



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**BOTANY-HONOURS**

**BOTH-VII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 80

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

1. Answer **all** questions from the following: 2×8 = 16
- What do you mean by Scion and Stock?
  - Mention the phenotypic ratio of dominant and recessive epistasis.
  - Give the full form of AFLP and RAPD.
  - What do you mean by Penetrance and Heritability?
  - What is multiple allele? Give example.
  - State the general construction of the plasmid vector pBR322.
  - What do you mean by sex influenced traits? Give examples.
  - How many types of Restriction Endonucleases are there? Which type is commonly used in Genetic engineering?
2. Answer any **two** questions from the following: 16×2 = 32
- Briefly discuss the mechanism of positive and negative control of different operons with suitable examples and diagrams. 16
  - What is linkage? What is Coefficient of Coincidence? Define interference. A cross was made between yellow-bodied (*y*), echinus (*ec*), white-eyed (*w*) flies (genotype: *yecw/yecw*) and wild type flies (genotype: *YEcW/YEcW*). A test cross was performed with the  $F_1$  flies. The following genotypes were present in a sample of 1000 progeny flies: 2+2+2+10

<u>Genotype</u>	<u>Frequency</u>
<i>YEcW/yecw</i>	455
<i>yecw/yecw</i>	449
<i>yEcW/yecw</i>	16
<i>Yecw/yecw</i>	20
<i>yEcw/yecw</i>	30
<i>YecW/yecw</i>	23
<i>YEcw/yecw</i>	03
<i>yecW/yecw</i>	04

- Determine the order in which the three loci occur on the chromosome and prepare a linkage map.
- (c) Describe the process of constructing a genetically modified crop with suitable example. 16
- (d) Write short notes on: 4×4
- (i) Dominance and over-dominance hypothesis
  - (ii) YAC
  - (iii) Northern analysis
  - (iv) Gene cloning.
3. Answer any *four* questions from the following: 8×4 = 32
- (a) Describe the Holiday model of chromosomal crossing-over with suitable diagrams. 8
- (b) Differentiate between trisomy and tetrasomy. Discuss the currently accepted evolutionary history of hexaploid wheat. 2+6
- (c) What is mutation? Briefly discuss the molecular mechanism of any one chemical mutagen. 2+6
- (d) Define plant introduction and acclimatization. Briefly discuss the process of introducing a new variety. 2+2+4
- (e) Describe the process of splicing through spliceosome complex with suitable diagrams. 8
- (f) Write briefly on: 4×2
- (i) RFLP
  - (ii) Translocation heterozygote.



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Full Marks: 80

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1. Answer **all** questions from the following: 2×8 = 16
- (a) Define photoperiodism in its modern concept.
  - (b) Name one metalloenzyme and one metal-activated enzyme.
  - (c) "ETS is very important in respiration" – Justify.
  - (d) What are the difference between absorption and adsorption?
  - (e) "All plant growth regulators are not phytohormones" – Justify the statement.
  - (f) Define 'Krantz' anatomy. State its importance in plant physiology.
  - (g) "ABA is considered as stress hormone" – Why?
  - (h) What is the formula for T-Test calculation?

2. Answer any **two** questions from the following: 16×2 = 32
- (a) Define biological nitrogen fixation. Describe the biochemistry of nitrogen fixation in nodules of leguminous plants. What is leghemoglobin? Mention its function. 2+10+2+2
  - (b) Define dormancy. Describe the physiological changes occurring during seed germination. How electrons from water are transferred to NADP through photosystems in illuminated chloroplasts? Characterize RUBISCO. 2+6+6+2
  - (c) Find out mean, standard deviation and standard error from the following:

Group	121-130	131-140	141-150	151-160	161-170	171-180	181-190
Frequency	3	5	7	9	6	4	3

- (d) How does active transport differ from passive transport? Explain the different theories regarding ascent of sap. What do you mean by apoplastic and symplastic movement of water?

3. Answer any *four* questions from the following: 8×4 = 32
- (a) Write short note on: 2×4
- (i) Nitrogen respiration
  - (ii) Tracer elements
  - (iii) Goodness of fit
  - (iv) Random sampling.
- (b) Find role and deficiency effects of the following essential elements: 4+4
- (i) Phosphorus
  - (ii) Potassium.
- (c) Write difference between: 4+4
- (i) C<sub>3</sub> and C<sub>4</sub> plants
  - (ii) Auxin and Cytokinin.
- (d) Describe the mechanism of the transport of water from root to leaves. 8
- (e) Write the roles of abscisic acid in the regulation of stomatal movement. 8
- (f) Mention the regulatory steps of glycolysis. What is Proton Motive Force (PMF)? 6+2



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B.Sc. Honours Part-III Examinations, 2018

**BOTANY-HONOURS**

**BOTH-IX**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 80

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1. Answer the following questions: 2×8 = 16
- (a) What is endemic disease? Give an example.
  - (b) Write the function of leghaemoglobin during  $N_2$ - fixation.
  - (c) Name one bacterium having peritrichous and another having lophotrichous flagella.
  - (d) Define dedifferentiation.
  - (e) What is 'Shuttle Vector'? Give an example.
  - (f) Write the differences between prototrophs and auxotrophs.
  - (g) Define hypertrophy and hyperplasia.
  - (h) Name two fungi which produce organic acid.
2. Answer any *two* questions from the following: 16×2 = 32
- (a) Describe the symptoms, causal organism, disease cycle and control (2+1+3+2) measures of brown spot of rice and black stem rust of wheat. ×2
  - (b) Describe the structure of cell wall of Gram positive and Gram negative bacteria. State the mode of action of penicillin and lysozyme on bacterial cell wall. 7+7+2
  - (c) What is protoplast culture? Describe the technique of protoplast isolation. What is artificial seed? Describe the process of embryo culture. 2+6+2+6
  - (d) Write short notes on: 4×4
    - (i) Koch's postulates
    - (ii) Horizontal resistance
    - (iii) Endospore
    - (iv) Carbon cycle,

3. Answer any *four* questions from the following: 8×4 = 32
- (a) Describe the biochemical basis of plant defence responses. 8
  - (b) What are the differences between  $F^+$ ,  $F^-$  and  $Hfr$  strains of bacteria? Describe the conjugation process between  $F^+$  and  $F^-$  strains of *Escherichia Coli*. 3+5
  - (c) Distinguish between beer and wine. Describe the process of commercial production of wine. 2+6
  - (d) Describe the structure of TMV. Name two prion disease. 6+2
  - (e) Describe *Agrobacterium* mediated gene transfer mechanism in plants with suitable sketches. 8
  - (f) Write in brief: 2×4
    - (i) Viroids
    - (ii) Nod gene
    - (iii) PR protein
    - (iv) Plant quarantine.



COOCH BEHAR PANCHANAN BARMA UNIVERSITY

B.Sc. General Part-III Examinations, 2018

BOTANY-GENERAL

BOTG-VII

UNDER-(1+1+1) SYSTEM

Time Allotted: 3 Hours

Full Marks: 60

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1. Answer the following questions: 2×6 = 12  
নিম্নলিখিত প্রশ্নগুলির উত্তর দাও:
- (a) What is pathogenesis?  
প্যাথোজেনেসিস কি?
- (b) Name two active principles of Sarpagandha.  
সর্পগন্ধার দুটি কার্যকরী উপাদানের নাম লেখো।
- (c) Define Chlorine.  
ক্লোরিনের সংজ্ঞা দাও।
- (d) What is leghaemoglobin? State its function.  
লেগ-হিমোগ্লোবিন কি? এর কাজ লেখো।
- (e) Write down the scientific names of coffee and cumin.  
Coffee এবং Cumin-এর বিজ্ঞানসম্মত নাম লেখো।
- (f) What is palindromic sequence?  
প্যালিনড্রোমিক সিকোয়েন্স কি?
2. Answer any *two* questions from the following: 12×2 = 24  
নিম্নলিখিত যে-কোনো দুটি প্রশ্নের নাম উত্তর দাও:
- (a) Describe the symptoms, causal organisms and control measures of late (2+2+2)×2  
blight of potato and rust of wheat.  
আলুর ধসে রোগ এবং গমের সবুজ রোগের লক্ষণ, রোগ সৃষ্টিকারী জীবাণু এবং রোগ দমন  
পদ্ধতি আলোচনা করো।
- (b) What is spawn? Describe the cultivation process of *Pleurotus*. 2+10  
স্পন কী? *Pleurotus*-এর কর্ষন পদ্ধতি আলোচনা করো।

- (c) What is tissue culture? Illustrate the techniques of embryo culture and its significance. 2+8+2  
 কলা পালন কি? জর পালন পদ্ধতি এবং এর তাৎপর্য বর্ণনা করো।
- (d) Write short notes on: 4×3  
 সংক্ষিপ্ত টীকা লেখোঃ
- (i) Role of biopesticides in agriculture  
 কৃষিক্ষেত্রে বায়োগেসিসাইডের ভূমিকা
- (ii) Grafting  
 গ্রাফটিং
- (iii) Disease resistance.  
 রোগ প্রতিরোধন।
3. Answer any **three** questions from the following: 8×3 = 24  
 নিম্নলিখিত যে-কোনো **তিনটি** প্রশ্নের উত্তর দাওঃ
- (a) Write scientific name, family, parts used and uses of ginger and neem. (1+1+1+1) ×2  
 আদা ও নিম-এর বিজ্ঞানসম্মত নাম, গোত্র উদ্ভিদ অঙ্গ এবং ব্যবহার লেখো।
- (b) Write short notes on: 4×2  
 সংক্ষিপ্ত টীকা লেখো
- (i) Koch's postulate  
 কোচ-এর নীতি
- (ii) Symbiosis.  
 মিথোজীবিত্ব।
- (c) What are medicinal plants? Describe the phytochemistry and medicinal uses of *Citronella* and *Vasak*. 2+6  
 ঔষধি উদ্ভিদ কি? *Citronella* এবং *Vasak*-এর উদ্ভিদ রসায়ন এবং ঔষধি ব্যবহার লেখো।
- (d) What is Vector? Explain the role of restriction endonuclease in producing recombinant DNA. 2+6  
 ভেক্টর কী? রিকম্বিন্যান্ট DNA উৎপাদনে রেস্ট্রিকশন এন্ডোনিউক্লিয়াসের ভূমিকা আলোচনা করো।
- (e) Write briefly on: 2×4  
 অতি সংক্ষেপে লেখোঃ
- (i) Symptoms  
 লক্ষণ / উপসর্গ
- (ii) MS medium  
 MS মাধ্যম
- (iii) pBR322  
 pBR322
- (iv) Bonsai.  
 বনসাই।





**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**ZOOLOGY-HONOURS**

**ZOOH-VIII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 80

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**GROUP-A**

**(Histology and Histochemistry)**

1. Answer any *six* questions from the following: 1×6 = 6
- (a) Give an example of a transitional epithelium.
  - (b) \_\_\_\_\_ tissue is specialised to store neutral fat.
  - (c) What are zymogen granules?
  - (d) Write an example of a mordant.
  - (e) Give an example of an additive fixative.
  - (f) The most distal part of collecting duct system that empties in minor renal calyx is known as
    - (i) Papillary duct
    - (ii) Collecting duct
    - (iii) Vasa recta
    - (iv) Distal convoluted tubule. (Choose correct answer)
  - (g) Blood testis barrier is formed by
    - (i) Tunica vaginalis
    - (ii) Rete testis
    - (iii) Sertoli cells
    - (iv) Tunica albuginea. (Choose correct answer)
  - (h) Aldosterone is produced by
    - (i) Cells of adrenal medulla
    - (ii) Cells of zona glomerulosa
    - (iii) Cells of zona reticularis
    - (iv) Cells of zona fasciculata. (Choose correct answer)

- (i) Parafollicular cells of thyroid produces calcitonin. (True/False) (Choose correct answer)
- (j) The stellate macrophage cells in the space of Disse are also known as \_\_\_\_\_. (Fill in the blanks)

2. Answer any *three* questions from the following: 3×3 = 9

- (a) State the composition of FAA and its utility.
- (b) Distinguish between voluntary and involuntary muscle.
- (c) Differentiate between fixative and preservative.
- (d) Write down the location, structure and function of principal cells.
- (e) State the paracrine control between Leydig and Sertoli cells.

3. Answer any *one* question from the following: 10×1 = 10

- (a) Write down the process of cryo preservation in brief. Write its application. 6+4
- (b) What is the composition of thyroid follicular colloid? How the colloid is formed in thyroid gland? State the diseases in human due to the hypo and hyper secretion of thyroid hormones. 2+3+5

**GROUP-B**  
**(Embryology and Teratology)**

4. Answer any *six* questions from the following: 1×6 = 6

- (a) Extraembryonic coelom is represented by the \_\_\_\_\_ cavity. (Fill in the blanks)
- (b) Notochordal process induces the overlying ectoderm to become the neural plate. (True/False) (Choose correct answer)
- (c) The umbilical cord does not include part of chorion. (True/False) (Choose correct answer)
- (d) Neural crest cells are derivatives of
  - (i) Ectoderm
  - (ii) Extraembryonic mesoderm
  - (iii) Endoderm
  - (iv) Intraembryonic mesoderm (Choose correct answer).
- (e) Chordamesoderm becomes the \_\_\_\_\_. (Fill in the blank)
- (f) Cleavage in avian eggs is holoblastic. (True/False)
- (g) Give an example of non-cleidoic egg.
- (h) Expand MBT.
- (i) Zona pellucida is a \_\_\_\_\_ egg membrane (primary / secondary / tertiary).
- (j) What is chorio allantoic placenta?

5. Answer any *three* questions from the following; 3×3 = 9
- (a) Write a short note on capacitation.
  - (b) Enumerate the teratogenic effect of alcohol.
  - (c) Distinguish between cleidoic and non-cleidoic eggs. Give examples.
  - (d) Distinguish between facultative and obligatory parthenogenesis.
  - (e) Distinguish between arrhenotoky and thelytoky.
6. Answer any *one* question from the following; 10×1 = 10
- (a) What is reciprocal induction? Describe reciprocal induction in kidney development in chick. What is organiser? 2+6+2
  - (b) What is spermiation? What is spermiogenesis? State the events of spermiogenesis with labelled diagram. 1+1+(5+3)

### GROUP-C

#### (Adaptation, Behaviour and Evolution)

7. Answer any *eight* questions from the following; 1×8 = 8
- (a) What is punctuated equilibrium?
  - (b) Give an example of a vestigial organ.
  - (c) What is hybrid sterility?
  - (d) Give an example of ethological isolation.
  - (e) Give an example of convergent evolution.
  - (f) Founder effect occurs in large population. (True/False)
  - (g) Humming bird and kite illustrate
    - (i) Convergent evolution
    - (ii) Parallel evolution
    - (iii) Adaptive radiation
    - (iv) Homology. (Choose correct answer)
  - (h) \_\_\_\_\_ is the study of fossils. (Fill in the blank)
  - (i) Earliest fossil form of modern horse is \_\_\_\_\_. (Fill in the blank)
  - (j) Genetic drift is the change of
    - (i) Gene frequency in the same generation
    - (ii) Appearance of recessive genes
    - (iii) Gene frequency from a generation to next
    - (iv) None of the above. (Choose correct answer)

- (k) Species occurring in different geographic areas are known as
- (i) Neopatric species
  - (ii) Sibling species
  - (iii) Allopatric species
  - (iv) Sympatric species. (Choose correct answer)
- (l) At a particular locus, frequency of 'A' allele is 0.6 and that of 'a' is 0.4. What would be the frequency of heterozygotes in a random mating population at equilibrium?
- (i) 0.16            (ii) 0.24            (iii) 0.36            (iv) 0.48.

