Time: 2 hours   **Use Separate Scripts for Each Group**   Full Marks: 40

The figures in the right hand margin indicate marks
Candidates are required to give their answers in their own words as far as practicable

GROUP - A
(Non-Chordates)

1. Answer any *two* questions from the following: 2x2=4
   a) Describe the test structure of Foraminifera.   2
   b) What is FCI?   2
   c) Mention two threats that the Gooty tarantulas face.   2
   d) What is unusual about rotifer sperm?   2

2. Answer any *two* questions from the following: 2x4=8
   a) State the importance of foraminiferans in palaeoclimatology and palaeoceanography.   2+2= 4
   b) Which is the only free living stage of an entomophagous nematode? Describe in brief about the activities of the stage during interaction with insects.   1+3= 4
   c) Explain Blastea and Gastraea theory regarding origin of metazoa.   4
   d) Mention the characteristic features of coelom in arrow worm. State two features of spoon worms showing similarities with annelids.   2+2= 4

3. Answer any *one* question from the following: 1x8=8
   a) What do you mean by the word lophophorate? Distinguish between Phylactolaemata and Gymnolaemata. State the role of muscles related to protraction and retraction of lophophore in Bryozoa.   2+3+3=8
   b) What is anhydrobiosis? What is unique about the female reproductive system of rotifers? Give a brief account of the 'tun stage' in the life history of rotifers.   2+3+3=8

GROUP - B
(Chordates)

4. Answer any *two* questions from the following: 2x2=4
   a) State the function of Pillar cell.   2
   b) What is root effect?   2
   c) Discuss the problems of marine fisheries in India.   2
   d) What is pro nephros?   2

5. Answer any *two* questions from the following: 2x4=8
   a) Discuss the mechanism of regulating salt levels in elasmobranch.   4
   b) With the help of phylogenetic scheme of lung, explain which came first, lung or gas bladder?   4
   c) Trace the origin and evolution of craniates from lower chordate.   4
   d) What is the importance of "Lucy" in human evolution?   4

6. Answer any *one* question from the following: 1x8=8
   a) Discuss the electron microscopic structure of endostyle of any Urochordata with necessary diagram and comment on the functional importance of its different parts.   (3+3)+2=8
   b) Why mustached bat perform Doppler shift compensation? Explain in the light of neural network delay why one harmonic delay (FM2) is not enough for mustached bat to navigate by echolocation.   3+5=8

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GROUP - A
(Histochemistry)

1. Answer any *two* questions from the following: 2x2=4
   a) What is Methylene Bridge?   2
   b) What are diagnostic applications of EHC?   2
   c) Write a note on Post-Incubation Coupling method in respect to EHC.   2
   d) What is freeze drying?   2

2. Answer any *two* questions from the following: 2x4=8
   a) What is fixative? What does an ideal fixative do?   1+3=4
   b) Write a note on Heat induced Epitope Retrieval (HIER) for IHC-P?   2
   c) What are the advantages of immuno-histochemistry (IHC)? Why do you think we need multiplex-IHC (m-IHC)?   2+2=4
   d) What is the mechanism of PAS technique?   4

3. Answer any *one* question from the following: 8x1=8
   a) What is dye? State the features of a good dye. Justify whether haematoxylene is dye or not. What is resonance?   1+3+2+2=8
   b) Write down the working principle of Fluorescent Multiplex Immunohistochemistry with Tyramide Signal Amplification. What are advantages of HRP-Polymer Secondary Antibody based signal amplification method over the traditional ABC method.   5+3=8

GROUP - B
(Animal Physiology)

4. Answer any *two* questions from the following: 2x2=4
   a) Mention two causes of each for decrease and increase of blood volume.   2
   b) Differentiate between Aneurism and Stenosis.   2
   c) Define pacemaker potential.   2
   d) Comment on R and T states of haemoglobin.   2

5. Answer any *two* questions from the following: 2x4=8
   a) State the role of HTF-1 and Adenosine in hypoxia.   2+2=4
   b) Distinguish between Extrinsic and Intrinsic pathway of prothrombin activator formation.   4
   c) Draw and describe the ventricular-pressure volume loop. Show the change of loop in increased preload.   3+1=4
   d) Briefly write down the steps of erythropoiesis. Comment on its regulation.   2+2=4

