max	9-11	33-37	15-25
Molybdenum	5.0 to 7.0	–	9-10.5	3.0-4.0
Carbon	0.35 max	0.05 to 0.15	0.025 max	0.05 max
Iron	0.75 max	3.0 max	1.0 max	4-6
Tungsten		14-16		3-4
Titanium			1.0 max	0.5-3.5
Cobalt	Balance	Balance	Balance	Balance

Fig: Composition of Cr alloy

Properties of Cr alloy: High cost, High density and modulus, Difficult fabrication, Elongation, High tensile & yield strength. — 02

properties of cobalt chromium alloy

property	cocrmo	cocrwni	conicrmo		
			solution annealed	cold worked	fully annealed
tensile strength	655	860	795 - 1000	1790	600
Yield strength	450	310	240 - 655	1585	276
Elongation	8	10	50	8	50
Reduction of area (%)	8	-	65	35	65
fatigue strength	310	-	-	-	340

Table: Properties of Cr alloy

c) List two properties and three applications of alumina. — 02
(Any two properties 2m + Any three applications 2m)

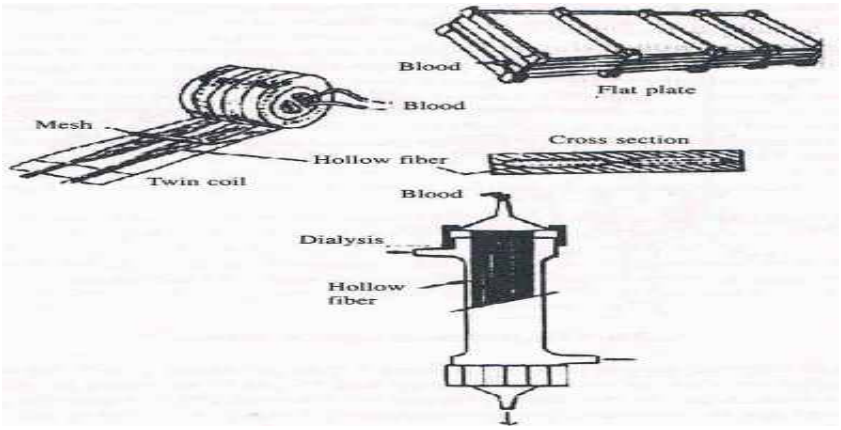
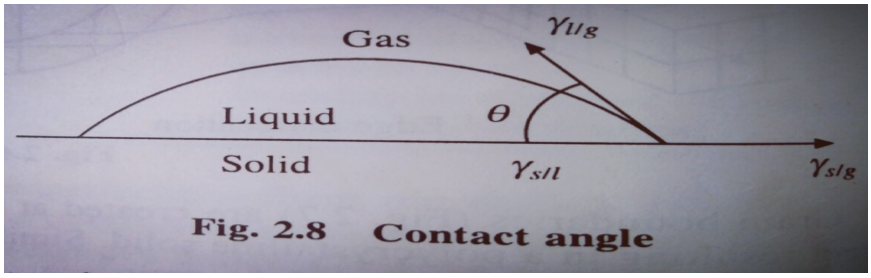
Ans:

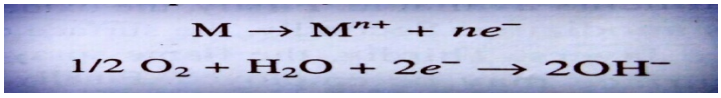
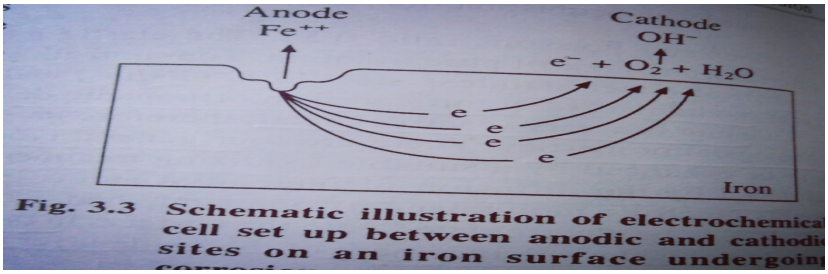
Properties of alumina :

