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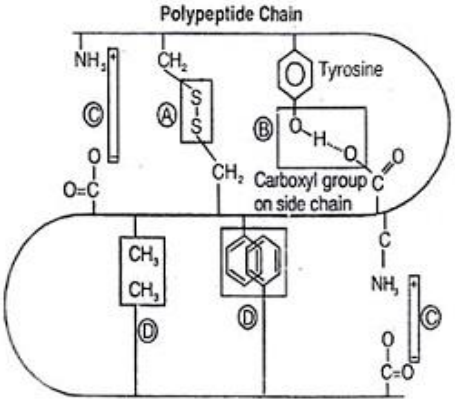
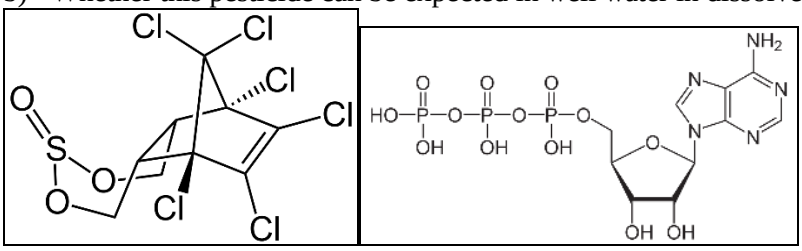
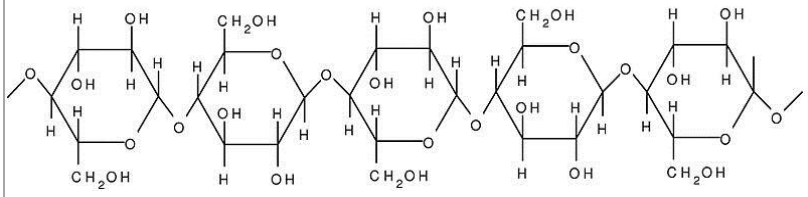
II SEMESTER B.TECH.
END SEMESTER EXAMINATIONS, JAN/MAY 2017
SUBJECT: BIOLOGY FOR ENGINEERS [BIO 1001]
(3/5/2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Geologists are often faced with the problem of camouflage, like the case of zirconium (Zr)-hafnium (Hf), where a rare element is camouflaged in the minerals of a more common element. How it is that hafnium can so easily substitute for zirconium atoms in nature?	**1**
1B.	 Observe the figure alongside and answer the following questions: a) Name the interactions at position B and D. b) What is the level of organization of the given polypeptide chain? Whether primary, secondary or tertiary? Justify. c) If one of the amino acids at site C was replaced by Alanine, how would it affect the stability of the polypeptide chain? Explain.	**3**
1C.	Given below is the structure of endosulfan, a chemical pesticide, and ATP. a) Can endosulfan react with ATP in living systems? Justify. b) Whether this pesticide can be expected in well water in dissolved form? Justify.  Endosulfan ATP	**2**
1D	In a cell at 25 °C, in the ATP hydrolysis reaction the concentration of ATP = 8 x 10^{-3} M, ADP = 1 x 10^{-3} M, and inorganic Phosphate = 8 x 10^{-3} M. What is the free energy change (ΔG') for ATP hydrolysis under these conditions, if the equilibrium concentrations of ATP = 1.0 x10^{-7} M, ADP = 0.165 M and inorganic Phosphate = 0.1 M? [Note: R= 8.314 x 10^{-3} kJ/(mol•K); T= 298 K]	**2**
1E	 The figure depicts a polymer of glucose. Observe the figure and answer the following questions: a) Identify the given polymer. b) Identify the bonding between the monomer units. c) How does a single chain of this polymer interact with adjacent chains of the same polymer? Justify. d) Can this polymer act as a storage polysaccharide in humans? Justify.	**2**

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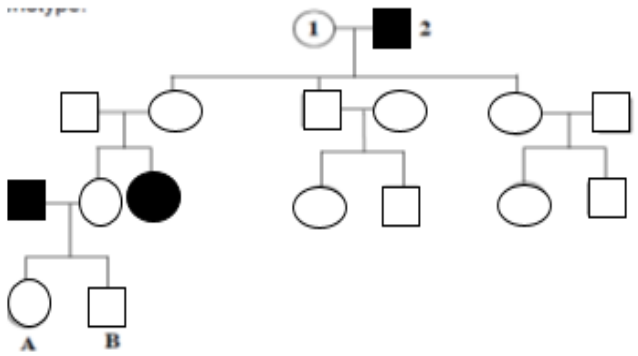
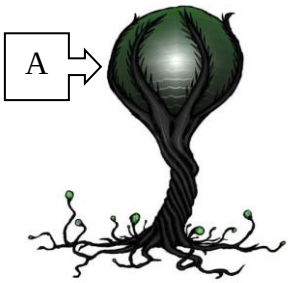
2A		Analyze the following human pedigree. a) What is the most likely mode of inheritance of this disease and give reason for why the other modes of inheritance are not possible? Justify. (1.5 marks) b) List the genotypes of individuals 1 and 2 in the given pedigree. (1 mark) c) Based on the given information, what is the probability of A being affected? (0.5 marks)	**3**
