

PROGRAMME: PhD – BIOMATERIALS SCIENCE AND TECHNOLOGY

Duration: 120 Minutes

Total Marks: 100

(Select the most appropriate answer; Each question carries one mark. There is no negative marking)

- 1) A train running at the speed of 60 km/hr crosses a pole in 9 seconds. What is the length of the train?
a) 120 meters b) 180 meters c) 324 meters d) 150 meters
- 2) The angle of elevation of a ladder leaning against a wall is 60° and the foot of the ladder is 4.6 m away from the wall. The length of the ladder is:
a) 2.3 m b) 4.6 m c) 7.8 m d) 9.2 m
- 3) A sum of money at simple interest amounts to Rs. 815 in 3 years and to Rs. 854 in 4 years. The sum is:
a) Rs. 650/- b) Rs. 690/- c) Rs. 698/- d) Rs. 700/-
- 4) Alfred buys an old scooter for Rs. 4700 and spends Rs. 800 on its repairs. If he sells the scooter for Rs. 5800, his gain percent is:
a) 4.57% b) 5.45% c) 10% d) 12%
- 5) A fruit seller had some apples. He sells 40% apples and still has 420 apples. Originally, he had
a) 588 apples b) 600 apples c) 672 apples d) 700 apples
- 6) Today is Monday. After 61 days, it will be
a) Wednesday b) Saturday c) Tuesday d) Thursday
- 7) The average monthly income of P and Q is Rs. 5050. The average monthly income of Q and R is Rs. 6250 and the average monthly income of P and R is Rs. 5200. The monthly income of P in rupees is:
a) 3500 b) 4000 c) 4050 d) 5000
- 8) Which one of the following is not a prime number?
a) 31 b) 61 c) 71 d) 91

9) If $a - b = 3$ and $a^2 + b^2 = 29$, find the value of ab .

- a) 10 b) 12 c) 15 d) 18

10) A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue?

- a) 10/21 b) 11/21 c) 2/7 d) 5/7

11) An accurate clock shows 8 o'clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2 o'clock in the afternoon?

- a) 144° b) 150° c) 168° d) 180°

12) Find the statement that must be true according to the given information:

Sheela is twelve years old. For three years, she has been asking her parents for a dog. Her parents have told her that they believe a dog would not be happy in an apartment, but they have given her permission to have a bird. Sheela has not yet decided what kind of bird she would like to have.

- a) Sheela's parents like birds better than they like dogs
b) Sheela does not like birds.
c) Sheela and her parents live in an apartment
d) Sheela and her parents would like to move

13) Odometer is to mileage as compass is to

- a) Speed b) Hiking c) Needle d) Direction

14) Optimist is to *cheerful* as pessimist is to

- a) Gloomy b) Mean c) Petty d) Helpful

15) Statement: Unemployment allowance should be given to all unemployed Indian youth above 18 years of age.

Assumptions:

I) There are unemployed youth in India who needs monetary support.

II) The government has sufficient funds to provide allowance to all unemployed youth.

- a) Only assumption I is implicit
b) Only assumption II is implicit
c) Either I or II is implicit
d) Neither I nor II is implicit

16) Statements: All mangoes are golden in colour. No golden-coloured things are cheap.

Conclusions:

1) All mangoes are cheap.

2) Golden-coloured mangoes are not cheap.

- a) Only conclusion I follows
b) Only conclusion II follows
c) Either I or II follows
d) Neither I nor II follows

17) Look at this series: 7, 10, 8, 11, 9, 12, What number should come next?
 a) 7 b) 10 c) 12 d) 13

18) The words in the bottom row are related in the same way as the words in the top row. For each item, find the word that completes the bottom row of words.

Candle	Lamp	Floodlight	
Hut	Cottage	???	

a) Tent b) City c) Dwelling d) House

19) Apple Fruit Supermarket
 Novel Book ???

a) Vegetable b) Magazine c) Bookstore d) Shopping

20) Here are some words translated from an artificial language.