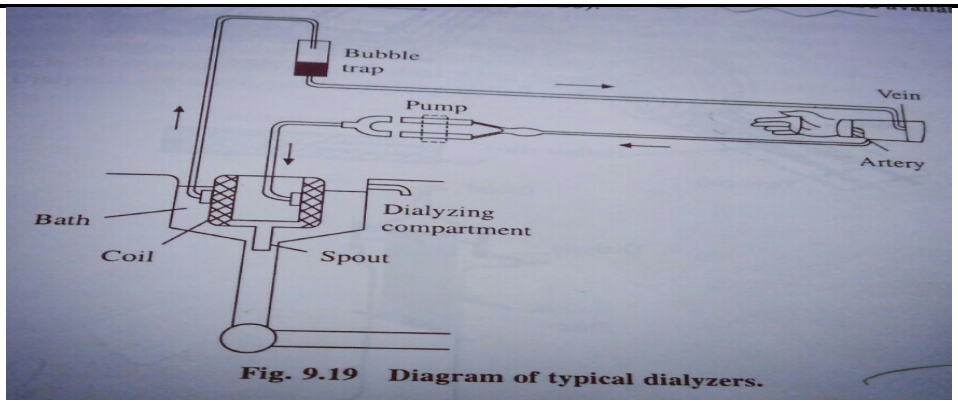
1. Chemically stable and excellent corrosion resistant.
2. It is insoluble in water & slightly soluble in strong alkali and acid.
3. High melting point.
4. Highest hardness.
5. Highest mechanical strength
6. Good biocompatibility.
7. High wear resistance & reasonable strength.

Applications of alumina : — 02

1. The implant devices are prepared from purified alumina.
2. High density alumina is used in load bearing hip prostheses.
3. Dental implant.
4. Orthopedic uses of alumina consist of hip & knee joints, tibial plates, femur shaft, shoulders, radius, vertebra, leg lengthening spacer & ankle joint prosthesis.
5. Reconstructive maxillofacial surgery to cover bone defects.
6. Porous alumina is also used in teeth roots.

	d)	**State the procedure & evaluation of dental implants.** **Ans:** **The procedure and evaluation of dental implants involves several stages.** 1. First, materials are tested for toxicity by implantation subcutaneously in rats for periods of time up to 30 days and through tissue culture tests. 2. The second step is to test the devices in an animal model. Of all animals, the baboon is considered the most preferred experimental animal in dental-implant studies, since its physiology and immunological responses are very similar to those of humans. 3. In general, the clinical condition of dental implants is evaluated by using radiographs, gingival tone, pocket depth and mobility. A stereo-photogrammetric method of measuring the extent of tissue changes and mobility of sub periosteal implants technique utilizes stereo photographs to measure quantitatively, the extent of tissue swelling or resorption, as well as, migration of dental implants to an accuracy of 16 µm.	**04**
	e)	**List two types of dialyzers & draw two among them. (Any 2Types 2m + Diagram 2m)** **Ans: Types of dialyzers** 1. Flat plate 2. Coil-type 3. Hollow fiber  **Fig: Types of dialyzers**	**02** **03**
	f)	**Draw the diagram of contact angle to measure surface properties. Describe Young Dupree equation.** **Ans :** **Young-Dupree equation:** $\gamma s/g = \gamma s/l + \gamma l/g \cos \theta$ where **γs/g, γs/l** and **γl/g** are the interfacial free energy between the solid and gas; solid and liquid, liquid and gas respectively and **θ** the contact angle.  **Fig: Contact angle between the liquid and solid surface**	**02** **02**
3.		**Attempt any <u>FOUR</u>**	**16**