2B	The genes (factor) for two Drosophila mutant phenotypes curved-wings (a allele) and curved back (b allele). A wild-type female (straight wings and straight back) is crossed to a curved-winged, curved backed male to produce F1 flies that all look normal. An F1 female is then crossed to a curved-winged, curved backed male and 100 progeny from this cross are examined. The results are as follows: Wild-type 41, curved-wings, straight back 12, straight wings, curved back 9, curved-wings, curved back 38 a) What are the genotypes of the parents? (0.5 marks) b) Represent the cross in the form of a Punnett square. (1 marks) c) Calculate the recombination frequency of the genes a and b. (0.5 marks) d) What is the distance between a and the b loci in cM? (0.5 mark) e) Based on the given data, can it be predicted if the genes are on same or different chromosomes? Justify. (0.5 marks)	**3**
2C	In humans, alkaptonuria is a metabolic disorder in which affected individuals produce black urine. Alkaptonuria results from an allele (a) that is recessive to the allele for normal metabolism (A). Priya has normal metabolism, but her brother has alkaptonuria. Priya's father has alkaptonuria, and her mother has normal metabolism. a) Give the genotypes of Priya and her brother. b) If Priya's parents have another child, what is the probability that this child will have alkaptonuria?	**2**
2D	 Given is the figure of an animal called Jackalope. The results of controlled matings of this animal are given below F1 Progeny P1 cross | # long horn | # short horn i)long horn x long horn | 39 | 2 ii)long horn x short horn | 42 | 0 iii)short horn x short horn | 0 | 40 a) If any one of the male F1 progeny of cross (b) is mated with a female of F1 progeny of cross (iii) what will be the result? b) What is the possible explanation for the 2 short horn animals in cross (i)?	**1**
2E	In Pokemons the yellow color and jagged tail is dominant. In Pokemon genetics, the symbol Y is for yellow Pikachu and y is for white, L is for jagged tail and l is for straight. In the cross YyLl x YyLl, what fraction of the Pikachu that will be white and straight tail?	**1**
3A	Ms. Bincy got an RNA fragment from her professor, which can produce a protein. Unfortunately, due to some unknown reasons the RNA was cut into four pieces. The following is the sequence of these four fragments AAAUUUUG UGUGGUGG AAUUAAA AGAAAUA a) Help Bincy in rejoining the RNA fragment so that it produces a protein by giving the sequence of RNA. b) Bincy forgets the 5' and 3' ends. Can you label the 5' and 3' ends of the RNA? c) Illustrate the primary structure of the polypeptide chain produced from this mRNA by giving the sequence. d) Label the amino terminus and carboxyl terminus of the protein.	**4**
3B	Dr. Balasubramanian was analyzing the Guanine rich areas of a chromosome. Can you suggest a logical	**1**

	reason for the following findings? a) He found that protective tips (telomere) of chromosomal DNA is guanine rich. b) His analysis also indicates that origin of replication has a very low number of guanine nucleotides.	