8. Answer any *four* questions from the following: 3×4 = 12

- (a) Write down the criticisms of Lamarck's theory.
- (b) How does migration change gene frequency in a population?
- (c) Differentiate between Batesian and Mullerian mimicry.
- (d) Write a note on vicariant speciation.
- (e) State differences between crypsis and aposematism with example.
- (f) State the role of population bottleneck in relation to evolution.
- (g) What conclusion may be drawn from the evidence of industrial melanization?

9. Answer any *one* question from the following: 10×1 = 10

- (a) State the differences between convergent and divergent evolution. Discuss the process of divergent evolution citing a suitable example. Define preadaptation and give one example. 4+4+2
- (b) Differentiate between allopatric and sympatric speciation. What is the role of isolation in speciation? 6+4



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ZOOLOGY-HONOURS

ZOOH-IX

UNDER-(1+1+1) SYSTEM

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GROUP-A

(Ecology)

1. Answer any *six* questions from the following: 1×6 = 6
- (a) What is sedimentary cycle?
  - (b) Explain the term-parasitoid.
  - (c) Name the place where two major communities meet and blend.
  - (d) Second law of thermodynamics deals with the idea of conservation of energy. (True/False)
  - (e) High birth rate, high juvenile mortality and low parental care are the features of a K-selected species. (True/False)
  - (f) Inverted age distribution pyramid signifies \_\_\_\_\_ (stable / expanding / declining) population. (Fill in the blank)
  - (g) What do you mean by ecological equivalents?
  - (h) Immigration means to move into a territory in which a population is not a native one. (True/False)
  - (i) A \_\_\_\_\_ (xerosere / lithosere / psammosere) is a seral community in an ecological succession that begins on a newly exposed coastal sand. (Fill in the blank)
  - (j) Define microclimate.
2. Answer any *three* questions from the following: 3×3 = 9
- (a) State and elaborate the idea of Shelford's law of tolerance.
  - (b) Write a short note on: Sigmoid Growth Curve.
  - (c) Briefly explain the Leibig's "law of minimum". 3
  - (d) Differentiate between 'r-selection' and 'K-selection'. 3
  - (e) Describe the 'Y-shaped' energy flow model in an ecosystem. 3

3. Answer any *one* question from the following: 10×1 = 10
- (a) Define ecological succession. Provide a generalized account of the different stages of ecological succession. What is poly-climax theory? 2+6+2
- (b) Define carrying capacity. Give an account of 'logistic growth' of a population. How does it differ from 'exponential growth'? Explain population fluctuation. 2+3+3+2

### GROUP-B

#### (Environmental Biology and Toxicology)

4. Answer any *eight* questions from the following: 1×8 = 8
- (a) Expand the acronym: P.A.N.
- (b) Xenobiotics are metabolized in the liver. (True/False)
- (c) Minamata disease is caused by \_\_\_\_\_ (lead / cadmium / copper / mercury). (Fill in the blank)
- (d) Expand the acronym: D.D.T.
- (e) An endocrine disrupter which is commonly found in the plastic bottles is Bisphenol A. (True/False)
- (f) Arsenic poisoning in water causes \_\_\_\_\_ disease. (Fill in the blank)
- (g) Biotransformation of xenobiotics is catalyzed by \_\_\_\_\_ (cytochrome P450 / cytochrome C / cytochrome 65). (Fill in the blank)
- (h) Name one biological indicator of air pollution.
- (i) Name one pathogenic soil bacteria.
- (j) X-ray is an example of ionizing radiation – (True/False).
- (k) Name one major pollutant emitted in automobile exhaust.
- (l) N<sub>2</sub>O is a major greenhouse gas. (True/False)
5. Answer any *four* questions from the following: 3×4 = 12
- (a) Write the toxic effects of organophosphate insecticides. 3
- (b) Explain 'biological magnification'. 3
- (c) State the biological sources of soil pollution. 3
- (d) Write a short note on: Radioactive waste management.
- (e) Discuss the causes and symptoms of botulism.
- (f) Write a short note on: Ramsar Convention.
- (g) Elucidate the causes and effects of acid rain.
6. Answer any *one* question from the following: 10×1 = 10
- (a) How domestic sewage and industrial effluents causes severe water pollution? What do you mean by 'blue baby syndrome'? Define BOD and COD. 2+2+2+2+2

- (b) What do you mean by habitat fragmentation? Briefly discuss its ecological impacts. Discuss the idea of sustainable development in the light of present day environmental crisis. 2+3+5

**GROUP-C**  
**(Animal Behaviour)**

7. Answer any *six* questions from the following: 1×6 = 6
- (a) Genes affect behaviour by altering  
(i) Morphology, (ii) Physiology, (iii) Anatomy, (iv) Mentality.
- (b) What is bombycol?
- (c) Concept of imprinting was strongly established by  
(i) Lorenz, (ii) Parlor, (iii) Heinroth, (iv) Tinbergen.
- (d) Altruism is a self-sacrificing behaviour in social animals. (T / F)
- (e) A faster waggle dance indicates that food is far away – (T / F).
- (f) Animals active at dawn and dusk are called –  
(i) diurnal, (ii) nocturnal, (iii) crepuscular, (iv) hibernator.
- (g) \_\_\_\_\_ (Amygdala / Suprachiasmatic nucleus / Cerebellum) of brain is responsible for controlling circadian rhythm. (Fill in the blank)
- (h) The reproductive castes of a mature termite colony include \_\_\_\_\_ (one king and one queen / several kings and one queen / one king and several queens / multiple pairs of kings and queens). (Fill in the blank)
- (i) Earth's magnetic field does not influence a migrating bird. (True/False)
- (j) Skinner box is related to classical conditioning. (True/False)
8. Answer any *three* questions from the following: 3×3 = 9
- (a) Discuss F.A.P. with a classical example.
- (b) State the role of pheromones in communication with suitable examples. 2+1
- (c) What is biological clock? Write about different factors affecting it. 1+2
- (d) Explain reciprocal altruism with suitable example. 1.5+1.5
- (e) Discuss Hamilton's rule in the light of kin selection.
9. Answer any *one* question from the following: 10×1 = 10
- (a) What is bee dance? Write the different types of bee dance with suitable diagram. Explain the significance of such dance. 2+5+3
- (b) Distinguish between innate and learnt behaviour. Interpret the results of Pavlov's Experiment in the light of conditional learning. What do you mean by imprinting? How is critical period related to it? 3+3+2+2



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ZOOLOGY-HONOURS

ZOOH-X

UNDER-(1+1+1) SYSTEM

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GROUP-A

(Applied Zoology)

1. Answer any *eight* questions from the following: 1×8 = 8
- (a) Expand CIFA.
  - (b) The International Centre for Training and Research in Tropical Sericulture is located at Mysore. (True/False)
  - (c) The most virulent protozoan disease of silkworm is \_\_\_\_\_ (Pebrine / Flachariae).
  - (d) Rohu fish is a \_\_\_\_\_ (surface / bottom) feeder.
  - (e) Example of Indian Endogenous breed is \_\_\_\_\_ (Brahama / Aisel).
  - (f) A freshwater prawn is \_\_\_\_\_ (Palaemon / Macrobrachium).
  - (g) How will you identify a male and female *Clarias batrachus*?
  - (h) Which type of silkworm prefers to eat aromatic leaves?
  - (i) Define mariculture.
  - (j) What do you mean by sea-ranching?
  - (k) Why oral polio vaccine can be given three times / years up to 5 years of a baby?
  - (l) Cos-7 is an African green monkey liver cell line. (True/False)
2. Answer any *four* questions from the following: 3×4 = 12
- (a) Why cell sub-culturing is essential? How cytotoxicity is determined? 1+2



- (b) How wildlife health can be preserved technologically? 3
- (c) Which chromosomes are responsible for the synthesis of fibroin silk protein? What are the recent varieties of univoltine and bivoltine silk moth in India? 1+2
- (d) What do you mean by Royal Jelly? Comment on medicinal value of Royal Jelly. 1+2
- (e) How nutrient is different from media? Name one natural and one synthetic media utilized widely in *in vitro* culture. 1+2
- (f) Mention the advantage of individual cage system. 3
- (g) Give an account of physical characters of White Leg Horn breed.
3. Answer any *one* question from the following: 10×1 = 10
- (a) Describe life cycle of mulberry silk moth with suitable sketch. Comment on rearing appliances of silkmoth. 6+4
- (b) Delineate hybridoma formation for making antibody. What are the various products of animal cell cultures? Mention composition of RPML. 4+4+2

#### GROUP-B

##### (Conservation Biology and Wildlife)

4. Answer any *eight* questions from the following: 1×8 = 8
- (a) Zoological garden is an example of \_\_\_\_\_ (in *situ* / ex *situ*) conservation.
- (b) Project tiger was launched in the year 1976. (True / False)
- (c) Expand TERI.
- (d) *Tylostotriton* is an example of \_\_\_\_\_ (endangered / rare / vulnerable) species.
- (e) *Dodo* is (i) Endangered (ii) Critically endangered (iii) Rare (iv) Extinct species.
- (f) Expand SSC.
- (g) Define protected area.
- (h) Write the names of two Indian wild life sanctuaries where Hoolock gibbons are conserved.
- (i) What do you mean by black data book?
- (j) Write on cryopreservation with examples.
- (k) The only one Biosphere reserve of West Bengal — Sundarban was established in the year 1997. (True/False)
- (l) Give examples of flagship species.

5. Answer any *four* questions from the following: 3×4 = 12
- (a) Illustrate any three Prime characteristics of National Forest Policy (1988).
  - (b) Write down three major differences between National Park and Biosphere Reserve.
  - (c) Illustrate three prime causes of wildlife loss in North Bengal.
  - (d) What is game reserve? Write four importances of wildlife for upliftment of country's economy.
  - (e) Define keystone species. Focus its different benefits. 1+2
  - (f) Briefly narrate different management practices for endangered species. 3
  - (g) Analyze the functions and power of State Biodiversity Board. Is the convention on Biodiversity legally binding? 2+1
6. Answer any *one* question from the following: 10×1 = 10
- (a) What do you mean by Peoples Biodiversity Registrar (PBR)? Discuss different steps involved in it. Comment on project tiger in India. 2+4+4
  - (b) Mention four main purposes of Biosphere conservation. What are the functions of six different zones of Biosphere reserve? 4+6

**GROUP-C**

**(General Informatics and Bio-Informatics)**

7. Answer any *four* questions from the following: 1×4 = 4
- (a) What do mean by Entrez?
  - (b) State the function of Taq DNA polymerase.
  - (c) What is probing?
  - (d) Expand HTML.
  - (e) Systematic Performance of operations upon data is known as \_\_\_\_\_ (Data warehouse / Data Processing).
  - (f) The alignment of two nucleotide or protein sequences over their entire length is known as Maximum Likelihood Analysis. (True / False)
  - (g) A graphical procedure for representing the output of a hierarchical clustering is known as \_\_\_\_\_ (Cladogram / Dendrogram).
8. Answer any *two* questions from the following: 3×2 = 6
- (a) Who developed RasMol computer programme? State its several utilities in structural biology. 1+2
  - (b) Write the principle and main ingredients of PCR. Cite the name of primer design software for PCR. 2+1
  - (c) Comment on Practical uses of sequence alignment.
  - (d) With example mention different types of taxonomy Databases.

9. Answer any *one* question from the following: 10×1 = 10
- (a) Mention main principles of DNA sequencing. Write different DNA sequencing strategies. What is the importance of Swiss Prot? 4+4+2
- (b) Establish the logic behind DNA fingerprinting as a tool of polymorphism studies. With suitable sketch describe the process of DNA fingerprinting. Mention salient features of NCBI as an example of Nucleic Acid sequence database. 2+3+5



COOCH BEHAR PANCHANAN BARMA UNIVERSITY

B.Sc. General Part-III Examinations, 2018

ZOOLOGY-GENERAL

ZOOG-VII

UNDER-(1+1+1) SYSTEM

Time Allotted: 3 Hours

Full Marks: 60

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Ecology, Evolution and Applied Zoology**

1. Answer any six questions from the following: 2×6 = 12  
নিম্নলিখিত যে-কোনো ছয়টি প্রশ্নের উত্তর দাও:
- (a) What is polytypic species?  
পলিটাইপিক প্রজাতি কি ?
- (b) Write the full form of CITES and WWF.  
CITES এবং WWF-এর পুরো নাম লেখো।
- (c) Define natality.  
ন্যাটালিটির সংজ্ঞা লেখো।
- (d) What is the ideal condition to store rice to avoid damage by *Sitophylus oryzae*?  
*Sitophylus oryzae* দ্বারা ক্ষতি রোধ করতে ধান রাখার আদর্শ অবস্থা কি ?
- (e) What is 'Weber's line'?  
ওয়েবার রেখা কি ?
- (f) Name a disease caused by (i) Sand fly, (ii) House fly.  
নিম্নলিখিত দ্বারা গঠিত একটি করে রোগের নাম লেখো: (i) স্যান্ডফ্লাই (ii) মাছি।
- (g) Define carrying capacity.  
ধারণ ক্ষমতার সংজ্ঞা লেখো।
- (h) Name two endemic animals.  
দুটি এণ্ডেমিক প্রাণীর নাম লেখো।
- (i) What is founder effect?  
ফাউন্ডার এফেক্ট কি ?
- (j) Name two National Parks of India.  
ভারতবর্ষের দুটি জাতীয় উদ্যানের নাম লেখো।