	a)	**Define biomaterials & give two examples.** **Ans:** **Definition of biomaterials** A biomaterial is defined as any systemically, pharmacologically inert substance or combination of substances utilized for implantation within or incorporation with a living system to supplement or replace functions of living tissues or organs. In order to achieve that purpose, a biomaterial must be in contact with living tissues or body fluids resulting in an interface between living and non-living substances. **OR** It replaces a part or function of the body in safe reliable, economic and physiologically acceptable manner. **Examples of biomaterials:** 1. **Polymers:** Polysters, polymides, silicon rubber, polyether, collagen, elastin, mucopolysaccharides, chitin, Polysaccharides, polyurethane, rubber, nylon, polytetrafloroethylene, bone cement. 2. **Metals:** stainless steel, cobalt-chromium, titanium alloys, etc. 3. **Ceramics:** Alumina, zirconia, calcium phosphate 4. **Composites:** Fiber reinforced, Particle reinforced.	**02** **02**
	b)	**Draw the schematic of metallic corrosion & state anodic & cathodic reaction.** **Ans:** **Anodic & cathodic reaction** Reactions of metals with aqueous environments are electrochemical in nature involving the movement of electrons to the cathode. For implanted metals in aqueous environment with dissolved oxygen. The primary anodic & cathodic reactions are represented by equation.  $M \rightarrow M^{n+} + ne^-$ $1/2\ O_2 + H_2O + 2e^- \rightarrow 2OH^-$ **Fig: Anodic & cathodic reaction**  Fig. 3.3 Schematic illustration of electrochemical cell set up between anodic and cathodic sites on an iron surface undergoing **Fig: metallic corrosion**	**02** **02**
	c)	**Draw structure of artificial kidney & give its two functions.** **Ans:** **Functions of artificial kidney** 1. It can be remove nitrogenous metabolic waste products. 2. Remove excess body water. 3. Partially reestablish appropriate plasma acid base & electrolyte composition and concentration.	**02**

		 Fig. 9.19 Diagram of typical dialyzers. **Fig: Structure of artificial kidney**	**02**
	d)	**List four applications of acrylic polymers.** **Ans:** **Applications of acrylic polymers :** 1. It is used extensively in medico-surgical application as contact lenses. 2. Implantable ocular lenses. 3. Bone cement for joint fixation. 4. Dentures and maxillofacial prostheses. 5. It is used for treatment for coxarthropathy & in hip arthroplasties. 6. It is suitable for the repairs of cranial defects.	**04**
	e)	**List factors affecting bone formation resorption.** **Ans:** **Table 11.2 Factors affecting bone formation and resorption** 1. Vascular in growth: Fibronectin, endothelial cell growth factor (ECGF). 2. Bone formation: Insulin-like growth factor (IGF-1) somatomedin c, platelet-derived growth factor. (PDGF), Fibroblast growth factor (FGF) IL-1, ECGF, insulin, bone-derived growth factors (BDGF II and I) bone morphogenetic protein (BMP). 3. Bone resorption, IL-1, Osteoclast-activating factor: (OAF), parathyroid hormone, PDGF, transforming growth factor B (TGF-B), tumor necrosis factor (TNF), prostaglandin E_2. * Adapted from Ziats et al., (1988). **Table: Factors affecting bone formation and resorption**	**04**
4.	**(A)**	**Attempt any <u>THREE</u>**	**12**
	a)	**Describe electrokinetic theory used in surface analysis.** **Ans:** **Electrokinetic theory** : When a material with a charged surface is placed in a solution with ions, a diffused layer of oppositely charged ions (counter ions) appears close to the surface. The electrical double layer is the Stern theory, which describes the change in potential Ψ as the distance from the surface increases. The distance from the surface is Debye length γ. Materials acquire charge due to many reasons, example: Metals develop a surface potential due to surface oxidation. The presence of the electrical double layer gives rise to electrokinetic phenomena when either the particles or the medium moves.	