6. Answer any *one* question from the following: 1x8=8
   a) (i) What is methemoglobin? Waht do you mean by positive cooperativity? What is Bohr Effect?
      (ii) State the role of thermogenin in thermogenesis.
      (iii) Elaborate the concept of Thermal Neutral Zone.   (1+1+1)+2+3=8

   b) (i) State the clinical significance of Frank-Starling mechanism.
      (ii) Describe with a neat diagram the cardiac action potentials.
      (iii) What is Reynold's number? State its significance.   2+4+2=8

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GROUP - A
(Immunology)

1) Answer any *two* questions from the following: 2x2=4
    a) What are super antigens?   2
    b) What is the relation in between monocyte and macrophages?   2
    c) If the function of CDR is to bind epitopes of antigens, what is the function of the rest of V-domain then?   2
    d) What is the significance of somatic hypermutation in immunity?   2

2) Answer any *two* questions from the following: 2x4=8
    a) Write a short note on peptide delivery to MHC-I molecules.   2
    b) Write briefly the steps involved in MAC formation.   2
    c) How are B cell antigens different from T cell antigens?   2
    d) What are NK cells? How do they recognize targets?   2+2=4

3) Answer any *one* question from the following: 1x8=8
    a) (i) Elaborate the steps of T cell maturation in thymus.
      (ii) What is T cell anergy? Explain its clinical significance.   5+(2+1)=8
    b) (i) What is the significance of chaperons in antigen processing and presentations?
      (ii) State the importance of stringency in hybridization reaction.   4+4=8

GROUP - B
(Methods in Biology)

4) Answer any *two* questions from the following: 2x2=4
    a) Why bioremediation is called a 'triple corner process'?   2
    b) What is cryopreservation? Mention its application.   1+1=2
    c) In what respect DNA-gel electrophoresis is different from RNA-gel electrophoresis?   2
    d) Mention the use of alkaline phosphatase in recombinant DNA technology.   2

5) Answer any *two* questions from the following: 2x4=8
    a) In TLC non-polar compounds move up the plate most rapidly than polar compounds. - Explain.   4
    b) State how molecular weight of a protein can be determined by molecular sieving chromatography.   4
    c) What is C-DNA library? Describe schematically the construction of C-DNA library.   1+3=4
    d) Describe how his-tag protein can be purified by Ni-NTA chromatography.   4

6) Answer any *one* question from the following: 1x8=8
    a) (i) Mention two advantages of COS vector over plasmid vector.
      (ii) Discuss how recombinant bacteria can be screened on the basis of α-complementation.   2+6=8
    b) (i) What is RT PCR? Write the application of western Blotting Hybridization.
      (ii) Discuss the advantages and limitation of phytoremediation.   (1+3)+(2+2)=8

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Time: 2 hours   **Use Separate Scripts for Each Group**   Full Marks: 40

The figures in the right hand margin indicate marks
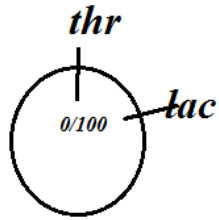*Candidates are required to give their answers in their own words as far as practicable*

GROUP - A
(Cell Biology)

1) Answer any *two* questions from the following: 2x2=4
    a) State the role of CDC 25 in cell cycle regulation.   2
    b) Explain why plasma membrane is considered as selectively permeable barrier?   2
    c) What do you mean by signal amplification?   2
    d) State the function of integrin.   2

2) Answer any *two* questions from the following: 2x4=8
    a) Why the asymmetry of lipid bilayer is functionally important?   4
    b) Describe the properties of integral membrane proteins with necessary diagram. 4
    c) What signal transduction pathways are involved in a0 to a1 transition?   4
    d) How replication silencing is important in cell cycle?   4

3) Answer any *one* question from the following: 1x8=8
    a) Describe cellular signalling event where NO and cGMP act hand in hand as second messenger. How do you identify Prometaphase?   6+2=8
    b) State the role of SRP protein in subcellular protein sorting. What is translocon? Describe the structure of γ tubulin ring complex. State its role in microtubule formation.   2+2+2+2=8