2. Answer any *six* questions from the following: 4×6 = 24  
 নিম্নলিখিত যে-কোনো ছয়টি প্রশ্নের উত্তর দাও:
- (a) What is fundamental niche and realized niche?  
 ফাণ্ডামেন্টাল নীচ ও রিয়েলাইজড নীচ কি ?
- (b) Briefly describe the mechanism of formation of pearl.  
 মুক্তা সৃষ্টির পদ্ধতি সংক্ষেপে বর্ণনা করো।
- (c) Give the names, the causal agents and preventive measures of two poultry diseases.  
 দুটি পোলট্রির রোগের কারণ ও প্রতিরোধ ব্যবস্থার নাম লেখো।
- (d) What is Hardy-Weinberg Equilibrium? Mention the factors that affect it. 2+2  
 হার্ডী-ওয়েনবার্গ সাম্যাবস্থা কি ? এর প্রভাবগুলি উল্লেখ করো।
- (e) Differentiate between Batesian mimicry and Mullerian mimicry with suitable examples.  
 উদাহরণসহ বেটেসিয়ান ও মুলেরিয়ান মিমিক্রির মধ্যে পার্থক্য লেখো।
- (f) Mention the main propositions of Lamarck.  
 ল্যামার্কের মূল প্রস্তাব উল্লেখ করো।
- (g) Give a brief account of mutation caused by base analogues.  
 বেস এনালগস্ দ্বারা ঘটিত পরিব্যক্তির সংক্ষেপে বর্ণনা দাও।
- (h) Write down the scientific name of cabbage semilooper. Why is it called semilooper? Mention in brief, its nature of damage.  
 বাধাকপির সেমিলুপারের বিজ্ঞানসম্মত নাম লেখো। একে সেমিলুপার বলা হয় কেন ? এর দ্বারা গঠিত ক্ষতির সংক্ষেপে উল্লেখ করো।
- (i) Write a short note on 'bottle-neck effect'.  
 'Bottle-neck effect'-এর সম্পর্কে একটি সংক্ষিপ্ত টীকা লেখো।
- (j) Give a brief account of the ecological pyramids.  
 বাস্তুতন্ত্রের পিরামিড সম্পর্কে সংক্ষেপে লেখো।
3. Answer any *two* questions from the following: 12×2 = 24  
 নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:
- (a) Write the scientific name and systematic position of Mulberry silk worm. 1+2+1  
 What is the difference between univoltine and multivoltine strains of silk moths? Briefly describe the structure of silk-gland with a suitable diagram. +4+4  
 Name a protozoan disease of silk worm, its causative agent and mention its prevention.  
 তত্ত্ব রেশম মথের বিজ্ঞানসম্মত নাম ও সিস্টেমাটিক পজিশন লেখো। ইউনিভোল্টাইন ও মাল্টিভোল্টাইন রেশম মথের পার্থক্য লেখো। চিত্রসহ রেশম গ্রন্থির গঠন ব্যাখ্যা করো। রেশম মথের একটি প্রোটোজোয়া গঠিত রোগের কারণ ও প্রতিরোধ ব্যবস্থা লেখো।

- (b) Write about the geographical limits and subregions of oriental realm. Mention the climate and distribution of fauna of this realm. Which realm is known as 'Bird continent' and why?

2+3+2  
+3+2

ওরিয়েন্টাল অঞ্চলের ভৌগোলিক সীমা এবং উপঅঞ্চল সম্পর্কে লেখো। এর জলবায়ু ও প্রাণী সম্পর্কে লেখো। কোন অঞ্চলকে 'পক্ষী মহাদেশ' বলে ও কেন?

- (c) Define population density. Write the characteristics of 'J-Shaped' and 'S' shaped population growth curves with suitable diagrams. Distinguish between density dependent and density independent process of population regulation.

1+8+3

জনসংখ্যা ঘনত্বের সংজ্ঞা লেখো। J-আকৃতি ও S-আকৃতি শ্রোত কর্ভের চিত্রসহ বৈশিষ্ট্য লেখো। ঘনত্ব নির্ভরশীল ও ঘনত্ব অনির্ভরশীল জনসংখ্যা রেগুলেশনের মধ্যে পার্থক্য লেখো।

- (d) Mention the different methods of in-situ and ex-situ conservation. Write a short note on tiger conservation in India. Mention the importance of wild life. What is extinction risk?

4+4+2+2

In-situ এবং ex-situ সংরক্ষণের বিভিন্ন পদ্ধতি লেখো। ভারতে ব্যাঘ্র সংরক্ষণ সম্পর্কে টীকা লেখো। বন্যপ্রাণীর গুরুত্ব উল্লেখ করো। বিলুপ্তির ঝুঁকি কি?



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**PHYSICS-HONOURS**

**PHSH-VII**

**UNDER-(I+I+I) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 90

*The figures in the margin indicate full marks.*

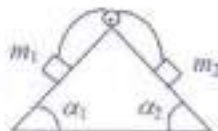
*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

**Answer Questions No. 1 and five other questions from the rest, taking at least one each from group-A and Group-B, and at least two from Group-C**

1. (a) A particle of mass ' $m$ ' moves in one dimension such that the Lagrangian, 3+1  
 $L = \frac{1}{2}m^2\dot{x}^4 + m\dot{x}^2V(x) - V^2(x)$ , where  $V$  is differential function of ' $x$ '. Find the equation of motion of  $x(t)$  and interpreted it.
- (b) What are generalized coordinates? Write down the generalized coordinates of a particle moving on the surface of a sphere. 3
- (c) Two particles of masses  $m_1$  and  $m_2$  are located on a frictionless double inclined and connected by a inextensible massless string passing over a smooth peg. Use the principle of virtual work to show that at equilibrium we must have. 3

$$\frac{\sin \alpha_1}{\sin \alpha_2} = \frac{m_2}{m_1}$$



- (d) If ' $f_1$ ' and ' $f_2$ ' are the lower and upper half power frequencies of one stage R-C coupled amplifier, find the corresponding values for two stages in cascade. 3
- (e) Show that for a single particle with constant mass the equation of motion implies the following differential equation for the kinetic energy. 2

$$\frac{dT}{dt} = \vec{F} \cdot \vec{v}$$

## GROUP-A

## (Classical Mechanics II &amp; Fluid Mechanics)

2. (a) Define virtual displacement. Show that the virtual work done by holonomic constraint force is zero. 1+3
- (b) Briefly explain the basic difference between Lagrangian and Hamiltonian formulations of mechanics. 2
- (c) Write down the Lagrangian of a particle moving under a central force. Obtain the equation of motion. What is the cyclic co-ordinate of a system? Obtain the corresponding conserved momentum. 1+1+1+2
- (d) Obtain the normal co-ordinates of a system of which the Lagrangian is given by  $L = \frac{1}{2}(m_1 \dot{x}^2 + m_2 \dot{y}^2) + \beta \dot{x} \dot{y} - \frac{1}{2}(x^2 + y^2)$ , where  $m_1$ ,  $m_2$  and  $\beta$  are constants. 4
3. (a) Derive Hamilton's canonical equations of motion. Explain the significance of the Hamiltonian  $H$ . 3+2
- (b) What is small oscillations of a mechanical system? In small oscillations, show that the kinetic energy and potential energy assumes the form of homogeneous quadratic functions when expressed in terms of normal co-ordinates. 2+3
- (c) Show that if a number of  $s$  co-ordinates  $q_1, q_2, \dots, q_s$  are cyclic in nature, then  $\frac{d}{dt} \left( \frac{\partial R}{\partial \dot{q}_k} \right) = \frac{\partial R}{\partial q_k}$  3  
 Where  $k$  runs over the non-cyclic co-ordinates and  $R(q, \dot{q}, p, t)$  is defined as  $R = L - \left( \sum_{i=1}^s p_i \dot{q}_i \right)$ .
- (d) Explain what is constrained motion? What are generalized coordinates? 1+1
4. (a) Drive the expression for equation of continuity of a liquid. Hence show that for irrotational flow of incompressible liquid, the velocity potential satisfies the Laplace's equation. 3+2
- (b) A horizontal tube has radii 0.4 cm and 0.6 cm at two places. For the flowing water the pressure difference at two places is 1 cm of water. What is the rate of flow? 3
- (c) The potential of a system is given by,  $V = k(x^3 - 2x^2 + 1)$ , where  $k > 0$ . Find out the equilibrium positions and discuss its stability. 2
- (d) What is Hamilton's principle? Obtain Hamilton's Canonical equation of motion in phase space using Hamilton's principle. 2+3



**GROUP-B**  
(Statistical-Mechanics)

5. (a) State and prove the Stirling's formula for the factorial of a large number. 4  
 (b) State and establish Liouville's theorem. Establish the Boltzmann relation connecting entropy and Probability. 3+3  
 (c) There are about  $2.5 \times 10^{28}$  free electron per  $\text{m}^3$  of sodium. Calculate its Fermi energy, Fermi velocity & Fermi temperature.  $n = 6.62 \times 10^{-34} \text{Js}$ . 5
6. (a) Consider a macroscopic system, with its micro states designated as 1, 2, 3, ... r. If  $P_r$  be the probability of the system to be found in state r, prove that the entropy of the system is given by  $S = -k \sum_r P_r \ln P_r$ . 5  
 (b) A particle is executing a One-dimensional SHM. Find the nature of its trajectory in the phase space. 2  
 (c) Deduce Einstein's formula for the specific heat of solids. Discuss how far it agrees with the experimental results at low temperatures. Show that the formula yields Dulong and Petit's law at high temperatures. 4+2+2

**GROUP-C**  
(Electronics)

7. (a) What are the fundamental differences among Class A, Class B and Class C amplifiers? 3  
 (b) Draw a circuit diagram of a two-stage R-C coupled amplifier and derive an expression for the voltage gain of the amplifier in mid frequency range. Draw the frequency response of the amplifier and explain its nature. 1+4+2  
 (c) What do you mean by "impedance matching" in multistage amplifier? 2  
 (d) A FET amplifier in common-source configuration uses a load resistance of  $250 \text{ k}\Omega$ . Its a.c drain resistance is  $100 \text{ k}\Omega$  and transconductance is  $0.5 \text{ mA/V}$ . Calculate the voltage gain and output resistance of the amplifier. 3
8. (a) What is frequency modulation? Drive an expression of frequency modulation wave with sinusoidal modulation. 1+3  
 (b) An AM broadcast transmitter radiates  $10 \text{ kW}$  of unmodulated carrier and  $12.5 \text{ kW}$  of total power when carrier is modulated by sinusoidal message signal. What is the depth of modulation? 3  
 (c) Draw the circuit diagram of a common source JFET amplifier. Discuss its small signal operation. 1+3  
 (d) An n channel JFET has  $I_{DSS} = 12 \text{ mA}$  and pinch off voltage  $V_p = -4 \text{ V}$ . Find the drain current for  $V_{GS} = -2 \text{ V}$ . If the transconductance  $g_{m0}$  of the JFET with  $I_{DSS} = 12 \text{ mA}$  and  $V_{GS} = 0 \text{ V}$  is  $4 \text{ milimho}$ , find the pinch off voltage. 4

9. (a) What are the differences between an encoder and a decoder? With the help of circuit, diagrams explain how a demultiplexer can be converted into a decoder. 2+4
- (b) Show how an OPAMP can be used as an (i) adder and a (ii) differentiator. 3+3
- (c) Consider two 1-bit numbers  $A$  and  $B$ , what are the logic gates required to test if (i)  $A = B$ , (ii)  $A > B$  and (iii)  $A < B$ ? 1+1+1
- 10.(a) What is 4-bit shift register? Explain its operation. 1+4
- (b) What is multiplexer? Explain the operation of a 4:1 multiplexer using basic gates. 1+4
- (c) Draw the logic circuit diagram, wave forms and truth table to form a mod-5 counter and explain how it works. 1+1+1+2



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**PHYSICS-HONOURS**

**PHSH-VIII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 90

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

**Answer Question No.-1 and five from the rest, taking at least one from each group but not more than two from a group.**

- 1.(a) What are the states of polarization of the waves represented by the following equations? 2+1

$$\vec{E}_1 = \hat{i}E_0 \cos(kz - \omega t) + \hat{j}E_0 \sin(kz - \omega t);$$

$$\vec{E}_2 = \hat{i}E_0 \cos(kz - \omega t) - \hat{j}E_0 \sin(kz - \omega t)$$

What does the resultant of these two waves  $\vec{E}_1$  and  $\vec{E}_2$  represent?

- (b) Calculate the skin depth for radio waves of wavelength 3 m (in free space) in copper, given that the electric conductivity of copper is  $6 \times 10^7 \text{ Ohm}^{-1} \text{ m}^{-1}$ . 3

- (c) Show explicitly that two successive Lorentz transformation in the same direction with velocity  $v_1$  and  $v_2$  are equivalent to a single Lorentz transformation with a velocity,  $v = \frac{v_1 + v_2}{1 + \frac{v_1 v_2}{c^2}}$  4

- (d) Show that the atomic radius of a BCC lattice is  $r = \frac{\sqrt{3}a}{4}$ . 3

- (e) Can two independent laser beams produce an interference pattern? Explain. 2

**Group-A**  
**(Physical Optics-II)**

2. (a) Describe "Spatial and Temporal" coherence. 2+2  
(b) What are Einstein's  $A$ ,  $B$  coefficients? Derive a relation between these coefficients. 2+3

- (c) What do you mean by optical resonator? Derive threshold condition for laser action. What is a hologram? 2+3+1
3. (a) State and explain Brewster's law of polarization. Show that the reflected and refracted components are mutually perpendicular to each other. 2+3
- (b) What is meant by numerical aperture and acceptance angle of an optical fibre? Obtain their expressions for a step index fibre. 3+4
- (c) Considering  $\mu_E = 1.5508$  and  $\mu_o = 1.5415$  for a quartz, calculate the phase retardation for  $\lambda = 5000 \text{ \AA}$ , if the plate thickness is 0.32 mm. 3
4. (a) What is Babinet's Compensator? Explain how it can be used to analyze elliptically polarized light. 2+4
- (b) What are polaroids? What is the advantage of a Polaroid over a Nicol prism? 2+3
- (c) Explain how a quarter-wave plate can be used to analyze (i) a circularly polarized light and (ii) an elliptically polarized light. 2+2

### Group-B

#### (Electromagnetic Theory and Special Theory of Relativity)

5. (a) Show that,  $\square^2 = \nabla^2 - \frac{1}{c^2} \frac{\partial^2}{\partial t^2}$  is a Lorentz invariant. 3
- (b) What do you mean by "proper mass" and "relativistic mass"? Find the relation between them. 2+4
- (c) Calculate the momentum of photon having kinetic energy of 500 MeV. 2
- (d) Using the invariance of the law of momentum conservation, derive the formula for the variation of the relativistic mass with velocity. 4
6. (a) Establish Sellmeier's and Cauchy's dispersion formulae. 6
- (b) Distinguish between Rayleigh scattering and Thompson scattering. On the basis of Rayleigh scattering, explain why red light is used for danger signals even though our eye is most sensitive to yellow-green colour. 3+3
- (c) The intensity of the sunlight reaching the earth surface is  $2 \text{ calories cm}^{-2} \text{ min}^{-1}$ . Calculate the strength of the electric field in volt/m of the sunlight. 3
- 7.(a) Show that for a plane wave propagating in an isotropic, homogeneous dielectric medium, the magnetic electric field vectors are perpendicular to each other. 5
- (b) Express Poynting theorem in the form  $\frac{\partial U}{\partial t} + \nabla \cdot \vec{S} = 0$ , where  $\vec{S} = \frac{1}{\mu_0} (\vec{E} \times \vec{B})$  and  $U$  is the energy density. 3

- (c) Find the relation among the angles of incidence, reflection and refraction, when a plane polarized electromagnetic wave is incident on an interface between two dielectric media. 4
- (d) Discuss briefly the term "Displacement current" used in Maxwell's equations. 3