		The streaming potential and electro osmosis owe their existence to the electrical double layer. Electro osmosis is observed when an electrical potential is applied to the opposite ends of porous plug in a liquid medium. A flow of liquid through plug occurs. The streaming potential is the converse. Forced motion of liquid through a porous plug generates an electrical potential, called Zeta potential (ζ). The Zeta potential is the electrical potential at the plane of shear in the liquid. Measurements of ζ potential have been useful for determining characteristics of blood vessels. The surface properties are among the most important material properties that a biomaterial possesses. This is due to the fact that when a device is implanted into tissues, the surface chemistry will determine to a large extent how the material and the tissues, or fluids interact.	**04**
	b)	**List four properties & two applications of Zirconia.** **Ans :** **Properties of Zirconia:** 1. Use temperatures up to 2400°C 2. High density 3. Low thermal conductivity (20% that of alumina). 4. Chemical inertness. 5. Resistance to molten metal's. 6. Ionic electrical conduction. 7. Wear resistance. 8. High fracture toughness. 9. High hardness. 10. High refractive index. 11. Excellent biocompatibility and wear properties. 12. Fine grain size, lack of surface roughness. **Applications of Zirconia:** 1. Dental implants 2. Zirconia ceramics are employed to develop new shoulder prosthesis, 3. Knee and hip replacements (orthopedic prosthesis). 4. Middle-ear reconstruction. 5. Zirconium cyclosilicate is under investigation for oral therapy in the treatment of hyperkalemia. 6. It is a highly selective oral sorbent designed specifically to trap potassium ions over other ions throughout the gastrointestinal tract.	**02** **02**
	c)	**State two types of blood clot formation technique & differentiate them.** **(types 02m + Any two difference 02m)** **Ans:** 1. **Intrinsic pathway:** The contact activation pathway (Intrinsic) begins with formation of the primary complex on collagen by high-molecular-weight kininogen (HMWK), prekallikrein, and FXII (Hageman factor). Prekallikre in is converted to kallikrein and FXII becomes FXIIa. FXIIa converts FXI into FXIa. Factor XIa activates FIX, which with its cofactor FVIIIa form the tenase complex, which activates FX to FXa. The minor role that the contact activation pathway has in initiating clot formation can be illustrated by the fact that patients with severe deficiencies of FXII, HMWK, and prekallikrein do not have a bleeding disorder. Instead, contact activation system seems to be more involved in inflammation. 2. **Extrinsic pathway**: The main role of the tissue factor pathway (Extrinsic) is to generate a "thrombin	

burst", a process by which thrombin, the most important constituent of the coagulation cascade in terms of its feedback activation roles, is released very rapidly. FVIIa circulates in a higher amount than any other activated coagulation factor. **02**

Intrinsic pathway	**Extrinsic pathway**
1) All the factors in the intrinsic pathway are available in circulation.	1) The extrinsic pathway is so named because it requires a substance not normally present in the blood for activation.
2) It is a natural technique for clotting.	2) It require external substance o get clotting.
3) The extrinsic pathway is initiated when blood comes into contact with tissue factor following the rupture of a blood vessel.	3) The intrinsic pathway, of which both clotting factor VIII and IX are a part, is initiated by the activation of certain contact factors in the plasma (e.g. factor XII, prekallikrein, or high-molecular-weight kininogen) following blood vessel injury.
4) Activated by: (-) charged surfaces in vivo (collagen, sub endothelial connective tissue) & in vitro (glass)	4) Activated by: Factor VII activation by tissue factor (TF) on sub endothelium.
5) Factors: XII, XI (↓in hemophilia B), IX (↓in hemophilia A)	5)Factors Involved: VII
6)Activation time: 1 - 6 min (slow)	6)Time to Activation: 15s (fast)

02

Table: Difference between Intrinsic & Extrinsic blood clot formation

d) Draw diagram of cellular events in bone healing.

Ans:

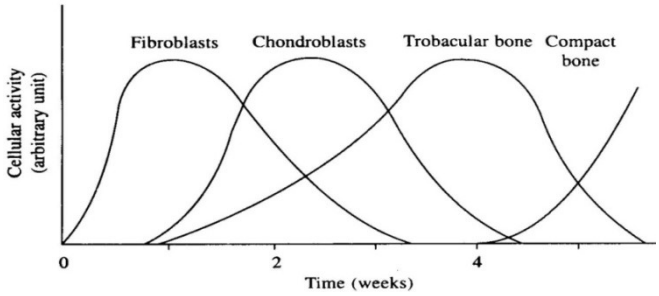


Fig: cellular events in bone healing

04

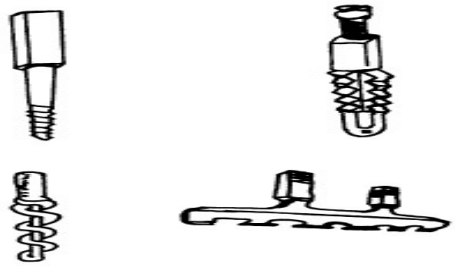
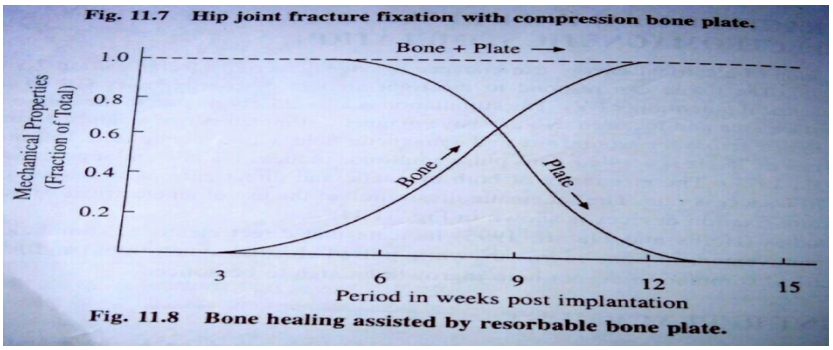
(B) Attempt any ONE **06**

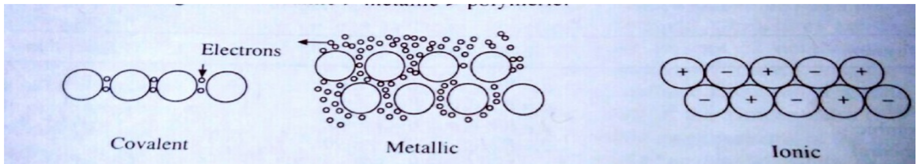
a) State the meaning of reimplantation of teeth. Draw various designs of self-tapping dental implants.

Ans:

Reimplantation of teeth :

The ideal implant is the tooth itself pulled from the socket, if it can be replanted. With the natural tooth, collagen fibers of the periodontal ligament bridge the gap between the bone and the tooth root. The re-implantation studies have indicated that a highly **03**

		cellular periodontal membrane can develop. Reattachment to both the bone and cementum is observed, but the reattached periodontal membrane often does not regain a functional orientation. The epithelial and underlying tissues reattach to the cement-enamel junction, unless there is considerable infection in the supporting tissues  **Fig: Self-tapping dental implants**	**03**
	b)	**Sketch graphically bone healing assisted by resorbable bone plate & explain it.** **Ans:**  **Fig: Bone healing assisted by resorbable bone plate** The purpose of temporary fixation device is to stabilize fractured bone until natural healing processes restored sufficient strength so that the implant can be removed. These devices include pins, nail, wires, screws, plates and intramedullary devices. Bone plates are used for joining bone fragments together during healing of load bearing bones. The plate provides rigidity for fixation of the fracture. Screws are used with the plates to secure them to the bone. There are different types and sizes of fracture plates. The force generated by the muscles in the limbs are very large ,femoral and tibial plates must be very strong.one major drawback of the healing by rigid plate fixation is the weakening of the underlying bone such that refracture may occur following removal of the plate. This is largely due to the stress shield effect. Therefore new material are being evaluated for fabrication of plates with a low axial stiffness and moderate bending and torsional stiffness to facilitate fracture healing without bone atrophy. Another approach is to use a resorbable material for bone plate. As the strength of the fracture site increases due to healing processes, the resorption of the implant begins to take place. The gradual reduction of strength of implant transfers an increasingly larger percent of the load to the healing bone .The degradation products of such plates must be biocompatible .the design aspect must involve producing the appropriate combination of initial strength and time dependent performance through the variation in absorption rate and microstructure. There is no need for second operation in removing these plates.	**03** **03**
5.		**Attempt any <u>FOUR</u>**	**16**
	a)	**List three different types of Chemical bond. Also draw their sketches.** **Ans:** **Types of Chemical bond.**	