3C	A four stranded DNA has been recently discovered in some cells. If semi conservative mode of replication happens in this four stranded DNA, can you illustrate how the bands will appear in a density gradient centrifugation if one follows Meselson and Stahl experiment for three generations?	**2**
3D	a) In DNA replication mechanism, if the primase is not functional, replication of which strand is highly affected? Leading, Lagging or both? Justify. b) Why does the cell invest a lot of energy in error correction from DNA to DNA and not in DNA to RNA? c) An extinct species RNA fragment was recovered by a research group. Can the complementary DNA be synthesized from this RNA fragment? Justify.	**3**
4A	Certain ants lay eggs in the hollow spaces within the thorns of Acacia tree. The ants gain nutrition and shelter from this association with no harm caused to the tree. The ants do not allow any other insects to invade their sheltering spot. Thus, preventing many types of predatory ants and insects from taking over the tree. Determine the type of association and explain your reasoning.	**2**
4B	 Dr. Wonderly stays in a space mission 120 light years from earth searching for earth like planets targeting for future human settlement. He send a photograph of an alien tree which is given below. a) Based on the external appearance of the tree can you predict about any feature of the planet? (Like wind conditions, water availability, nature of soil surface etc.). Justify your reasoning b) The upper region A (shown with an arrow) releases spores which help in reproduction of the plant. The spores are light, easily carried by wind and can attach to surfaces easily. What bioinspiration can be drawn from this aspect of the plant for applying in various engineering fields?	**4**
4C	Justify the statement 'Form follows function' with the help of an example.	**2**
4D	a) A student repeats the Miller Urey experiment and claims that after one month, he isolates Phenylalanine from the sample. Do you agree with the results? Justify. b) Another student repeated the experiment by adding oxygen. Whether he will get same results as Miller Urey? Justify.	**2**
5A	Scientists discover a gene in a prokaryotic organism that produces protein YMTase which is only required for digestion of a sugar YMT. The gene is strictly used for digesting only YMT sugar and has no other function. In presence of sugar JMT, the production of protein YMTase is completely stopped. Answer the questions: a) On basis of given information, which is the preferred sugar source for the organism. Explain. (1 mark) b) In a cloning experiment, the plasmid contains the gene for YMTase enzyme and a restriction site is present within the YMTase gene. The foreign gene is inserted in the plasmid by cutting the restriction site in the YMTase gene. How would the screening process be carried out for bacterial cell (after transformation) to select for the recombinant plasmid? (1 mark) c) In the cloning experiment mentioned above, if JMT is added to the media how would it affect the results of the experiment? (1 mark)	**3**
5B	The following sequence codes for the beta subunit of hemoglobin in a normal individual: 5'—AUG ACG TGG ACT GAG GAC TCA TAA CAG TGG TTA---3' An addition and deletion mutation event causes the sequence to change as follows: 5'---AUG ACG TGG ACT GAG ACT TCA TAA CAG TGG TTA---3' a) Write the sequence of the changed polypeptide chain after mutation. (1.5 marks) b) Will the person suffer from sickle cell anemia after the mutation? Justify. (1.5 marks)	**3**

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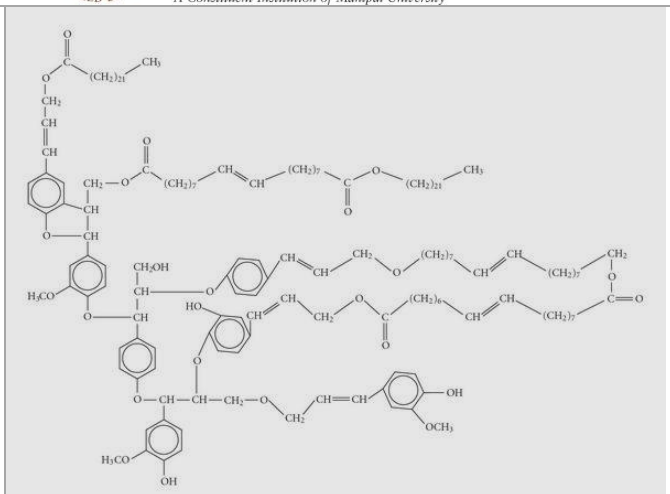
5C		Prof. Naresh was working with plants and for its water logging tolerance. He found a plant nicknamed as "Xap" which is having the highest water logging tolerance (does not wilt even at high levels of water). He wanted to investigate the reason for it. He found that some of its root cells contain lots of chemical whose structure is depicted alongside. Based on this, can you predict why Xap is having water logging tolerance?	**2**
5D	A hypothetical antiviral drug is developed by researchers. To test the new drug, scientists carry out a set of experiments in which they treat the host cell with the new drug and then infect the host cell with Ds DNA virus. They find that the virus is not forming complete virus particle in the host cell. The assembly step is hindered. Will this drug molecule affect the host cell? Explain.		**2**