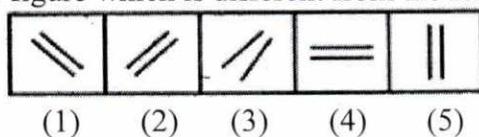
gorblflur means fan belt
pixngorbl means ceiling fan
arthtusl means tile roof

Which word could mean "ceiling tile"?
 a) gorbltusl b) flurgorbl c) arthflur d) pixnarth

21) A word is underlined followed by four answer choices. You will choose the word that is a necessary part of the underlined word

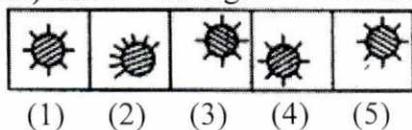
Book
 a) Fiction b) Pages c) Pictures d) Learning

22) Choose the figure which is different from the rest.



a) 1 b) 2 c) 3 d) 4

23) Choose the figure which is different from the rest.



a) 5 b) 2 c) 3 d) 1

24) Choose the alternative which closely resembles the mirror image of the given combination.

TARAIN1014A

(1) AƆƆ01NIARAL

(2) A1014NIARAT

(3) A1014TARAIN

(4) AƆƆ01NIARAT

a) 1

b) 2

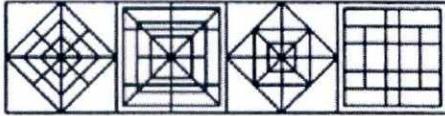
c) 3

d) 4

25) Find out the alternative figure which contains figure (X) as its part.



(X)



(1)

(2)

(3)

(4)

a) 1

b) 2

c) 3

d) 4

26) Identify the figure that completes the pattern



(X)



(1)



(2)



(3)



(4)

a) 1

b) 2

c) 3

d) 4

27) Find the correctly spelt word.

a) Efficient

b) Treatmeant

c) Beterment

d) Employd

28) Find the correctly spelt word.

a) Ommineous

b) Omineous

c) Ominous

d) Omenous

29) The study of ancient societies is known as

a) Anthropology

b) Archaeology

c) History

d) Ethnology

30) List of the business or subjects to be considered at a meeting is termed as

a) Schedule

b) Timetable

c) Agenda

d) Plan

31) Which of phrases given below each sentence should replace the phrase printed in *italics* type to make it grammatically correct?

The small child does whatever his father *was done*.

a) has done

b) did

c) does

d) had done

32) The man *to who I sold* my house was a cheat.

- a) to whom I sell b) to who I sell c) who was sold to d) to whom I sold

33) From the given alternatives, choose the one which best expresses the given sentence in Indirect/Direct speech.

"If you don't keep quiet I shall shoot you", he said to her in a calm voice.

- a) He warned her to shoot if she didn't keep quiet calmly.
b) He said calmly that I shall shoot you if you don't be quiet.
c) He warned her calmly that he would shoot her if she didn't keep quiet.
d) Calmly he warned her that be quiet or else he will have to shoot her

34) Pick out the most effective word from the given words to fill in the blank to make the sentence meaningfully complete.

Fate smiles those who untiringly grapple with stark realities of life

- a) with b) over c) on d) round

35) If you smuggle goods into the country, they may be by the customs authority.

- a) Possessed b) Punished c) Confiscated d) Fined

36) Joule is the unit of

- a) Temperature b) Pressure c) Energy d) Heat

37) For which of the following disciplines is Nobel Prize awarded?

- a) Physics and Chemistry
b) Physiology or Medicine
c) Literature, Peace and Economics
d) All of the above

38) Professor Amartya Sen is famous in which of the fields?

- a) Biochemistry b) Electronics c) Economics d) Geology

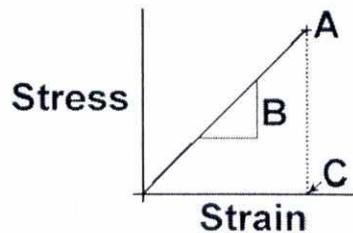
39) What is the name of the CalTech seismologist who invented the scale used to measure the magnitude of earthquakes?

- a) Charles Richter b) Hiram Walker c) Giuseppe Mercalli d) Joshua Rumble

40) Sometimes computers are connected to a UPS system. What does UPS mean?