**Group-C**  
**(Solid State Physics)**

8. (a) What do you mean by the terms 'lattice' and 'basis' in crystallography? Explain the statement; lattice + basis = crystal structure. 2+2
- (b) What are Miller indices? Determine the interplanar spacing between the two parallel planes with Miller indices  $(hkl)$  in a cubic crystal of side ' $a$ '. 1+3
- (c) What do you mean by 'atomic packing fraction'? Find the atomic packing fraction of FCC structure. 1+3
- (d) Show that for a simple cubic system,  $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$ . 3
9. (a) Discuss few demerits of 'Classical free electron theory'. 3
- (b) Obtain the relation,  $g(E) = \frac{4\pi V}{h^3} (2m)^{3/2} E^{1/2}$ , where  $E$  is the energy of an electron cloud each having mass  $m$  and restricted to move in a volume  $V$ . 4
- (c) Explain (i) Fermi energy and (ii) Fermi sphere. 2+2
- (d) Prove that the average energy of an electron in a metal at  $T = 0$  K is  $\frac{3}{5} E_f$  ( $E_f$  represents Fermi energy). 4
- 10.(a) Derive Curie's law of paramagnetism from Langevin's theory. 4
- (b) Establish the relation between the molecular polarizability ( $\alpha$ ) and dielectric constant ( $k$ ) for non-polar fluids. 6
- (c) NaCl crystal has cubic structure. If its density is 2.163 g/cc and its molecular weight is 58.45, calculate its lattice constant. 3
- (d) State Wiedemann-Franz law regarding thermal and electrical conductivities. 2



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**PHYSICS-HONOURS**

**PHSH-IX**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 90

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

**Answer Questions No. 1 and any five from the rest, taking at least one from each group but not more than two from each group**

1. (a) Prove that it is not possible for a photon to transfer its entire energy to a free electron. 3
- (b) Why is the resolving power of an electron microscope much greater than that of an optical microscope. 3
- (c) Show that the function  $\psi(x) = Cx \exp(-x^2/2)$  is an eigen function of the operator  $\left(x^2 - \frac{d^2}{dx^2}\right)$ . Also find the eigen value. 3
- (d) Show that the operator  $i \frac{\partial}{\partial x}$  is Hermitian. 3
- (e) How can the continuous nature of  $\beta$  ray spectrum be theoretically explained? 3

**Group-A**

**(Atomic Physics)**

2. (a) Describe with necessary theory of Millikan's Oil-drop method for determination of electronic charge. Indicate the importance of this experiment. 5+2
- (b) When the principal quantum number ' $n$ ' is very large, show that the frequency of revolution of the electron in the orbit of a hydrogen-like atom is equal to the radiation frequency for a transition between orbits that differ in ' $n$ ' by unity. What has this result got to do with classical and quantum physics? 5+3

3. (a) State and explain Moseley's law and discuss its importance. Show that this law can be deduced from modified Bohr's theory. 3+2
- (b) Give an elementary theory of the interpretation of Compton effect. 4
- (c) Explain the origin of anomalous Zeeman effect using vector atom model and derive the formula for the splitting of atomic energy levels. 3+3
4. (a) Determine the radius of a hypothetical Bohr atom in its first orbit if the potential energy is that of a 3-D simple harmonic oscillator. 4
- (b) The wave length of the first line of Balmer series is  $6563\text{\AA}$  and that for an isotope of hydrogen atom is  $6561.21\text{\AA}$ . Find the mass of the isotope. Given that  $M_{H1}/m = 1840$ , where  $m$  is the mass of the electron and  $M_{H1}$  is the mass of hydrogen nucleus. 3
- (c) In a many-electron atom, the orbital, spin and total angular momentum are denoted by  $\vec{L}$ ,  $\vec{S}$  and  $\vec{J}$  respectively. If  $L = 2$ ,  $S = 1$ , find out the possible values of  $J$ . If  $J = 2$ , find the angle between  $\vec{L}$  and  $\vec{S}$  using vector atom model. 2+2
- (d) Write a short note on Kerr Effect. 4

**Group-B**  
**(Quantum Mechanics)**

5. (a) Prove the operator relation  $\left[ \frac{1}{x} \frac{d}{dx} x \right]^2 = \frac{d^2}{dx^2} + \frac{2}{x} \frac{d}{dx}$ . 2
- (b) A perfectly monochromatic light source is not possible. Explain on the basis of Heisenberg uncertainty principles. 2
- (c) Show that the de Broglie wavelength associated with a particle of rest mass  $m_0$  and kinetic energy  $k$  is given by  $\lambda = \frac{hc}{\sqrt{k(k + 2m_0c^2)}}$ . 4
- (d) Show that the minimum of a linear harmonic oscillator is  $\hbar\omega$ , where the symbols have their usual meaning. 4
- (e) Derive the expression for the rotational energy levels of a diatomic molecule. 3
6. (a) What are Rayleigh-Jeans laws and ultraviolet catastrophe in case of blackbody radiation? 1+2
- (b) The wave function of a particle is given by 4
- $$\psi(x) = x\sqrt{3}, \text{ for } 0 < x < 1;$$
- $$= 0, \text{ elsewhere.}$$
- Calculate the probability of finding the particle in the region  $0 < x < 0.5$  and determine  $\langle x \rangle$  for the particle.

- (c) A particle of energy  $E$  moving in one dimension is incident on a step potential 4  
 $V(x) = 0$  for  $x < 0$ ;  
 $= V_0$  for  $x \geq 0$ .  
 Determine the reflectivity co-efficient.
- (d) An  $\alpha$ -particle of energy 4 Mev is accelerated through 500 kV. Compute the fractional change in de Broglie wave length. 4
7. (a) Find the normalized wave function for a particle trapped in an one dimensional box and calculate the expectation values of  $\hat{p}_x$  and  $\hat{x}$  of the particle. 4+3
- (b) What is zero-point energy? Calculate the zero point energy of a mass  $1.67 \times 10^{-24}$  gm connected to a fixed point by a spring with force constant  $10^4$  dyne/cm. 1+4
- (c) Three identical fermions each of mass 'm' are confined in a one dimensional box of width 'L'. The potential inside the box is zero. Calculate the energy of the system in the ground state. 3

### Group-C

#### (Nuclear and Elementary Particle Physics)

8. (a) Plot the average binding energy per nucleon as a function of mass number  $A$  of the nucleus. Distinguish between nuclear fission and nuclear fusion and explain the energy release in these processes with respect to the binding energy curve. 2+2+2
- (b) Using the semi-empirical nuclear binding energy formula determine the atomic number of the most stable nucleus for a given mass number  $A$ . Given the Coulomb energy parameter  $a_c = 0.71$  Mev and the symmetry parameters  $a_s = 22.7$  Mev. 4
- (c) Show that the nuclear density is about  $10^{12}$  times the atomic density. 2
- (d) Deduce the relation between  $\alpha$ -decay energy and  $\alpha$  particle kinetic energy. 3
9. (a) What do you mean by magnetic focusing? How it is use to obtain successful acceleration of electron in betatron. 1+3
- (b) Define  $Q$  value of nuclear reaction. Explain and compute the threshold energy of a nuclear reaction. 1+2
- (c) Which of the following reactions are forbidden? 3  
 (i)  $\pi^- \rightarrow \mu + \bar{\nu}_e$   
 (ii)  $\mu^- \rightarrow e^- + \bar{\nu}_e + \gamma_\mu$   
 (iii)  $\bar{\nu}_\mu + p \rightarrow n + \mu^+$



- (d) Calculate the  $Q$  value of the reaction  $^{14}\text{N}(\alpha, p)^{17}\text{O}$ . The atomic masses of  $^{14}\text{N}$ ,  $^4\text{He}$ ,  $^1\text{H}$  and  $^{17}\text{O}$  are 14.00753 u, 4.00386 u, 1.00813 u and 17.0045 u respectively. 3
- (e) Explain why a free neutron is not a stable particle, where as neutron inside a nucleus is stable. 2
- 10.(a) Describe giving schematic diagram, the working principle of a fixed frequency cyclotron. 5
- (b) Calculate the kinetic energy of the Muon emitted in the decay of a Pion at rest. Consider  $m_\pi = 140$  Mev and  $m_\mu = 106$  Mev. 4
- (c) State with reason (s) whether the following reactions are possible or not. 1.5+1.5
- (i)  $p \rightarrow n + e^+ + \gamma$
- (ii)  $\pi^0 \rightarrow \gamma + \gamma$
- (d) A beam of monoenergetic  $\gamma$  rays is incident on an Al sheet of thickness 8 cm. The sheet reduces the intensity of the beam to 20% of the original value. Calculate the linear and mass absorption co-efficients. 3
- (Given density of Al =  $2700 \text{ kg m}^{-3}$ ).



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. General Part-III Examinations, 2018

**PHYSICS-GENERAL**

**PHSG-VII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 3 Hours

Full Marks: 60

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Answer any five questions taking at least one from each group**

**Group-A**

বিভাগ-ক

**(Electronics-II)**

1. (a) What are the characteristics of an ideal OPAMP? Find the voltage gain of OPAMP in a non-inverting mode. 2+4  
একটি আদর্শ OPAMP-এর বৈশিষ্ট্যগুলি কি কি? একটি বিপরীত দশাকারী বিবর্ধক এর ক্ষেত্রে বিভব বিবর্ধনের রাশিমালা প্রতিষ্ঠা করো।
- (b) What is DIAC? Draw its characteristic curve. 2+2  
DIAC বলতে কি বোঝো? এর বৈশিষ্ট্য লেখ অঙ্কন করো।
- (c) Show how an OPAMP may be used as an adder. 2  
OPAMP কিভাবে adder হিসাবে কাজ করে?
2. (a) What is the difference between positive and negative feedback? How non-linear distortion can be minimised by using negative feedback? 1.5+2.5  
ধনাত্মক এবং ঋণাত্মক ফিডব্যাকের মধ্যে পার্থক্য কী? ধনাত্মক ফিডব্যাক ব্যবহার করে কিভাবে অসরলরেখিক বিকৃতি হ্রাস পায়?
- (b) What is S.C.R.? What is its 'ON' and 'OFF' state? 1.5+1.5  
S.C.R.- কি? উহার 'ON' এবং 'OFF' অবস্থা কী?

- (c) With the help of a block diagram show the main elementary parts of a transistor oscillator and explain the function of these elementary parts. 2+3  
 ব্লক চিত্রসহ একটি ট্রানজিস্টার স্পন্দকের প্রধান উপাদানগুলি দেখাও এবং প্রতিটি উপাদানের কাজ ব্যাখ্যা করো।
3. (a) What is J-K flip-flop? 1  
 J-K ফ্লিপ-ফ্লপ বলতে কী বোঝো ?  
 J-K ফ্লিপ-ফ্লপের বর্তনী চিত্র অঙ্কন করো এবং ট্রুথ টেবিল ব্যবহার করে এর কার্যনীতি ব্যাখ্যা করো।
- (b) Draw the circuit diagram of a clocked J-K flip-flop, and explain its principle of operation using a truth table. 5  
 একটি clocked J-K ফ্লিপ-ফ্লপের বর্তনী চিত্র অঙ্কন করো এবং এর কার্যনীতি ব্যাখ্যা করো।
- (c) Draw the circuit diagram of a 3-bit BCD encoder and explain its operation. 4  
 একটি 3-বীট BCD এনকোডারের বর্তনী চিত্র অঙ্কন করো এবং এর কার্যনীতি ব্যাখ্যা করো।
- (d) Draw a neat circuit diagram for addition of two four-bit binary number using half adder and OR gate. 2  
 Half adder এবং OR গেট ব্যবহার করে দুটি four-bit বাইনারী সংখ্যা যোগের জন্য একটি পরিষ্কার বর্তনী চিত্র অঙ্কন করো।

### Group-B

#### বিভাগ-ব

#### (Mechanics and Energy Sources)

4. (a) Describe the working principle of a rotary pump. 4  
 একটি রোটরী অয়েল পাম্পের কার্যনীতি লেখো।
- (b) What are the differences between a rotary pump and diffusion pump? 3  
 একটি রোটরী পাম্প এবং ব্যাপন পাম্পের মধ্যে পার্থক্যগুলি কি কি ?
- (c) Write the names of machines for the measurement of low pressure and write about their advantages and disadvantages. 2+1.5+1.5  
 নিম্নচাপ মাপার যন্ত্রসমূহের নাম উল্লেখ করো এবং তাদের সুবিধা ও অসুবিধাগুলি সংক্ষেপে লেখো।
5. (a) What do you mean by thermal efficiency of a heat engine? 2  
 একটি তাপীয় ইঞ্জিনের দক্ষতা বলতে কী বোঝো ?
- (b) Discuss the working principle of an internal combustion engine. 5  
 একটি অন্তর্দহন ইঞ্জিনের কার্যপ্রণালী সংক্ষেপে আলোচনা করো।
- (c) Mention the parts of the internal combustion engine. 2  
 একটি অন্তর্দহন ইঞ্জিনের বিভিন্ন অংশগুলি উল্লেখ করো।
- (d) Find the expression for the efficiency of Rankin cycle. 3  
 র্যানকিন সাইকেলের কর্মদক্ষতার রাশিমালা নির্ণয় করো।

6. (a) With a suitable diagram, describe the action of a nuclear reactor. 5  
উপযুক্ত চিত্রের সাহায্যে Nuclear reactor এর কার্যনীতি বর্ণনা করো।
- (b) Give the constructional details of a solar cell and discuss how it can be used as an alternate source of energy. 2+2  
একটি সৌরকোষের গঠন আলোচনা করো এবং এটি কিভাবে বিকল্প শক্তির উৎস হিসাবে ব্যবহার করা যায় লেখো।
- (c) Describe different types of ocean energy that are utilized for alternate source of energy. 3  
অপ্রচলিত শক্তির উৎস হিসাবে ব্যবহৃত বিভিন্ন ধরনের সামুদ্রিক শক্তিগুলি বর্ণনা করো।