GROUP - B
(Cytogenetics)

4) Answer any *two* questions from the following: 2x2=4
    a) What are tumour viruses and viral oncogenes?   2
    b) Why hypomorphic mutations are not fit for cis-trans test?   2
    c) What is lysis inhibition?   2
    d) What is abortive transduction?   2

5) Answer any *two* questions from the following: 2x4=8
    a) Why are mutant plaques larger than the wild type plaques in Benzer's experiment? State two limitations of the cis-trans test.   2+2=4
    b) In an attempt to determine the amount of recombination between two mutations in the rII locus of phage T4, strain B of *E.coli* is doubly infected with both kinds of muatants. A dilution of 1: 10^9 is made of the lysate and plated on strain B. A dilution of 1: 10^7 is also plated on *E.coli* K12 (λ). 2 plaques are found on strain K12 (λ), 20 plaques are on strain B. Calculate the recombination frequency and the recombination percentage.   3+1=4
    c) Explain the mechanism of signal transduction and regulation of gene expression by oncoproteins.   4
    d) In a large random mating population the frequency of the I^A, I^B and i alleles are 0.16, 0.10 and 0.74 respectively. Calculate the expected frequencies of each blood type.   4

6) Answer any *one* question from the following: 1x8=8
    a) (i) Briefly describe the competence pheromone mediated transformation in *B. subtilis*.
    (ii) Compare and contrast complementation and recombination.   5+3=8
    b) You have identified a mutant *E.coli* strain that can not synthesize histidine (His⁻). To determine the location of his⁻ Mutation on the *E.coli* chromosome, you perform interrupted mating experiment with 5 different Hfr strains. The following chart shows the time of entry (minutes , in parenthesis), of the wild type allele of the first 5 markers (mutant genes) into the His⁻ strain.

Hfr A-	his(1)	man(9)	gal(28)	lac(37)	thr(45)
Hfr B-	man(15)	his(23)	cys(38)	ser(42)	arg(49)
Hfr C-	thr(3)	lac(11)	gal(20)	man(39)	his(47)
Hfr D-	cys(30	his(18)	man(26)	gal(45)	lac(54)
Hfr E-	thr(4)	rha(18)	arg(36)	ser(43)	cys(47)

On the following map of the circular *E.coli* chromosome, indicate
  (i) The relative location of each gene relative to thr (located at 0/100 min)
  (ii) The position where the F factor is integrated in each of the 5 Hfr's and
  (iii) The direction of chromosome transfer for each hfr (indicate direction with an arrow or arrow head) 4+2+2=8

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GROUP - A
(Basic & applied Entomology)

1. Answer any *two* questions from the following: 2x2=4
    a) What is tentorium?   2
    b) State the difference between damage and injury.   2
    c) What is retrocerebral complex in insects?   2
    d) Distinguish between homoptera and heteroptera.   2

2. Answer any *two* questions from the following: 2x4=8
    a) Give a brief account of the stages of insect diapause.   4
    b) What are euplantulae and empodia?   4
    c) Write a note on peritrophic membrane.   4
    d) Describe the life cycle of a coleopteran major pest of jute mentioning the nature of damage caused by this pest. 4

3. Answer any *one* question from the following: 1x8=8
    a) Comment on the distribution of neurosecretory cell in insects. What are fates of corpora cardiaca and corpora allata in adult insects? What is the difference between neurohumor and neurohormones?   3+3+2=8
    b) With diagram show the different cell types of midgut epithelium. What are kairomones? What is economic injury level (EIL)?   4+2+2=8

GROUP - B
(Ecotoxicology)

4. Answer any *two* questions from the following: 2x2=4
    a) Mention the role of glucuronidation in human body.   2
    b) What do you mean by bioactivation of xenobiotic compounds?   2
    c) What are immunotoxicants?   2
    d) What is the fundamental difference between genotoxicity and mutagenecity?   2