- a) United Parcel Service
b) Uniform Product Support
c) Under Paneling Storage
d) Uninterruptable Power Supply

- 41) Blood cells flowing through a tube will be subjected to a maximal shear stress at which location?
- At the wall
 - In the centre
 - Midway between wall and centre
 - Equally across the tube
- 42) What is the function of the pancreas?
- Detoxification of the blood
 - Production of enzymes to aid digestion
 - Regulation of glucose levels in the blood
 - Supply of white blood cells to the blood
- 43) A shape memory alloy may be used for which of the following medical application?
- Bone plates
 - Contact Lenses
 - Total hip prosthesis
 - Brain electrodes
- 44) Ceramic materials are usually composed of molecules containing metallic and nonmetallic ions. Which class of molecules is used for bioceramics?
- Carbides (SiC)
 - Nitrides (Si_3N_4)
 - Oxides (Al_2O_3 , SiO_2)
 - Borides (AlB)
- 45) Consider the following stress–strain curve. What is point A called?



- a) Yield point b) Fracture stress c) Elastic modulus d) Strain point
- 46) Which of the following statement is NOT TRUE of polymers?
- A condensation polymer is formed by a chemical reaction that eliminates a small molecule, such as H_2O .
 - An addition polymer is produced from unsaturated monomers containing H–H double bonds.
 - Condensation polymers may be sensitive to hydrolytic degradation in the body.
 - Poly (methylmethacrylate) is an addition polymer.

- 47) Which of the following sequence of mer units is a homopolymer?
 a) ABABABABABABAB
 b) AAAAABBBBBBAAAA
 c) BBBBBBBBBBBBBB
 d) AABABBAABABA
- 48) Which group of tissues covers, lines and protects your organs?
 a) Epithelium b) Connective tissue c) Muscle d) Nervous tissue
- 49) Blood is what type of tissue?
 a) Epithelium b) Connective tissue c) Muscle d) Nervous tissue
- 50) Identify the type of cell(s) that can ingest and destroy foreign particles or macromolecules
 a) Chondroblast b) Osteoblast c) Fibroblast d) Macrophage
- 51) Select the type of tissue(s) that contracts and relaxes without conscious control.
 a) Nervous tissue b) Cardiac muscle c) Skeletal muscle d) Voluntary muscle
- 52) Which is/are NOT characteristic of inflammation due to tissue damage?
 a) Redness b) Coolness c) Pain d) Tension
- 53) Select one of the following types of cells that is NOT involved in wound repair.
 a) Phagocyte b) Microphage c) Macrophage d) Osteocyte
- 54) When a wound becomes infected with bacteria which cells are first needed to fight the infection?
 a) White blood cells b) Red blood cells c) Macrophages d) None of the above
- 55) Which category of tissue implant response is one where cells and surrounding tissues are killed (become necrotic)?
 a) Toxic b) Nearly inert c) Bioactive d) Biodegradable or bioresorbable
- 56) Which of the following biomaterials elicits a nearly inert tissue response?
 a) Stainless Steel b) Polystyrene c) NaCl d) Al₂O₃ (alumina)
- 57) Select the correct word to complete the formal definition of biocompatibility found in the *Dictionary of Biomaterials*.
 'A biocompatible material is one that possesses the ability to perform with a/an _____ host response in specific application.'
 a) Passive b) Active c) Appropriate d) Benign
- 58) Which of the following is not a constituent of bone?
 a) Osteoblasts b) Osteoclasts c) Type 1 collagen d) Type IV collagen
- 59) Which types of cells are present in cartilage?
 a) Fibroblasts b) Chondroblasts c) Osteoblasts d) Osteoclasts

- 60) Which is/are NOT CORRECT characteristic(s) of the heart?
- Contains cardiac muscle cells that contract rhythmically
 - Contraction is initiated by depolarisation of cells in the pacemaker region
 - Contraction decreases pressure allowing blood to flow in one direction only
 - Contraction forces blood to flow through one-way valves into the aorta
- 61) Which statement is NOT related to atherosclerosis?
- Deposits of fat in brain tissue
 - Deposits of fat in arteries
 - Underlying cause of coronary heart disease
 - Can impede blood flow (stenosis)
- 62) Poly (methylmethacrylate), PMMA, is a commonly used biomedical polymer. Which of the listed properties are true?
- It is flexible thermoplastic polymer
 - It can have good optical properties.
 - It can bond to bone.
 - It is thermosetting polymer
- 63) Which of the following is *not* true for resorbable polymers?
- They are usually made via the condensation route.
 - They can be thermosetting or thermoplastic polymers.
 - They often degrade via chain scission.
 - They absorb water easily.
- 64) Which of the following is true regarding natural polymers?
- Hyaluronic acid can cause immunological reactions following implantation in some patients as it is derived from animals.
 - Collagen can cause immunological reactions following implantation in some patients as it is derived from animals.
 - Natural polymers cannot be made to the same mechanical strength as synthetic polymers.
 - Composites cannot be made with natural polymers as they cannot bond to ceramics or glasses.
- 65) Which of the following is true regarding biodegradable polymers?
- The degradation products of the polymer are always harmless.
 - They always have a low melting point (lower than 150°C).
 - They always have a crystallinity below 90 %.
 - They have a lower glass transition temperature than bioinert polymers.
- 66) In general, which of the following is/are a natural polymer?
- Chitosan
 - Polyphosphazene
 - Poly(vinyl alcohol)
 - Polyurethane
- 67) Which of the following tissues is a highly hydrated tissue most similar in structure to a hydrogel?
- Bone
 - Liver
 - Cartilage
 - Neurons