## Group-C

বিভাগ-গ

## (Communication and Computers)

7. (a) Define frequency modulation. Obtain an expression for the FM wave when the modulating signal is sinusoidal wave. 1+4  
'কম্পাঙ্ক মডুলেশন' বলতে কী বোঝো? সইনইয় সংকেত তরঙ্গের সাহায্যে কম্পাঙ্ক মডুলেশন করা হলে FM তরঙ্গের রাশিমালা নির্ণয় করো।
- (b) What is sky wave? Which frequency is used in sky wave propagation? 1+1  
আকাশ তরঙ্গ কী? আকাশ তরঙ্গ সঞ্চালনের জন্য কোন কম্পাঙ্ক ব্যবহৃত হয়?
- (c) What is meant by modulation index of amplitude modulated wave? 2  
বিস্তার মডুলেশন তরঙ্গের ক্ষেত্রে মডুলেশন সূচক বলতে কী বোঝায়?
- (d) What are the advantages of frequency modulation over amplitude modulation? 3  
বিস্তার মডুলেশনের তুলনায় কম্পাঙ্ক মডুলেশনের সুবিধাগুলি কি?
8. (a) What is optical fibre? Explain its working with a suitable diagram. 1+3  
আলোকবাহী তন্তু কী? একটি উপযুক্ত চিত্রের সাহায্যে এর কার্যপ্রণালী ব্যাখ্যা করো।
- (b) Discuss different types of losses in optical fibre. 3  
আলোকীয় তন্তুর ক্ষেত্রে বিভিন্ন ধরনের ক্ষয়গুলি আলোচনা করো।
- (c) How are optical fibres used in communication system? 2  
যোগাযোগ ব্যবস্থায় আলোকবাহী তন্তুর কিভাবে ব্যবহৃত হয়?
- (d) A step-index optical fibre with  $\mu_{\text{core}} = 1.5$  and  $\mu_{\text{cladding}} = 1.4$  is used in water ( $\mu_{\text{water}} = 1.33$ ) environment. Calculate the numerical aperture and the acceptance angle. 3  
জল মাধ্যমে ( $\mu_{\text{water}} = 1.33$ ) ব্যবহৃত একটি স্টেপ ইন্ডেক্স অপটিক্যাল ফাইবার কোরের প্রতিসরাঙ্ক  $\mu_{\text{core}} = 1.5$  এবং ক্লাডিং-এর প্রতিসরাঙ্ক  $\mu_{\text{cladding}} = 1.4$ । নিউমেরিক্যাল অ্যাপারচার ও গ্রহণযোগ্য কোণের মান নির্ণয় করো।

9. (a) Why is the RAM called volatile memory? What is the difference between RAM and ROM. 1+1  
RAM কে ভোলাটাইল মেমরি বলা হয় কেন? RAM এবং ROM এর পার্থক্য কি?  
(b) What is the difference between Assembler and Compiler? 2  
Assembler এবং Compiler এর পার্থক্যগুলি লেখ।  
(c) Make a Flowchart to pick the largest of any three numbers. 3  
তিনটি সংখ্যার মধ্যে বৃহত্তম সংখ্যা নির্দিষ্ট করার জন্য একটি Flowchart তৈরী করে।  
(d) Write a C-program to find  $1!+2!+\dots+N!$  using 'for loop'. 5  
'for loop' ব্যবহার করে নিচের রাশিটির মান নির্ণয়ের জন্য C-ভাষার প্রোগ্রাম লেখো:  
 $1!+2!+\dots+N!$ .
- 10.(a) What is the CPU of a computer? Discuss the working principle of CPU. 2+2  
একটি কম্পিউটারের CPU কি? CPU-এর কার্যনীতি আলোচনা করে।  
(b) If a modem is working at a speed of 56 kbps, how much time will be required for that modem to download a file of size 4 MB. 2  
একটি Modem যদি 56 kbps হারে কাজ করতে পারে, সেই Modem দ্বারা 4 MB এর একটি ফাইল ডাউনলোড করতে কত সময় লাগবে?  
(c) What is the meaning of a HTML? What is www arrangement? 1+2  
HTML-বলতে কি বোঝে? www ব্যবস্থা কি?  
(d) Write a short note on CODEC. 3  
CODEC-এর উপর সংক্ষিপ্ত টিকা লেখো।



COOCH BEHAR PANCHANAN BARMA UNIVERSITY

B.Sc. Honours Part-III Examinations, 2018

CHEMISTRY-HONOURS

CEMH-VII

UNDER-(1+1+1) SYSTEM

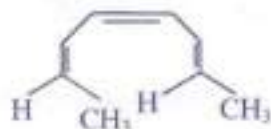
Time Allotted: 4 Hours

Full Marks: 65

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Answer Question No. 1 and any five questions from the rest**

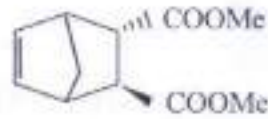
1. Answer any *five* form (a) to (f): 3×5 = 15
- (a)  $\beta$ -anomer of D-glucopyranoside undergoes oxidation with bromine water at a faster rate than that of  $\alpha$ -anomer. Explain the difference of rate.
  - (b) In IR spectroscopy, hydrogen bonded -OH group responses at lower  $\bar{\nu}$  than free -OH group. Justify the statement.
  - (c) In alkaline medium RNA is less stable than DNA. Suggest reason for instability.
  - (d) Unlike benzene, pyridine undergoes both electrophilic and nucleophilic substitution reaction. Explain the fact.
  - (e) Trans decalin is about  $2.7 \text{ kcal mol}^{-1}$  more stable than *cis* decalin. Why?
  - (f) In  $\text{CCl}_4$ , 2-Bromo-4-tButylcyclohexanone exists in axial form by  $\sim 78\%$ . While in dioxane this conformer records  $\sim 63\%$  of composition. Explain the changeover.
2. (a) What happens when [A] is kept exposed to photochemical irradiation. 1+2  
Describe the reaction on the basis of FMO theory.



[A]

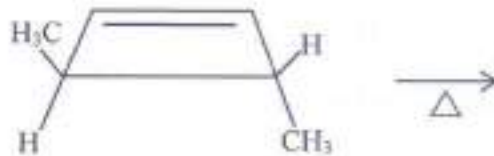
- (b) On heating a mixture of furan and maleic anhydride at  $25^\circ\text{C}$  endo adduct is formed predominantly but at  $90^\circ\text{C}$ , exo adduct becomes major product. Explain this shift of product spread. 3

- (c) Identify the diene and dienophile to prepare [B]. Also mention required reaction condition. 2

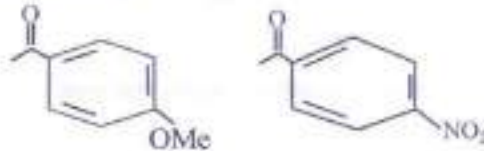


[B]

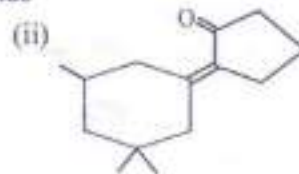
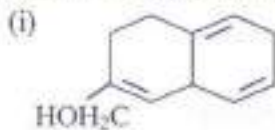
- (d) Identify product and state the type of rotation required to produce the product. 2



3. (a) Between following two compounds which carbonyl group responds at higher  $\bar{\nu}$  value and why? 3

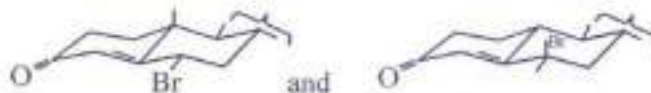


- (b) Between  $^{12}\text{C}$  and  $^{13}\text{C}$ , which one is NMR active and why? 2  
 (c) What type of shift in  $\lambda_{\text{max}}$  value is expected for  $\pi \rightarrow \pi^*$  transition when polarity of solvent is increased? 2  
 (d) Calculate  $\lambda_{\text{max}}$  for following compounds 1.5+1.5



4. (a) A compound with molecular formula  $\text{C}_8\text{H}_8\text{O}$  gives following  $^1\text{H-NMR}$  data.  $\delta$  2.8(d, 2H),  $\delta$  7.28(m, 5H),  $\delta$  9.78(t, 1H). Predict the structure of the compound. 3

- (b) How UV-spectroscopy can be used to distinguish between the axial and equatorial conformation shown below. 3



- (c) Pyridine-2-carboxylic acid readily loses carbon dioxide on heating. Suggests reason for decarboxylation. 2

- (d) What do you know about "Finger print region" in IR spectroscopy? 2

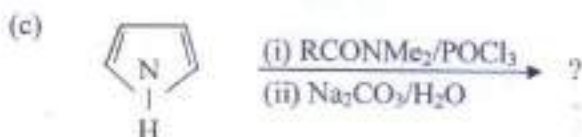
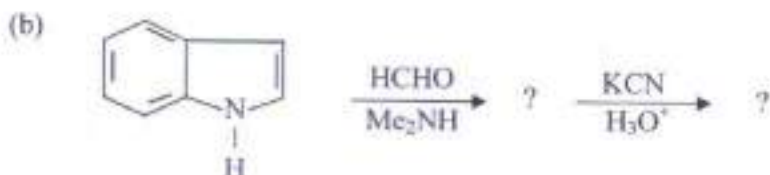
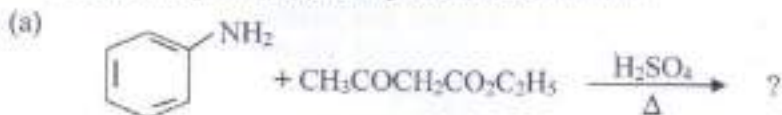
5. (a) All coloured substances cannot be termed dye. Justify the statement. 2

- (b) Give synthetic outline of the following compounds. 2+2

- (i) Malachite green (ii) Phenolphthalein

- (c) Describe origin of colour which makes phenolphthalein a good indicator. 2  
 (d) What happens when DEM is reacted with mesityl oxide in alkaline medium? 2

6. Predict the product(s) with plausible mechanism. 2.5×4 = 10



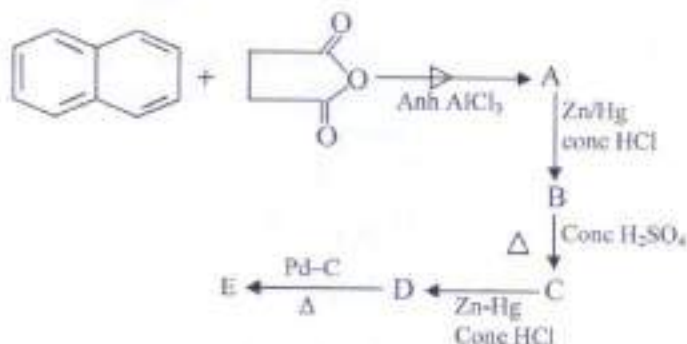
7. (a) How do you determine c-terminal residue of a polypeptide? 2.5

(b) How does zwitterionic character of an amino acid change with pH of the medium? 2.5

(c) Write names of complementary base pair of DNA. Give hydrogen bonded structures of these base pairings. 2+3

8. (a) What changes are expected in the nature of butane gauche interactions when a methyl group is introduced at bridgehead carbon of *cis* and *trans* decalin. 3

(b) Identify A, B, C, D, E. 5



(c) Suggest the preferred conformation for 2-<sup>t</sup>Butyl cyclohexanone. Cite reason for your preference. 2



9. (a) Sucrose does not undergo mutarotation but maltose does. Why? 2
- (b) Show a reaction scheme suggesting glucose-osazone formation. Why does osazone formation not proceed beyond first two carbon atoms? 1.5+1.5
- (c) When methyl  $\alpha$ -D-fructoside is methylated, hydrolyzed and oxidized by  $\text{KMnO}_4$  and nitric acid, trimethoxy glutaric acid is obtained. Predict ring size of 2-ketohexoside. 3
- (d) Lead acetate is a suitable reagent for oxidation of dextrose. Why? 2



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**CHEMISTRY-HONOURS**

**CEMH-VIII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 65

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Answer Question No. 1 and any five questions from the rest**

- |  |         |
|--|---------|
| 1. (a) He <sub>2</sub> does not exist. Explain.  | 2       |
| (b) Aqueous MnSO <sub>4</sub> is almost colourless though Mn <sup>2+</sup> contains five d-electrons while KMnO <sub>4</sub> solution is deeply coloured though it has no d-electron. Why? | 2.5     |
| (c) Co <sub>3</sub> O <sub>4</sub> assumes a normal Spinel structure. Explain.   | 2       |
| (d) CO and CN <sup>-</sup> forms more stable complexes with metal ions in low oxidation states. Explain.   | 2.5     |
| (e) Comment on the reaction of KNH <sub>2</sub> with NH <sub>4</sub> I in liq. NH <sub>3</sub> .   | 2       |
| (f) Explain the term overlap integral.   | 2       |
| (g) How is dimeric trimethyl aluminum prepared?  | 2       |
| 2. (a) Write down the Schrödinger wave equation for hydrogen atom explaining all the terms involved in it.   | 2       |
| (b) What is LCAO? Using LCAO-MOT, draw molecular orbital energy level diagram of N <sub>2</sub> molecule.  | 1+2.5   |
| (c) How many orbitals are possible for n = 4? Which of them may be described as gerade?  | 1+1.5   |
| (d) Is it possible to have a s-p π-bond?   | 2       |
| 3. (a) How is conductance measurement used to detect complex formation?  | 2       |
| (b) What is trans effect? Explain it with an example.  | 2       |
| (c) Calculate μ <sub>S</sub> of the following complex ions according to CFT:<br>(i) [Mn(CN) <sub>6</sub> ] <sup>3-</sup> and (ii) [FeF <sub>6</sub> ] <sup>3-</sup> .                      | 1.5+1.5 |
| (d) Discuss linkage isomerism with suitable examples.  | 3       |

4. (a) How will you define an organometallic compound? Do you consider  $K_3[Al(C_2O_4)_3]$  as an example of an organometallic compound? 1+1
- (b) How is ferrocene prepared? Discuss its structure and bonding. 1+2+3
- (c) The Carbonyl Stretching frequency of  $[Mn(CO)_5]^+$ ,  $Cr(CO)_6$  and  $[V(CO)_6]^-$  occurs at 2090, 2000 and  $1860\text{ cm}^{-1}$  respectively. Give reasons for such Variation. 2
5. (a) Write down the structure of chlorophyll. What is its basic function? 1+2
- (b) Usually the first transition metals are found in different metalloproteins and metalloenzymes. Which factor is mainly responsible for this natural selection? 2
- (c) Discuss about the allotropic modifications of metallic tin on the basis of Pauling's theory. 2
- (d) What are the differences between a Covalent bond and a metallic bond? 2
- (e) Predict the value of  $x$  in  $H_xCr(CO)_5$ . 1
6. (a) In the Spectrochemical Series, why is  $OH^-$  ion weaker than neutral  $H_2O$  molecule? 2
- (b) Give examples of complex compounds in which 1+1
- (i) both  $\Delta_0 = 0$  and  $CFSE = 0$
- (ii)  $\Delta_0 \neq 0$  but  $CFSE = 0$
- (c)  $NiCl_4^{2-}$  is paramagnetic but  $PtCl_4^{2-}$  is diamagnetic though both are  $d^8$ -system. Explain. 3
- (d) "C-C bond in coordinated Olefin is greater than that in the free Olefin." Justify. 2
- (e) Write down the IUPAC name of  $Fe_2(CO)_9$  1
7. (a) How is titanium extracted from its ore? 3
- (b) Mention the important uses of platinum. 2
- (c) Discuss the Structure of  $Co_2(CO)_8$ . 2
- (d) Elucidate the terms holoenzymes, apoenzymes and co-factors with suitable examples. 3
8. (a) What are lanthanides? What is lanthanide contraction? 1+2
- (b) Compare and contrast the electronic spectra of lanthanides and actinide metal ions. 3
- (c) Give one example each showing the use of chelating ligands in qualitative and quantitative analysis. 1.5+1.5
- (d) Point out the role of  $K^+$  ion in biological systems. 1
9. (a) Although HF is acidic, it can behave as an amphoteric solvent. Discuss citing examples. 2
- (b) Why is  $PCl_5$  soluble in liq.  $SO_2$ ? 2
- (c) Draw the Orgel diagram for  $d^0$  ion in the octahedral field and assign the spectral transition. 3
- (d) Discuss Hume-Rothery rule. 3