		1. Covalent bond 2. Metallic bond 3. Ionic bond  Fig. 2.1 Schematic representation of covalent, metallic and ionic bonds. **Fig: Chemical bond**	**02** **02**
	b)	**List four methods to improve blood compatibility and also comments on it.** **Ans : Methods to improve blood compatibility :** 1. Clot formation 2. Surface roughness 3. Negatively charged surface 4. Inert surfaces 5. Solution perfused surfaces **1. Clot formation:** Clot formation appears to be the normal consequence of the contact between blood & foreign materials except if the latter have specially designed to prevent this catastrophic event. It is initiated by the contact itself & depending on the nature of the surface, it may develop through different pathways leading to the central event of coagulation. **2. Surface roughness:** Surface roughness is an important factor affecting blood compatibility, since rougher the surface more the area is exposed to the blood. Therefore rough surfaces promote faster blood coagulation than highly polished surfaces. Sometimes porous vascular implants are used to promote clotting in porous interfaces to prevent initial leaking of blood, later coagulate & promotes the tissue ingrowth. **3. Negatively charged surface:** Negatively charged surfaces on polymers such as polyacrylic acid derivatives have been produced by co-polymerization or grafting. Negatively charged molecules on the surface of a polymer have been shown to enhance thrombo-resistance. **4. Inert surfaces:** Hydrogels PHEMA, polyvinyl alcohol, & polyacrylamide are classified as inert materials used for improving blood compatibility. **5. Solution perfused surfaces:** Another method of making surface non thrombogenic is perfusion of water through interstices of fabric, which is interfaced with blood. This approach has the advantage of minimizing damage to blood cells. The main disadvantage of this method is the dilution of blood plasma although this is not a serious problem. Polymeric flexible prosthetic devices such as vascular grafts, valves or catheters have been coated with vacuum vapor deposited carbon to improve blood compatibility. These coatings are generally very thin (0.5 to 1.0 μm).	**02** **02**
	c)	**Comment on electrical stimulation of bone healing.** **Ans:** **Electrical stimulation of bone healing :** The application of electrical energy can enhance osteogenic activity. The tissue can respond to the right amount of energy input (10-40 I1v) without excessive electrical potential (<1 V). The stimulation is also closely related to the nature of electrode material,	

surface area and location. Noninvasive magnetic stimulators use a pair of Helmholtz coils, which are aligned across the wound site and a magnetic field with a monophasic 150-ms phase with a repetition rate of 75 Hz is applied. This pulse amplitude induces 1-2 m V/*cm* of potential in the bone. The efficiency of both magnetic and direct current stimulation is about the same, over 70% success rate. Recent studies indicate that direct electrical stimulation provides a significant improvement in bone ingrowth, while pulsed electromagnetic field and AC capacitivity coupled electrical stimulation do not help ingrowth enough to be noticed. **04**

d) List two properties & two biomedical applications of Ti based alloy.

Ans:

Properties of Ti based alloy :

Titanium is a light metal, Density 4.505 g/cm cube at 25 Degree Celsius, Melting point of titanium is about 1665 Degree Celsius

OR

Properties	**Grade-1**	**Grade-2**	**Grade-3**	**Grade-4**
Tensile Strength (Mpa)	280	345	450	550
Yield Strength (Mpa)	170	275	380	485
Elongation (%)	24	20	18	15
Reduction of area (%)	30	30	30	25

Table: Properties of Ti based alloy

02

Biomedical applications of Ti based alloy:

1. It is used for the production of hip prostheses.
2. It is used for making of fracture equipment.
3. It is used for surgical implant applications.
4. It is used for manufacturing of implants.
5. It is used for making of bone screws and plates.
6. It is also used for orthopedic application.

02

e) Draw diagram of :

(i) Total knee replacement parts (02m)

(ii) Comments on a total knee replacement.(02m)

Ans:

02

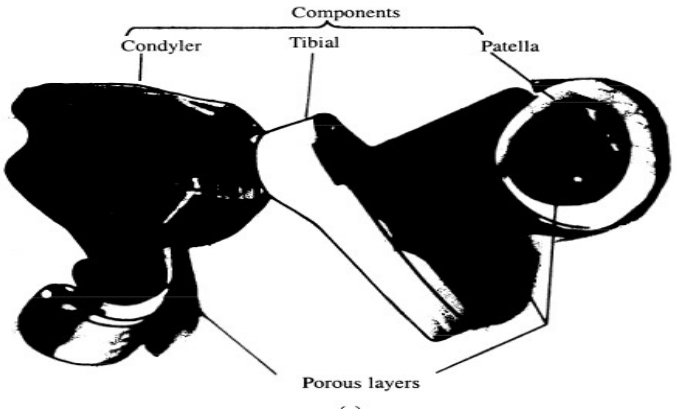


Fig: Total knee replacement parts **02**

Total knee replacement :