- 68) Which of the following is required for the polymerization of fibrinogen to form fibrin?
 a) $MgCl_2$ b) Mannuronic acid c) Thrombin d) Guluronic acid
- 69) Which device or implant is *not* used for internal fracture fixation?
 a) Plaster or resin cast b) Wires c) Plates d) Screws
- 70) A metal used in orthopaedics has a composition of 65% Fe, 12% Ni, 19% Cr, 3% Mo, 1% Mn. What is it?
 a) Ti6–Al4–V alloy
 b) 316 L stainless steel
 c) F–25 Co–Cr alloy
 d) F90 Co–Cr alloy
- 71) Which phase must form on a biomaterial surface in order for a bioactive bond to occur?
 a) Amorphous silica
 b) Silanols
 c) Amorphous calcium phosphates
 d) Hydroxyapatite
- 72) Which is NOT a typical cause of failure of total joint replacement?
 a) Infection
 b) Aseptic (non-infection) loosening
 c) Fracture of acetabular cup
 d) Dislocation
- 73) Which is the only function of the liver that can be mimicked artificially at present?
 a) Regulation of lipid levels
 b) Regulation of carbohydrates
 c) Regulation of clotting factor levels
 d) Detoxification of the blood
- 74) What is the most common need for skin replacement?
 a) Cosmetics b) Burns c) Skin cancer d) Trauma
- 75) Which of the following device involve the flow of blood?
 a) Dialyser b) Hip implant c) Intraocular lens d) Dental Restorative
- 76) Which statement, if any, is NOT CORRECT with respect to the rheological properties of blood?
 a) Red blood cells are deformable.
 b) The viscosity of blood is constant with shear rate.
 c) Blood is a non-Newtonian fluid.
 d) Blood behaves like a Bingham body

- 77) Which statement is NOT CORRECT regarding blood flow in artificial devices?
- Small tubes (of less than 1 cm diameter) are preferred because they prevent turbulent flow.
 - Turbulent flow of blood can lead to haemolysis.
 - Connectors between tubes and pumps can restrict flow and cause stagnant regions leading to thrombosis formation.
 - Bends in tubes should be avoided because they increase risk of shear damage to cells and also thrombosis.
- 78) Which term is used to describe the deposition of plaques containing cholesterol and lipids on arterial walls?
- Anaemia
 - Aneurysm
 - Angioplasty
 - Atherosclerosis
- 79) Which term is used for a flexible tube that drains fluid from the body?
- Stent
 - Pump
 - Cannula
 - Balloon
- 80) Which term describes an abnormal increase in the number of cells in a tissue, causing enlargement and can compromise function of an organ?
- Anaemia
 - Hyperplasia
 - Angioplasty
 - Atherosclerosis
- 81) Which one of the following statements best defines tissue engineering?
- It is the replacement of tissues using techniques developed from a combination of biology and engineering principles.
 - It is the growth of tissue components *in vitro* that can be used to regenerate diseased or damaged tissue.
 - It is the implantation of scaffolds for the *in situ* repair of diseased or damaged tissue.
 - It is a form of bioactive fixation.
- 82) Which of the following is true regarding stem cells?
- Embryonic stem cells have the potential to become any cell type.
 - It has been confirmed that there is no residual carcinogenic potential of stem cells.
 - Embryonic stem cells have a pre-determined path for differentiation.
 - They can only be passaged a handful of times before seeding onto scaffolds.
- 83) Which of the following bioceramics is NOT bioactive?
- Titania
 - Synthetic HA
 - Coralline HA
 - Alumina
- 84) Which of the following cell lines are NOT immortalized cells?
- Primary cell culture
 - Continuous cell culture
 - Cancerous cell line
 - Transformed cell line
- 85) Which of the following *cannot* assist in identifying cells from different tissue origins?
- Cell morphology
 - Cell phenotype
 - Cell colour
 - Cell behavior