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**CHEMISTRY-HONOURS**

**CEMH-IX**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 65

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Answer Question No. 1 and any five questions from the rest**

1. Answer any five questions from the following 3×5 = 15
- It is not possible to replace X-ray by UV in the diffraction studies of crystals. Explain.
  - Is the Einstein's law of photochemical equivalence always valid? Explain.
  - Define molecular partition function. Why is it so named?
  - Show that if the overall rate constant of a multistep reaction be written in terms of elementary step rate constants as  $k = \frac{k_1 \sqrt{k_2}}{\sqrt{k_3}}$  then the overall activation energy must be  $\left( E = E_1 + \frac{E_2}{2} - E_3 \right)$ .
  - "Colloid solutions are thermodynamically unstable"— Comment.
  - State and explain Franck-Condon principle.
  - Adsorption of gases on the surface of adsorbent is no more monolayer at high pressure and low temperatures. Explain.
2. (a) For the consecutive reaction 3
- $$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$
- show that the time at which B attains a maximum concentration is given by  $t_{\max} = \frac{1}{k_1 - k_2} \ln \left( \frac{k_1}{k_2} \right)$ .
- Arrive at the expression for the rate of enzymolysis. How the Michaelis constant and the rate constant for the enzymolysis reaction are evaluated? 2+2
  - For a first order reaction at 27°C, half-life time is 30 min. Calculate the time required for 25% of the reactant to undergo reaction at 37°C. The energy of activation of the reaction is 40 kcal mol<sup>-1</sup>. 3

3. (a) The spacing between two  $(hkl)$  planes in a cubic lattice cannot be  $a/\sqrt{7}$ . Justify. 2
- (b) Find the spacing of  $(110)$  planes in bcc crystal with unit cell volume  $27.0 \times 10^{-24} \text{ cm}^3$ . 2
- (c) NaCl and KCl have same geometric arrangements of positive and negative ions in their crystals. But X-ray diffraction indicates that KCl has a simple cubic lattice. – Explain. 3
- (d) What is radius ratio? Calculate the limiting radius ratio of cation to that of anion in face centred cubic structures. Assume cations are smaller than anions. 1+2

4. (a) Explain with example what do you mean by degeneracy in quantum mechanics. 2
- (b) Show that operators for position and momentum do not commute. 2
- (c) The wave functions of a particles are given by 3

$$\psi_n(x) = \left(\frac{2}{L}\right)^{\frac{1}{2}} \sin \frac{n\pi x}{L}; (n = 1, 2, 3, \dots)$$

Where  $x$  is defined within  $0 \leq x \leq L$ . Show that these wave functions are orthogonal.

- (d) Calculate the minimum uncertainty in position of a particle if the same in momentum be  $6 \times 10^{-2} \text{ kg.m.s}^{-1}$ . 2
- (e) What do you mean by a free particle? 1

5. (a) How many times does a molecule of  $\text{HCl}^{35}$  rotate per sec in the  $J = 1$  rotational level? 2.5  
Given :  $B(\text{for HCl}^{35}) = 10.6 \text{ cm}^{-1}$ .
- (b) Calculate the relative population of  $J = 2$  level with that of  $J = 0$  level at 298 K for a rigid rotator. 2.5
- (c) What are P and R branch in vibration-rotation spectra of a diatomic molecule? What are the selection rules for an anharmonic vibrator? Explain what do you understand by (i) overtone transition and (ii) hot bands. 2+1+2

6. (a) Show that the translational partition function of a particle of mass ' $m$ ' is 3

$$\text{given by } q_t = \frac{(2\pi m kT)^{\frac{3}{2}} V}{h^3}$$

Where the symbols have their usual significance and given that

$$\int_0^{\infty} e^{-x^2} dx = \sqrt{\pi}/2.$$

- (b) Derive expressions for the following thermodynamic functions in terms of partition function: 2+2  
 (i) Internal energy, (ii) Helmholtz free energy.
- (c) A polymer sample consists of 20% by weight of a polymer fraction having molecular weight 1000 and 80% by weight of another fraction with a molecular weight of 10,000. Calculate the number and weight average molecular weight of the sample. 3
7. (a) The photodecomposition of HI was carried out with radiation of wavelength  $\lambda = 2820 \text{ \AA}$ . Absorption of each calorie gave  $1.995 \times 10^{-5} \text{ gm H}_2$ . Find out the quantum yield. 3
- (b) Deduce Langmuir's adsorption isotherm pointing out the assumptions involved. Show that Freundlich's adsorption isotherm is a particular case of Langmuir's isotherm. 5
- (c) State and explain primary kinetic salt effect. 2
8. (a) A lyophilic colloid often serves to stabilize a lyophobic colloid. How would you account for this? 3
- (b) Why is ATP called universal energy transfer agent? 3
- (c) For the coagulation of a certain amount of a sol,  $\text{Al}(\text{NO}_3)_3$  was found to be much more effective than  $\text{NaNO}_3$ . How would you account for this observation? State the important rule in this connection. 3
- (d) What is the 'principle of equal a priori probabilities'? 1
9. Write short notes on any *four* of the following: 2.5×4
- (a) Double helix structure of DNA
- (b) Photosensitized reaction
- (c) Zeta potential
- (d) Molecular weight determination of polymer by viscometric method
- (e) Heterogeneous catalysis
- (f) "Acceptability of wave functions" in quantum mechanics
- (g) Lambert-Beer law.



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**CHEMISTRY-HONOURS**

**CEMH-X**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 4 Hours

Full Marks: 65

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

**Answer Question No. 1 and any five from the rest taking at least two from each Group.**

- |  |   |
|--|---|
| 1. (a) What are the differences between distribution ratio and distribution coefficient? | 2 |
| (b) What are surfactants?  | 2 |
| (c) Differentiate between standard potential and formal potential.                       | 2 |
| (d) Why an optical brightener is added to detergent?                                     | 2 |
| (e) In gravimetric analysis, a precipitate is sometimes digested. Why?                   | 2 |
| (f) What is baseline of a chromatogram?  | 2 |
| (g) What is 'Flash Point'?   | 2 |
| (h) Give the binary equivalent of $(12.6975)_{10}$ .                                     | 1 |

**GROUP-A**

**(Analytical)**

- |   |     |
|---|-----|
| 2. (a) Describe briefly about the possible sources of errors in quantitative analysis.  | 5   |
| (b) Zinc contents of a brass sample are analyzed with the following results:<br>Zn: 33.37%, 33.27%, 33.34% and 33.30%. Calculate standard deviation and coefficient of variation of the analysis. | 3   |
| (c) Can $\text{KMnO}_4$ oxidise $\text{Cl}^-$ ion in neutral medium (pH 7)? Explain.  | 2   |
| 3. (a) Explain Paneth-Fajans-Hahn rule regarding adsorption of ions on the surface of the precipitate.  | 3   |
| (b) Elucidate the principle of gas-liquid chromatography.   | 3   |
| (c) What is Zimmerman-Reinhardt reagent? Explain its role in the estimation of $\text{Fe}^{2+}$ against $\text{KMnO}_4$ solution in HCl medium.   | 1+3 |

4. (a) Discuss briefly least square method for obtaining best fitted line for the equation  $y = mx + c$ . 4  
 (b) Discuss how will you separate the components of a mixture of amino acids by paper chromatographic technique. 4  
 (c) What is ion-exchange capacity of a resin? 2
5. (a) Briefly write about 2+2  
 (i) BCD and (ii) Operating system.  
 (b) Explain the term 'column adsorption chromatography'. 2  
 (c) Discuss the use of complexing agent in solvent extraction. 3  
 (d) What is post-precipitation? 1

**GROUP-B****(Industrial)**

6. (a) What are the differences between low temperature and high temperature carbonization of coal? 3  
 (b) Differentiate between (i) Water gas and producer gas and (ii) Antibiotic and Antacid. 2.5+2.5  
 (c) What is meant by annealing of glass? 2
7. (a) Point out the differences between thermal and catalytic reforming of petroleum. 3  
 (b) Define fibres. Mention the important requirements for a polymer to be a fibre. 3  
 (c) Discuss briefly about the setting of cements. 3  
 (d) Give the chemical name and structure of aspirin. 1
8. (a) What is triple superphosphate? 2  
 (b) What is 'pigmentation power'? 2  
 (c) What are Foam Rubber and Buna-S Rubber? 2  
 (d) What is (i) Saponification value and (ii) Iodine number? 1.5+1.5  
 (e) What is the repeating unit of PVC? 1
9. (a) What are the differences between organic and chemical fertilizers? Which one of them is safer to use? 2+2  
 (b) Write short notes on any *two* of the following: 3×2  
 (i) Urea  
 (ii) Anti-knock compound  
 (iii) Penicillin-G  
 (iv) Classification of insecticides.





COOCH BEHAR PANCHANAN BARMA UNIVERSITY

B.Sc. General Part-III Examinations, 2018

CHEMISTRY-GENERAL

CEMG-VII

UNDER-(1+1+1) SYSTEM

Time Allotted: 3 Hours

Full Marks: 60

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Answer Q. No. 1 and any four from the rest.**

1. (a) What do you mean by Flash point of a fuel? 2  
জ্বালানীর প্রজ্জ্বলন বিন্দু বলতে কি বোঝায় ?
- (b) What is saponification value? 2  
সাবানীভবন মূল্য কি ?
- (c) Write down the name of a natural polymer along with the structural formula of its monomer. 2  
একটি প্রাকৃতিক পলিমারের নাম লেখো এবং উহার মনোমারের গঠনমূলক সংকেত লেখো।
- (d) Give the full name of DDT and also its structural formula. 2  
DDT এর পুরো নাম ও উহার গঠনমূলক সংকেত লেখো।
- (e) What do you mean by degree of polymerization? What is white cement? 2  
পলিমারাইজেশনের মাত্রা বলতে কি বোঝায় ? সাদা সিমেন্ট কি ?
- (f) Distinguish between oils and fats. 2  
তেল ও চর্বির মধ্যে পার্থক্য লেখো।
  
2. (a) Distinguish between automobile gasoline and aviation gasoline. 2  
মোটরগ্যাস এবং বিমান জ্বালানীর মধ্যে পার্থক্য লেখো।
- (b) Write a short note on Geo-thermal energy. Why is it necessary to explore the possibility of developing non-conventional sources of energy? 2  
ভূ-তাপশক্তির উপর একটি সংক্ষিপ্ত টীকা লেখো। অচিরচরিত শক্তির উৎসের সন্ধান ও তার মনোময়নের কেন প্রয়োজন ?
- (c) Why gypsum is added at the time of production of Portland cement? 2+2  
পোর্টল্যান্ড সিমেন্ট উৎপাদনের সময় জিপসাম মেশানো হয় কেন ?

- (d) What is TEL? Which purpose is it used for? 2+1  
TEL কি? ইহা কি উদ্দেশ্যে ব্যবহার করা হয়?
- (e) What is LNG? 1  
LNG কি?
3. (a) Give one example for each of organochloride and organophosphorous insecticides and distinguish between them in the field of using. 2+3  
একটি করে জৈব ক্লোরাইড এবং জৈব ফসফরাস ঘটিত কীটনাশকের উদাহরণ দাও এবং ব্যবহারের ক্ষেত্রে উহাদের মধ্যে পার্থক্য করো।
- (b) Write down the composition of water gas. Describe with a neat diagram the process of manufacturing of water gas. 2+3  
Water gas -এর সংযুক্তি লেখো। একটি সুন্দর চিত্রসহ Water gas তৈরির পদ্ধতি বর্ণনা করো।
- (c) What is CNG? Which purpose is it used for? 1+1  
CNG কি? কি উদ্দেশ্যে ইহা ব্যবহার করা হয়?
4. (a) What is paints? Write the role of each auxiliary constituents of paints. 1+3  
পেইন্টস কি? পেইন্টস তৈরির সহায়ক উপকরণগুলির প্রত্যেকটির ভূমিকা লেখো।
- (b) Write a short note on Emulsion paints. 3  
ইমালসন পেইন্টের উপর একটি সংক্ষিপ্ত টীকা লেখো।
- (c) What is plastic? Distinguish between thermoplastic and thermosetting plastic. 2+3  
প্লাস্টিক কি? তাপ নিয়ন্ত্রিত এবং তাপকৃত প্লাস্টিকের মধ্যে পার্থক্য লেখো।
5. (a) Describe briefly the manufacturing process of ultramarine blue with necessary flowchart diagram. 4  
প্রয়োজনীয় প্রবাহী চিত্রসহ Ultramarine blue সংক্ষেপে বর্ণনা করো।
- (b) How can you prepare polythene from ethylene by Zeigler process? 4  
Zeigler পদ্ধতিতে ইথিলিন থেকে পলিথিন কিভাবে প্রস্তুত করা হয়?
- (c) What do you mean by Pigment volume concentration? 2  
পিগমেন্টের আয়তন গাঢ়ত্ব বলতে কি বোঝায়?
- (d) What is Plasticizer? 2  
প্লাস্টিসাইজার কি?
6. (a) Write down the names and structural formulae of the constituents present in Portland cement. 3  
পোর্টল্যান্ড সিমেন্টে উপস্থিত উপাদানগুলির নাম ও গঠন সংকেত লেখো।
- (b) What is meant by setting of cement? Give the reactions involved therein. 2+2  
সিমেন্টের জমাট বাধা বলতে কি বোঝায়? এই প্রক্রিয়ায় সংশ্লিষ্ট বিক্রিয়াগুলি লেখো।

- (c) What are the compositions of porcelain? 2.5  
পোর্সেলিনের সংযুক্তিগুলি কি কি ?
- (d) What is added to kerosene to make it blue? 2.5  
কেরোসিন কে নীল রং করতে কি মেশানো হয় ?
7. (a) What do you mean by electroplating? Explain the steps involved in electroplating. How does it differ from galvanization? 2+3+2  
তড়িৎ লেপন বলতে কি বোঝো ? তড়িৎ লেপনে জড়িত ধাপগুলি ব্যাখ্যা করো। কিভাবে গ্যালভানাইজেশন থেকে ইহাকে পার্থক্য করা হয় ?
- (b) What do you mean by 'rancidification of oil'? 2  
তেলের রানসিডিফিকেশন বলতে কি বোঝো ?
- (c) What do you mean by vitrification of porcelain goods? 3  
পোর্সেলিন সামগ্রীর ভিট্রিফিকেশন বলতে কি বোঝায় ?
8. Write short notes on (any four) – 3×4  
যে-কোনো চারটি প্রশ্নের টীকা লেখোঃ
- (a) Cracking of petroleum  
পেট্রোলিয়ামের ভাঙ্গন
- (b) Liquid fuels  
তরল জ্বালানী
- (c) Inorganic Insecticides  
অজৈব কীটনাশক
- (d) Carbonisation of coal  
কয়লার কার্বনিকরণ
- (e) Coloured cement  
রঙিন সিমেন্ট
- (f) Detergent.  
ডিটারজেন্ট।