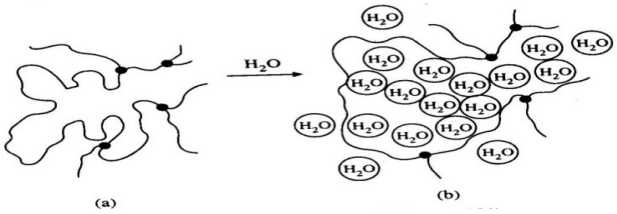
The femoral component consists of a fairly thin, rigid shell with an attached fixation system to bone. The geometry of the femoral shell requires a stiff, high strength, low wear rate material such as metal. The femoral component is fixed to the cortical bone of the femoral shaft. The fixation system may be either PMMA cement or a biological ingrowth type. The tibial portion consists of a broad plateau covering the tibia, consisting of a stiff metal tray supporting a polymeric or fiber reinforced polymer. Repeated tensile loading may cause failure of PMMA-bone interface. TKR utilizes a limited number of metallic alloys including cobalt-chromium and titanium alloy. Cobalt-chromium alloy combined with ultrahigh molecular weight polyethylene (UHMWPE) remains the contact surfaces of choice, despite some adverse effects on biocompatibility and mechanical problems. These include creep and fatigue of UHMWPE component due to high stresses and repeated loading and wear of polymeric contact surface due to adhesion of the polymeric surface to the metal.

f) State the meaning of Hydrogel. Draw its structure & give its two properties.

Ans:

Meaning of Hydrogel : **01**

Hydrogels are polymer which derived its name from their affinity for water and incorporation of water into their structure. The concentration of water in the hydrogel can significantly affect the interfacial free energy of the hydrogel as well as biocompatibility.

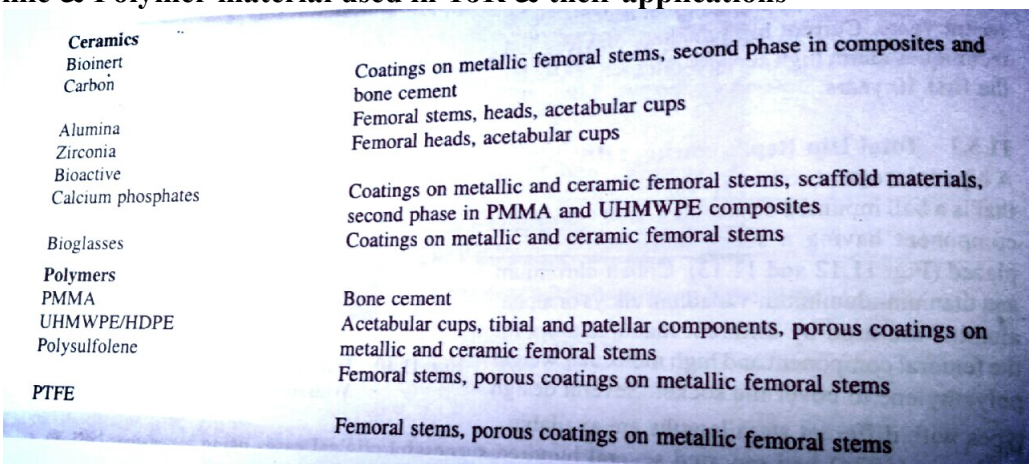
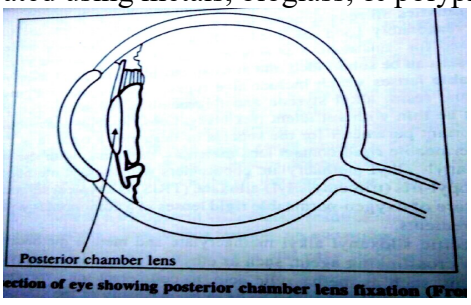