- 86) Which of these are not essential for cell growth?
a) Amino acids b) Proteins c) Vitamins d) Antimycotics
- 87) What is the optimum environment for most cell cultures?
a) 5% CO₂, 37°C, 90% humidity
b) 5% CO₂, 47°C, 90% humidity
c) 0.5% CO₂, 37°C, 90% humidity
d) 5% CO, 37°C, 90% humidity
- 88) What is sterilisation?
a) Inactivation and removal of micro-organisms
b) Removal of endotoxins
c) Inactivation of micro-organisms
d) All of the above
- 89) What does the acronym GLP stand for?
a) General laboratory procedures
b) Good laboratory practice
c) General laboratory practice
d) Good laboratory procedures
- 90) What type of microorganisms survive temperatures in excess of 80°C?
a) Mycoplasma and fungi
b) Bacterial endospores and prions
c) Prions and fungi
d) Mycoplasma and bacterial endospores
- 91) Endotoxins are:
a) Bacteria debris
b) Bacteria endospores
c) Micro-organism debris
d) Mycoplasma debris
- 92) Which of these cell culture observations indicate unhealthy adherent cells?
a) Cloudy media
b) Slow growth following passage
c) Rounded cells
d) All the above observations
- 93) Which of the following are suitable quantifiable methods for determining adherent fibroblast viability following exposure to novel biomaterial nanoparticles for 24 hours?
a) PCR
b) Immunofluorescent staining
c) Western blotting
d) MTT assay

- 94)** Antibodies bind to antigens via which part of the antibody?
a) Constant regions
b) Variable regions
c) Only light chains
d) Only heavy chains
- 95)** Which of these statements are correct? Epitopes ...
a) Are produced by B cells
b) Are antibody binding sites
c) Only bind to IgG immunoglobulins
d) Only bind to T-cells
- 96)** Which of the following immunochemical techniques would be suitable for determining the percentage of cells activated following exposure to dilution ions from a biomedical material?
a) ELISA b) FACS c) Immunohistochemistry d) Immunofluorescence
- 97)** Which of the following sterilisation techniques would be suitable for a biodegradable polymer scaffold to be used in a tissue engineering application?
a) γ -irradiation b) Autoclaving c) Ethylene oxide d) UV light
- 98)** Which federal agency in the USA is responsible for regulation of medical devices?
a) FDA b) CIA c) DOD d) NIH
- 99)** A medical device approved for clinical use in the European Union has what type of mark?
a) FDA b) EU c) EC d) CE
- 100)** What is characteristic(s) of a Class 3 medical device in the USA?
a) Non-invasive/medium risk
b) Invasive/medium risk
c) Long-term implantable
d) Metabolized

BIOMATERIALS SCIENCE & TECHNOLOGY (41-100) STREAM

1	D	35	C	69	A
2	D	36	C	70	B
3	C	37	D	71	D
4	B	38	C	72	C
5	D	39	A	73	D
6	B	40	D	74	B
7	B	41	A	75	A
8	D	42	C	76	B
9	A	43	A	77	A
10	A	44	C	78	D
11	D	45	B	79	C
12	C	46	B	80	B
13	D	47	C	81	B
14	A	48	A	82	A
15	A	49	B	83	D
16	B	50	D	84	A
17	B	51	B	85	C
18	D	52	B	86	D
19	C	53	D	87	A
20	D	54	A	88	C
21	B	55	A	89	B
22	C	56	D	90	B
23	B	57	C	91	A
24	D	58	D	92	D
25	D	59	B	93	D
26	C	60	C	94	B
27	A	61	A	95	B
28	C	62	B	96	B
29	B	63	B	97	C
30	C	64	B	98	A
31	C	65	D	99	D
32	D	66	A	100	C
33	C	67	C		
34	C	68	C		

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