5. Answer any *two* questions from the following: 2x4=8
    a) What are exposure and acceptable risk? What is the significance of LC_{50} and LD_{50} study?   2+2=4
    b) Explain how certain class of immunotoxicant can cause immunosuppression?   4
    c) Mention the importance of biomagnifications in trophic chain.   4
    d) Write a note on antiporter system of detoxification.   4

6. Answer any *one* question from the following: 1x8=8
    a) Elucidate the role of Cytochrome P450 and glutathione-s-transferase towards removal of xenobiotic compounds from our body.   4+4=8
    b) Mention the basic concept of chelation therapy. Briefly describe the mode of action of hazardous heavy metal toxicity.   4+4=8

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GROUP - A
(Molecular Evolution)

1. Answer any *two* questions from the following: 2x2=4
   a) Differentiate Orthologs and Paralogs.   2
   b) What do you mean by maximum likelihood method of phylogenetic tree preparation?   2
   c) Suppose the observed phylogenetic distance (D_{OBS}) between two taxa is 0.49. What will be the Jukes-Cantor distance (D_{JC})?   2
   d) What are antioxidants? How does an antioxidant work?   1+1=2

2. Answer any *two* questions from the following: 2x4=8
   a) " Nearest Neighbour Interchange (NNI) is a subset of Subtree Pruning and Regrafting (SPR)" – validate the statement.   4
   b) Write down the Fitch algorithm for determining the length of a given tree.   4
   c) Draw a cladogram showing clad, branch & node. Is cladogram an evolutionary tree?   2+2=4
   d) Consider a population in which p= 0.9 and q= 0.1. if the forward mutation rate A→a is 5×10^{-5} and reverse mutation rate a→A is 2×10^{-8}, calculate the equilibrium frequency q̂ of the 'a' allele.   4

3. Answer any *one* question from the following: 1x8=8
   a) (i) What is random genetic drift?
   (ii) How does a balance between mutation and drift can bring equilibrium in a population?   2+6=8

   b) (i) Why Heuristic Search gains advantage over Exhaustive Search in tree Space Searching algorithms?
   (ii) Differentiate between strict consensus tree and majority rule consensus tree.
   (iii) Write down the Neighbor-Joining (NJ) Algorithm.   2+1+5=8

GROUP - B
(Microbiology)

4. Answer any *two* questions from the following: 2x2=4
   a) What do you mean by growth rate and generation time of bacteria ?   2
   b) Write a short note on virion.   2
   c) What is autoinducer? Give example.   2
   d) Give example of a naturally occurring plasmid based inter-kingdom gene transfer.   2

5. Answer any *two* questions from the following: 2x4=8
   a) Name two bacteria having linear genome. What are cryptic plasmid and F factor?   2+2=4
   b) What is lipoteichoic acid? What is pure culture?   2+2=4
   c) Write a note on nutritional requirements of bacteria.   4
   d) What is methylation dependent adaptation of bacterial chemotaxis?   4

6. Answer any *one* question from the following: 1x8=8
   a) Discuss the molecular mechanism of Al-2 based quorum sensing in *Vibrio harveyi* in low cell density (LCD) and high cell density (HCD) conditions.State how knowledge of quorum sensing can help scientist to develop new antibiotic.   (3+3)+2=8

   b) What is glycocalyx? Compare and contrast Gram-negative and Gram-positive bacteria.   2+6=8

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M.Sc. Semester-III Examination, 2019
ZOOLOGY
Paper-ZOO-303B

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GROUP - A
(Biodiversity and Conservation Ecology)

1) Answer any *two* questions from the following: 2x2=4
     a) Name any two endemic animals of Ganga river belonging to different classes.   2
     b) What is red data book?   2
     c) Distinguish between total count and sample count.   2
     d) What do you mean by wild life crime?   2

2) Answer any *two* questions from the following: 2x4=8
     a) Mention two benefits of (i) buffer zone (ii) world heritage site   2+2=4
     b) What are the advantages of joint forest management programme? Comment on Arabari model in this context.   2+2=4
     c) Write a note on molecular marker technique regarding measurement of genetic diversity.   4
     d) State the essential features of protected area.   4