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**MATHEMATICS-HONOURS**

**MTMH-IX**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

*All symbols are of usual significance.*

**GROUP-A**

1. Answer the following questions:
- (a) Find the extreme points if any of the set  $S = \{(x, y) : |x| \leq 1, |y| \leq 1\}$ . 2
- (b) What is unbalanced assignment problem? How can you convert it into a balanced assignment problem? 2
- (c) Define 'convex polyhedron'. 1
2. Answer any *two* questions from the following: 5×2 = 10
- (a) Prove that the set of all basic feasible solutions of a LPP is a convex set. 5
- (b) Prove that any point of a convex polyhedron can be expressed as a convex combination of its extreme points. 5
- (c) Solve graphically the L.P.P. 5
- Maximize:  $Z = 5x_1 - 2x_2$
- Subject to:  $5x_1 + 6x_2 \geq 30$
- $9x_1 - 2x_2 = 72$
- $x_2 \leq 9, x_1, x_2 \geq 0.$
3. Answer any *one* question from the following: 15×1 = 15
- (a) (i) Prove that if some constraints in the primal problem be perfect equalities, then the corresponding dual variables are unrestricted in signs. 6
- (ii) Solve the following transportation problem. 5

	$D_1$	$D_2$	$D_3$	$D_4$	$a_i$
$O_1$	6	4	2	7	8
$O_2$	5	1	4	6	14
$O_3$	6	5	2	5	9
$O_4$	4	3	2	1	11
$b_j$	7	13	12	10	

- (iii) Find the dual of the following: 4  
 Maximize:  $Z = 4x_1 + 5x_2 - 3x_3$   
 Subject to:  $x_1 + x_2 + x_3 = 2$   
 $3x_1 + 5x_2 - 2x_3 \leq 6$   
 $x_1 + 7x_2 + 4x_3 \geq 12$   
 $x_1, x_2 \geq 0$  and  $x_3$  is unrestricted.
- (b) (i) Solve the following LPP by two phase method: 6  
 Maximize:  $Z = 2x_1 - x_2 + 2x_3$   
 Subject to:  $x_1 + x_2 - 3x_3 \leq 8$   
 $4x_1 - x_2 + x_3 \geq 2$   
 $2x_1 + 3x_2 - x_3 \geq 4$   
 $x_1, x_2, x_3 \geq 0$
- (ii) If any L.P.P. admits of an optimal solution, show that the objective function attains that optimum value at an extreme point of the convex set of all feasible solutions. 5
- (iii) Find the optimal assignment for the problem with the following cost matrix. 4

	I	II	III	IV
A	5	3	1	8
B	7	9	2	6
C	6	4	5	7
D	5	7	7	6

### GROUP-B

Answer Question No. 4 and any *three* from the rest

4. (a) Define inner product of tensors with example. 2  
 (b) If  $A^j$  is a skew symmetric tensor, show that  $A^k \begin{Bmatrix} i \\ j k \end{Bmatrix} = 0$ . 2  
 (c) Define null vector. 1
5. State and prove Ricci's theorem. 5
6. Show that  $\begin{Bmatrix} i \\ j \end{Bmatrix} = \frac{\partial(\log \sqrt{g})}{\partial x^j}$ ,  $g \neq 0$ . 5  
 Where  $g = |g_{ij}|$ .
7. Calculate the Christoffel symbols in cylindrical co-ordinate  $(u, \phi, z)$ . 5
8. Write down Serret-Frenet's formula and obtain the scalar functions of the Serret-Frenet's formula of a circular helix given by 5  
 $r = (\alpha \cos v, \alpha \sin v, \beta v)$ .



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**MATHEMATICS-HONOURS**

**MTMH-X**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.*

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**GROUP-A**

Answer Question No. 1 and any *four* questions from the rest

1. (a) Let  $f_n(x) = x^n$ ,  $x \in [0, 1]$ . Show that the sequence of functions  $\{f_n\}$  is not uniformly convergent on  $[0, 1]$ . 2
- (b) Find the radius of convergence of the power series  $\sum_{n=0}^{\infty} a_n x^n$  where 2

$$a_n = \begin{cases} \left(\frac{1}{3}\right)^n, & \text{if } n \text{ is odd} \\ \left(\frac{1}{2}\right)^n, & \text{if } n \text{ is even} \end{cases}$$
- (c) Give an example of two subsets  $A$  and  $B$  of  $\mathbb{R}$  of which  $A$  is closed and  $B$  is compact such that  $A \cap B$  is compact. 1
2. State MVT for a function of two variables. Apply it to 1+4
 $f(x, y) = \sin \pi x + \cos \pi y$  and express  $f\left(\frac{1}{2}, 0\right) - f\left(0, -\frac{1}{2}\right)$  in terms of partial derivatives of  $f$  and deduce that there exists  $\theta$  such that  $\frac{4}{\pi} = \cos \frac{\pi}{2} \theta + \sin \frac{\pi}{2} (1 - \theta)$ ,  $0 < \theta < 1$ .
3. Find  $\lim_{x \rightarrow 0} \sum_{n=1}^{\infty} \frac{\cos nx}{n(n+1)}$ . 5
4. Use Lagrange's method to find the shortest distance from the point  $(0, 8)$  to the parabola  $x^2 = 4y$ . 5
5. State and prove the converse of Heine-Borel theorem. 5

6. Prove that if  $K$  be a compact set in  $\mathbb{R}$ , every infinite subset of  $K$  has a limit point in  $K$ . 5
7. Find the extreme values of  $f(x, y) = 3x^2 - 2y^2 + 2y$  on the disk  $B = \{(x, y) : x^2 + y^2 \leq 1\}$ . 5

### GROUP-B

Answer Question No. 8 and any *four* questions from the rests

8. (a) Evaluate  $\iint_{\Omega} |x + y| dx dy$ , where  $\Omega = \{(x, y) \in \mathbb{R}^2 : |x| < 1, |y| < 1\}$ . 2
- (b) Check the convergence of the integral  $\int_0^1 \frac{1}{\sqrt{1-x^2}} dx$ . 2
- (c) Give an example of a piecewise continuous function. 1
9. Show with proper justification that  $\int_0^{\infty} e^{-x^2} \cos \alpha x dx = \frac{\sqrt{\pi}}{2} e^{-\frac{\alpha^2}{4}}$ , for all real  $\alpha$  5
10. Show that  $\int_0^{\infty} \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} dx = 2\beta(m, n)$ . 5
11. Obtain the Fourier series expansion assuming that  $f$  is periodic of period  $2\pi$  in  $\mathbb{R}$ , where  $f$  is defined by  $f(x) = x$ ,  $x \in [-\pi, \pi]$  and hence deduce that 5
- $$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots = \frac{\pi}{4}.$$
12. Find the volume of the region  $\Omega$  in  $\mathbb{R}^3$  bounded by the surfaces of the paraboloids  $z = x^2 + y^2$ ,  $z = 2(x^2 + y^2)$  and the cylindrical surfaces  $y = \sqrt{x}$ ,  $y = x^2$ . 5
13. Show that the volume of the greatest rectangular parallelepiped that can be inscribed in the ellipsoid  $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$  is  $\frac{8abc}{3\sqrt{3}}$ . 5
14. Use Dirichlet's test to prove that  $\int_0^{\infty} \frac{\sin x}{x} dx$  converges. Then use Abel's test 5
- to prove that  $\int_0^{\infty} e^{-ax} \frac{\sin x}{x} dx$ ,  $a \geq 0$  is convergent.



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B.Sc. Honours Part-III Examinations, 2018

MATHEMATICS-HONOURS

MTMH-XI

UNDER-(1+1+1) SYSTEM

Time Allotted: 2 Hours

Full Marks: 50

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Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

GROUP-A

Answer Question No. 1 and any *three* questions from the rest

- |  |     |
|--|-----|
| 1. (a) Define complete metric space with example.  | 1+1 |
| (b) Define interior point of a set in a metric space.  | 1   |
| (c) Prove that every convergent sequence is a Cauchy sequence in a metric space $(X, d)$ .   | 2   |
| 2. Let $(X, d)$ be a metric space and $A \subset X$ . Prove that $A$ is open iff every sequence $\{x_n\}$ which is convergent to a point of $A$ has $x_n \in A$ for sufficiently large values of $n$ . | 5   |
| 3. Show that $\mathbb{R}$ is a completion of the incomplete metric space $\mathbb{Q}$ (under usual metric).  | 5   |
| 4. Prove that (i) intersection of finite number of open sets in a metric space is open and (ii) union of finite number of closed sets in a metric space is closed.                                     | 5   |
| 5. Let $A, B$ be two subsets of a metric space $(X, d)$ . Prove that $\overline{A \cup B} = \overline{A} \cup \overline{B}$ , where $\overline{A}$ is the closure of $A$ .                             | 5   |



## GROUP-B

Answer Question No. 6 and any *three* questions from the rest

6. (a) Prove that the function  $|z|^2$  is continuous everywhere but nowhere differentiable except origin. 2  
 (b) Define harmonic function. 1  
 (c) If  $f(z)$  is analytic everywhere and  $f'(z) = 0$  for all values of  $z$ , show that  $f(z)$  is constant. 2
7. If  $f(z) = u + iv$  be an analytic function in a region  $G$ . Show that  $u, v$  satisfy the equation  $\frac{\partial^2 L}{\partial r^2} + \frac{1}{r} \frac{\partial L}{\partial r} + \frac{1}{r^2} \frac{\partial^2 L}{\partial \theta^2} = 0$ . 5
8. Show that a harmonic function  $u$  satisfies the formal differential equation  $\frac{\partial^2 u}{\partial z \partial \bar{z}} = 0$ . 5
9. If  $f(z) = u + iv$  be an analytic function on a region  $G$ , then show that  $f'(z) = \frac{r}{z} \left( \frac{\partial u}{\partial r} + i \frac{\partial v}{\partial r} \right)$ . 5
10. Show that  $u(x, y) = e^{x^2 - y^2} \cos 2xy$  is a harmonic function. Find the harmonic conjugate of  $u$ .

## GROUP-C

Answer any *two* questions from the following

11. Prove that a cyclic group of finite order  $n$  is isomorphic to the additive group of residue classes of integer modulo  $n$ . 5
12. If  $G_1, G_2$  be two groups and  $f: G_1 \rightarrow G_2$  be a group homomorphism. Then prove that  $\ker f$  is a normal subgroup of  $G_1$ . 5
13. Find all homomorphisms from  $(\mathbb{Z}_6, +)$  to  $(\mathbb{Z}_4, +)$ . 5



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B.Sc. Honours Part-III Examinations, 2018

**MATHEMATICS-HONOURS**

**MTMH-XII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 2 Hours

Full Marks: 50

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Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**Group-A**

Answer Question No. 1 and any *three* questions from rest

- |  |   |
|--|---|
| 1. (a) State law of large numbers for equal components.  | 2 |
| (b) If $\log X$ has normal distribution with $m=1$ , $\sigma=2$ ; then find $E(X)$ and $\text{var}(X)$ .   | 2 |
| (c) Define Poisson trial.  | 1 |
| 2. (a) Prove that $P(B A) \geq 1 - \frac{P(\bar{B})}{P(A)}$  | 2 |
| (b) If $\{A_n\}$ be a monotone sequence of events, then prove that<br>$P\left(\lim_{n \rightarrow \infty} A_n\right) = \lim_{n \rightarrow \infty} P(A_n)$   | 6 |
| (c) Six dice are thrown simultaneously. What is the probability that all dice show different faces?  | 2 |
| 3. (a) Let $U = X + aY$ and $V = X + \frac{\sigma_x}{\sigma_y} Y$ , where $a$ is a constant and $\sigma_x, \sigma_y$ are the standard deviations of $X$ and $Y$ , where $X$ and $Y$ are positively correlated. If $\rho(U, V) = 0$ , then show that $a = -\frac{\sigma_x}{\sigma_y}$ . | 5 |
| (b) Show that the distribution function $F(x)$ satisfies the following properties  |   |
| (i) $F(x)$ is monotonically non decreasing   | 2 |
| (ii) $F(x)$ is right continuous.   | 3 |

4. (a) The joint probability density function of  $X$  and  $Y$  is 5  

$$f(x, y) = \begin{cases} 8xy & \text{if } 0 \leq x \leq y, \quad 0 \leq y \leq 1 \\ 0 & \text{elsewhere} \end{cases}$$
 Examine whether  $X$  and  $Y$  are independent. Also compute  $\text{var}(X)$  and  $\text{var}(Y)$ .
- (b) State and prove binomial law connected to the compound experiment resulting from Bernoulli trials. 5
5. (a) The distribution of a random variable  $X$  is given by  $P(X = -1) = \frac{1}{8}$ , 5  
 $P(X = 0) = \frac{3}{4}$  and  $P(X = 1) = \frac{1}{8}$ . Verify Tchebycheff's inequality for the distribution.
- (b) If  $X$  is  $\gamma(l)$  variate, find  $E(\sqrt{X})$ . Also find the mean of  $X$ . 5
6. (a) There are 500 misprints in a book of 500 pages. Find the probability that a given page will contain at most three misprints. 5
- (b) A point is chosen at random on a semicircle having centre at the origin and radius unity and projected on the diameter. Prove that the distance of the point of projection from the centre has the probability density 5  

$$\frac{1}{\pi\sqrt{1-x^2}}$$
 for  $-1 < x < 1$  and zero elsewhere.