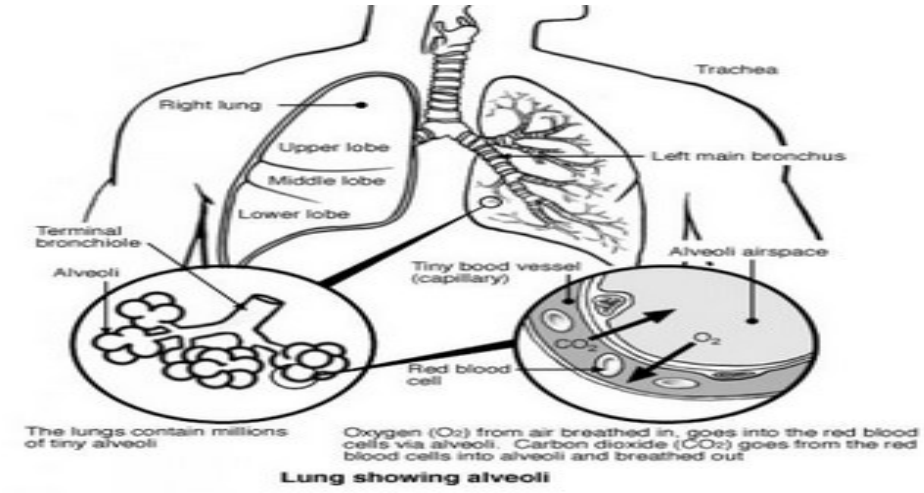
01

Fig: Structure of hydrogel (a). hydrogel in normal state (b) Hydrogel after incorporation of water in it

Properties of Hydrogel :

1. Hydrogel have inherently weak mechanical properties.
2. The soft, rubbery nature.
3. These polymers may have low or zero interfacial tension with surrounding biological fluids and tissues. **02**
4. It is transparent when wet.
5. It can be easily machined while dry, yet is very pliable when wet.

6.		**Attempt any <u>FOUR</u>**	**16**
	a)	**List ceramic & polymer material used in TJR & list application of same.** **Ans:** **Ceramic & Polymer material used in TJR & their applications**  **Table: Ceramic & Polymer material used in TJR & their applications**	**04**
	b)	**State the concept of artificial implants of eye.** **Ans:** **Artificial Implants :** Eye implants are used to restore functionality of cornea, lens, vitreous humor, when they are damaged or diseased. Ophthalmology is a field that has rapidly advanced as a result of the development of new techniques & materials. Biomaterials are an important component of the procedures that are used to improve & maintain vision. The materials that make up normal structures of eye, as well as, those used for replacements. These biomaterials includes viscoelastic solutions, intraocular lenses, contact lenses, eye shields, artificial tears, vitreous replacements, correction of corneal curvature, scleral buckling materials.	**04**
	c)	**Draw cross section of eye showing posterior chamber lens fixation & list the material used.** **Ans:** **Materials :** Optical portion of the IOL is composed of PMMA, PHEMA, silicone, Attachment region is fabricated using metals, bioglass, & polypropylene.  **Fig: Cross section of eye showing posterior chamber lens fixation**	**02** **02**
	d)	**List types of prosthetic valve & biomaterials used for same.** **Ans:** **The four types of heart valves & used biomaterials :**	

			Types of prosthetic valve	**Biomaterials used**	**04**
			Disk - in - cage	Titanium, silicon rubber, Teflon, polypropylene	
			Ball - in - cage	Titanium, silicon rubber, Teflon, polypropylene	
			Tilting disk	Pyrolytic carbon, UHMPE, Titanium, Teflon, Dacron	
			Porcine aortic valve	Dacron, Teflon cloth, silicone rubber	
	e)	**Draw structure & four functions of lungs.** **Ans:**  **Fig: Structure of lungs** **Functions of lungs:** 1. The lungs' main function is to help oxygen from the air we breathe enter the red cells in the blood. 2. Red blood cells then carry oxygen around the body to be used in the cells found in our body. 3. The lungs also help the body to get rid of CO2 gas when we breathe out. 4. Changing the pH of blood (whether the blood is more acid or alkali) by increasing or decreasing the amount of CO2 in the body. 5. Filtering out small gas bubbles that may occur in the bloodstream. 6. Converting a chemical in the blood called angiotensin I to angiotensin II. These chemicals are important in the control of blood pressure.	**02** **02**