3) Answer any *one* question from the following: 1x8=8
     a) What is IBA? Why population of vultures declined rapidly in last decade? Mention some conservation initiative of Indian tiger. What is the reason of human elephant conflict?   1+2+3+2=8
     b) What is camera trap? Mention one advantage and one disadvantage of satellite telemetry. What are the essential instruments for radio telemetry? Write a short note on GPS telemetry.   1+ (1+1) +2+3=8

GROUP - B
(Aquatic Ecology)

4) Answer any *two* questions from the following: 2x2=4
     a) What do you mean by 'Ramsar site'? Give one example from West Bengal.   1+1=2
     b) Mention two threats of mangrove ecosystem.   2
     c) What are limnoplankton and periphyton?   2
     d) What is integrated river management approach?   2

5) Answer any *two* questions from the following: 2x4=8
     a) What do you mean by water foot print and virtual water?   2+2=4
     b) Explain lake effect snow fall with diagram.   4
     c) State two achievements and two drawbacks of Ganga Action Plan.   2+2=4
     d) Write a note on sustainable ground water management.   4

6) Answer any *one* question from the following: 1x8=8
     a) What are sewage, sullage and sludge? What are primary and secondary treatments? Add a note on strategies of coastal dune conservation.   3+2+3=8
     b) Write the objectives of NPCA. Discuss the factors affecting water quality with special reference to rainfall and farming. What are the goals of water conservation effort?   2+3+3=8

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GROUP - A
(Genetics)

1) Answer any *two* questions from the following: 2x2=4
       a) What do you mean by interference?   2
       b) What are coupling and repulsion?   2
       c) What is spliciosome?   2
       d) Distinguish between DNA polymerase and RNA polymerase.   2

2) Answer any *two* questions from the following: 2x4=8
       a) What do you understand by 'Luxury gene' and 'House keeping gene'?   2+2=4
       b) How do you identify a pedigree to be that of a sex linked recessive trait?   4
       c) With the help of a test cross how would you confirm whether two genes are linked or not linked?   4
       d) Write a short note on Central Dogma in molecular biology.   4

3) Answer any *one* question from the following: 1x8=8
       a) "Exon shuffling is instrumental in the sex determination cascade of *Drosophila*"- elaborate with suitable diagram. 8
       b) Singed bristle (sn), cross veinless wing (cv) and vermillion eye colour (v) are due to recessive mutant alleles of three sex linked genes of *Drosophila melanogaster*. When a female heterozygous for each of three genes was test crossed with a singed (sn), cross veinless (cv) and vermillion (v) male the following progenies were obtained:

PHENOTYPES			NUMBER
sn	cv	v	3
+	cv	v	392
+	+	v	34
+	cv	+	61
sn	cv	+	32
sn	+	v	65
sn	+	+	410
+	+	+	3
		Total	1000

       i) What is the correct order of three genes on chromosome?
       ii) Calculate the genetic map distances between these three genes.
       iii) Calculate the coefficient of coincidence.   2+4+2=8

GROUP - B
(Haematology)

4) Answer any *two* questions from the following: 2x2=4
       a) Name two congenital bleeding disorders.   2
       b) What is haematopoietic stem cell?   2
       c) Write down the name and function of the molecules stored in the granules of neutrophil and eosinophil.   2
       d) What is aplastic anemia? Can it be turned to leukemia?   2

5) Answer any *two* questions from the following: 2x4=8
       a) What do you mean by inflammatory and patrolling monocytes? What do you understand by secondary lymphoid Organ?   2+2=4
       b) How embryonic stem cells are different from adult stem cells? What is microcytic anaemia?   3+1=4
       c) What are the symptoms of thrombophilia? Differentiate arterial clot from venous clot.   3+1=4
       d) Give a brief account on antithrombin.   4

6) Answer any *one* question from the following: 1x8=8
       a) What do you mean by CMP and CLP during haematopoiesis? Write a note on regulation of lineage commitment during haematopoiesis.   4+4=8
       b) Name the location of haemopoietic tissue in arthropoda and mammalia. Define haemostasis. Briefly describe the intrinsic pathway of prothrombin activator formation.   2+2+4=8

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