### Group-B

Answer Question No. 7 and any *one* question from the rest

7. (a) Define equimomental body. 1  
 (b) State principle of conservation of angular momentum. 2  
 (c) Define the length of the simple equivalent pendulum. 2
8. (a) Show that the momental ellipsoid at a point on the edge of a circular base of a thin hemispherical shell is  $2x^2 + 5(y^2 + z^2) - 3zx = \text{constant}$ . 6
- (b) A bent lever whose arms are of length  $a$  and  $b$ , the angle between them being  $\alpha$ , makes small oscillation in its own plane about the fulcrum. Show that the length of the corresponding simple pendulum is 4  

$$\frac{2/3(a^3 + b^3)}{\sqrt{a^4 + 2a^2b^2 \cos \alpha + b^4}}$$
9. (a) A rod of length  $2a$  is suspended by a string of length  $l$ , attached to one end. If the string and rod revolve about the vertical with uniform angular velocity, and their inclination to the vertical be  $\theta$  and  $\phi$  respectively, show that 5  

$$\frac{3l}{a} = \frac{(4 \tan \theta - 3 \tan \phi) \sin \phi}{(\tan \phi - \tan \theta) \sin \theta}$$
- (b) Derive the equation of motion of a rigid body about a fixed axis. 5



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B.Sc. Honours Part-III Examinations, 2018

**MATHEMATICS-HONOURS**

**MTMH-XIII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 2 Hours

Full Marks: 50

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**GROUP-A**

**Answer Question No. 1 and any two questions from the rest**

1. (a) If  $T$  is an unbiased estimator for  $\theta$ , show that  $T^2$  is a biased estimator for  $\theta^2$ . 2
- (b) Define type-I error. 1
- (c) Define "null hypothesis" and "alternating hypothesis". 2

2. (a) Prove that the standard deviation is independent of the origin but it depends on the scale of measurement. 4
- (b) Find the second, third and fourth central moment of the frequency distribution given below. Hence, find the measure of skewness and kurtosis. 6

Class Limits	110.0-114.9	115.0-119.9	120.0-124.9	125.0-129.9	130.0-134.9	135.0-139.9	140.0-144.9
Frequency	5	15	20	35	10	10	5

3. (a) Prove that sample mean is consistent estimate of population mean. 4
- (b) If  $X_1, X_2, \dots, X_n$  is a random sample from  $N(\mu, \sigma^2)$ , then show that 6

$$\frac{(n-1)S^2}{\sigma^2} \sim \chi^2(n-1).$$

4. (a) Given the frequency function: 6

$$f(x, \theta) = \frac{1}{\theta}, \quad 0 \leq x \leq \theta$$

$$= 0, \quad \text{elsewhere.}$$

To test the null hypothesis  $H_0: \theta = 1$  against  $H_1: \theta = 2$ , by means of single observed value of  $x$ , what would be the sizes of type I and type II errors if the chosen interval is (i)  $0.5 \leq x$ , (ii)  $1 \leq x \leq 1.5$  as the critical region? Also find the power function of the test.

- (b) Find the maximum likelihood estimate of
- $\theta$
- for distribution

4

$$f(x, \theta) = (1 + \theta)\theta^x; \quad \theta > 0, \quad 0 \leq x \leq 1.$$

## GROUP-B

Answer Question No. 5 and any two questions from the rest

5. (a) Define Poinsot's central axis. 2  
 (b) What is 'pitch'? 1  
 (c) Classify stability with one example of each. 2
6. (a) Find the centroid of the cycloid  $x = a(\theta + \sin\theta)$ ,  $y = a(1 - \cos\theta)$  which lies in the positive quadrant. 4  
 (b) A solid hemisphere of weight  $W$  and radius  $a$  is placed with its curved surface on a smooth horizontal table and a string of length  $l (< a)$  is attached to a point on its rim and to a point on the table. Show that the tension of the string is  $\frac{3}{8}W \frac{a-l}{\sqrt{2al-l^2}}$ . 6
7. (a) A uniform rod of length  $2l$  has its lower end attached by a light string of length  $r$  to a point  $O$ , and it is constrained to pass through a fixed point  $A$ , at a distance  $c$  vertically above  $O$ . Show that the rod is stable in the vertical position if  $l < \frac{(c+r)^2}{r}$ . 5  
 (b) Show that a system of non-coplanar forces acting on a rigid body can be reduced to a wrench. 5
8. (a) Three forces each equal to  $Q$  act on a rigid body; one at the point  $(1, 0, 0)$  parallel to  $Oy$ ; the second at the point  $(0, 1, 0)$  parallel to  $z$ -axis; the third at the point  $(0, 0, 1)$  parallel to  $Ox$ -axis; the axes being rectangular, find the equation of the central axis. 5  
 (b) Using the principle of virtual work deduce the condition of equilibrium for a given system of forces acting on a rigid body. 5



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MATHEMATICS-HONOURS

MTMH-XIV

UNDER-(1+1+1) SYSTEM

Time Allotted: 2 Hours

Full Marks: 50

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GROUP-A

1. Answer any *three* questions from the following: 1×3 = 3
- (a) What do you mean by holonomic constraints? 1
  - (b) Give example of Bilateral constraints. 1
  - (c) For a projectile in space, write down the degrees of freedom and generalised coordinates. 1
  - (d) State principal of virtual work. 1
2. Answer any *three* questions from the following: 4×3 = 12
- (a) State and prove conservation of angular momentum for a system of particle. 4
  - (b) Show that the laws of conservation of linear momentum and the conservation of energy remain invariant under Galilean transformations. 4
  - (c) What are meant by Scleronomic and Rheonomic constraints? Give examples of such constraints with reasons. 4
  - (d) Write down the limitation of Newtonian Mechanics. Obtain generalized coordinates and degrees of freedom for the moving particle in a plane curve  $xy = c^2$ . 4
  - (e) Deduce D'Alembert's principle. 4

GROUP-B

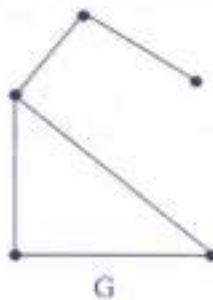
3. Answer any *two* questions from the following: 2×2 = 4
- (a) Solve the recurrence relation  $a_n - 8a_{n-1} + 21a_{n-2} - 18a_{n-3} = 0$ .

- (b) Find the logic networks corresponding to Boolean expressions  $AB + CD$ .  
 (c) Show by Pigeonhole Principle that if 9 books are to be kept in 4 shelves, there must be at least one shelf which contain at least 3 books.

4. Answer any *four* questions from the following: 4×4 = 16
- (a) Convert the Boolean function 4  
 $f(x, y, z) = (x' + y + z')(x' + y + z)(x + y' + z)$   
 in disjunctive normal form.
- (b) Solve the following recurrence relation 4  
 $a_{n+2} - a_{n+1} - 2a_n = n^2$
- (c) Determine the generating function of the following sequence 4  
 $a_r = 5^r + (-1)^r 3^r + 8^r + {}^3C_r$
- (d) If  $(L, *, \oplus)$  is distributive lattice and if  $a * b = a * c$  and  $a \oplus b = a \oplus c$  for all  $a, b, c \in L$ , show that  $b = c$  and also prove that 4  
 $(a * b) \oplus (b * c) \oplus (c * a) = (a \oplus b) * (b \oplus c) * (c \oplus a)$
- (e) Draw a switching circuit of the expression  $(B' + D)(A' + B)(C' + D)$ . 4
- (f) Draw Karnaugh map and simplify the following Boolean expressions: 4  
 $F(A, B, C, D) = \sum(7, 13, 14, 15)$ .

**GROUP-C**

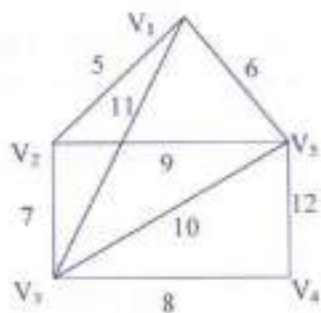
5. (a) Draw a graph having degree sequence (1, 2, 2, 4, 5). 1  
 (b) How many vertices are there in a 4-regular graph with ten edges? 1  
 (c) A graph  $G$  is given below, draw the corresponding  $\overline{G}$  1



6. Answer any *three* questions from the following: 4×3 = 12
- (a) What is simple graph? Prove that a simple graph with  $n(\geq 2)$  vertices must have at least two vertices of equal degree. 1+3

- (b) Find the minimal spanning tree of the following connected weighted graph  $G$  by applying Kruskal's algorithm.

4



- (c) Show that a graph is bipartite iff it does not contain a cycle of odd length. 4
- (d) Show that in a graph there are even number of vertices of odd degree. 4
- (e) What is walk? Let  $G$  be a graph and  $u, v$  be two distinct vertices of  $G$ . If there is a walk from  $u$  to  $v$ , then there is a path from  $u$  to  $v$ . 4





**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours Part-III Examinations, 2018

**MATHEMATICS-HONOURS**

**MTMH-XV**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**GROUP-A**

**Answer any five questions from the following**

6×5 = 30

- |    |  |   |
|----|--|---|
| 1. | Find, by power method, the extreme eigenvalue of the matrix  | 6 |
|    | $A = \begin{pmatrix} 2 & 5 & 7 \\ 3 & 4 & 6 \\ 8 & 9 & 1 \end{pmatrix}$  |   |
| 2. | Explain Euler's method for solving first order differential equation of the form $\frac{dy}{dx} = f(x, y)$ , $y(x_0) = y_0$ .                      | 6 |
| 3. | Explain Gauss elimination method for numerical solution of a system of simultaneous $n$ linear equations in $n$ unknowns.                          | 6 |
| 4. | Explain the method of fixed point iteration and obtain the condition of convergence for numerical solution of an equation of the form $f(x) = 0$ . | 6 |
| 5. | Establish Newton's backward interpolation formula (without error term).  | 6 |
| 6. | Show that divided differences are symmetric functions with respect to the arguments.   | 6 |
| 7. | Explain the principle of numerical differentiation. Deduce Lagrange's numerical differentiation formula (without error term).                      | 6 |
| 8. | Prove that Newton-Raphson method converges quadratically.  | 6 |

## GROUP-B

9. Answer any *four* questions from the following: 5×4 = 20
- (a) Describe CPU and monitor of a computer. 2
- (b) Evaluate  $(10101)_2 - (10001)_2$ . 2
- (c) What is a microprocessor? 1
- 10.(a) Explain the term BIT and BYTE. 2
- (b) Distinguish between RAM and ROM. 2
- (c) Express 565 as hexadecimal number. 1
11. Write a program in C to find the solution of  $\frac{dy}{dx} = x + y$ , given that  $y=1$  when  $x=0.0$ . 5
12. Write an algorithm and draw the flow chart of bisection method for finding a real root of the equation  $f(x)=0$ . 5
13. Write a programme in C to calculate the integral  $\int_0^1 \frac{dx}{\sin x + \log(\sec x)}$  using Simpson's  $\frac{1}{3}$ rd rule taking 25 ordinates. 5
14. Write a programme in C to find a forward difference table for a given set of tabular values of  $y = f(x)$  at 20 distinct equispaced values of  $x$ . 5



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. General Part-III Examinations, 2018

**MATHEMATICS-GENERAL**

**MTMG-VII**

**UNDER-(1+1+1) SYSTEM**

Time Allotted: 3 Hours

Full Marks: 75

*The figures in the margin indicate full marks.  
Candidates are required to give their answers in their own words as far as practicable.  
All symbols are of usual significance.*

**GROUP-A**

বিভাগ-ক

1. Answer *all* questions from the following:
 

নিম্নলিখিত সমস্ত প্রশ্নের উত্তর দাও:

(a) Convert $(1010.11)_2$ into octal system.	1
$(1010.11)_2$ কে অষ্টক পদ্ধতিতে রূপান্তরিত করো।	
(b) What is meant by volatile and non-volatile memory of computer? Give examples.	2
'Computer memory'-এর Volatile এবং Non-volatile বলতে কি বোঝায়? উদাহরণ দাও।	
(c) What are source programs and object programs?	2
'Source Programs' এবং 'Object Programs' বলতে কি বোঝায়?	
  
2. Answer any *two* questions from the following:
 

নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:

(a) How does compiler play the role in connecting source programs and object programs?	3
'Source programs' এবং 'Object programs' কে যুক্ত করার ক্ষেত্রে 'Compiler'-এর ভূমিকা কি?	
(b) Convert the hexadecimal number 2ADAC7B to binary form.	3
2ADAC7B এই hexadecimal সংখ্যাটিকে binary-তে রূপান্তরিত করো।	
(c) Give an algorithm to add $N$ terms of the series:	3
নিচের শ্রেণীটির $N$ -সংখ্যক পদের যোগফলের জন্য একটি algorithm নির্ণয় করো:	

$$1 + \frac{2}{3^2} + \frac{3}{5^2} + \frac{4}{7^2} + \dots$$

3. Answer any *two* questions from the following: 7×2 = 14  
 নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:
- (a) (i) Write short notes on assembly level language. 3  
 'Assembly level language' সম্পর্কে সংক্ষিপ্ত বিবরণ লেখো।
- (ii) Write a program in Fortran / C to obtain area, perimeter of a triangle whose sides are given. 4  
 কোনো ত্রিভুজের বাহুগুলি দেওয়া থাকলে তার পরিসীমা এবং ক্ষেত্রফল নির্ণয়ের জন্য একটি Fortran / C প্রোগ্রাম লেখো।
- (b) (i) Write a short note on LOGICAL – IF statement. 3  
 LOGICAL – IF statement সম্পর্কে সংক্ষিপ্ত বিবরণ দাও।
- (ii) Write a brief note on the generation of computers. 4  
 'Computer'-এর পরম্পরের উপরে সংক্ষিপ্ত বিবরণ দাও।
- (c) (i) Describe "go to" statement in C with example. 4  
 উদাহরণ সহযোগে 'C Language'-এ "go to" statement-এর বর্ণনা দাও।
- (ii) Write a C program to find 3  
 $1 + 2 + 3 + \dots + N$ .  
 $1 + 2 + 3 + \dots + N$ -এর মান নির্ণয়ের জন্য একটি C প্রোগ্রাম লেখো।

### GROUP-B

#### বিভাগ-খ

4. Answer *all* the questions from the following:  
 নিম্নলিখিত সমস্ত প্রশ্নগুলির উত্তর দাও:
- (a) Find  $L\{t^2 e^{-2t}\}$ . 2  
 মান নির্ণয় করো:  $L\{t^2 e^{-2t}\}$ .
- (b) State Dirichlet's criterion for Fourier series. 2  
 'Fourier series'-এর জন্য 'Dirichlet's criterion' বিবৃত করো।
- (c) Find the radius of convergence of the Fourier series  $\sum_{n=1}^{\infty} \frac{(2n)! x^{2n}}{(n!)^2}$ . 2  
 $\sum_{n=1}^{\infty} \frac{(2n)! x^{2n}}{(n!)^2}$  সূচক শ্রেণীটির অভিসারী ব্যাসার্ধ নির্ণয় করো।
5. Answer any *two* questions from the following: 4×2 = 8  
 নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:
- (a) Using Laplace transform to evaluate 4  

$$\int_0^{\infty} t^2 e^{-t} \sin t \, dt.$$
  
 'Laplace transform'-এর সাহায্যে  $\int_0^{\infty} t^2 e^{-t} \sin t \, dt$ -এর মান নির্ণয় করো।

(b) Solve  $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$  by Lagrange's method. 4

$x^2(y-z)p + y^2(z-x)q = z^2(x-y)$  সমীকরণটি Lagrange পদ্ধতিতে সমাধান করো।

(c) Find the Fourier series of  $f(x)$  where 4

$$f(x) = \begin{cases} x - \pi, & -\pi < x < 0 \\ \pi - x, & 0 \leq x < \pi \end{cases}$$

নিচের অপেক্ষকটির জন্য 'Fourier series' নির্ণয় করো

$$f(x) = \begin{cases} x - \pi, & -\pi < x < 0 \\ \pi - x, & 0 \leq x < \pi \end{cases}$$

6. Answer any two questions from the following:  $8 \times 2 = 16$

নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:

(a) Solve by the method of variation of parameters the equation 8

$$(D^3 - 6D^2 + 11D - 6)y = e^{2x}$$

$(D^3 - 6D^2 + 11D - 6)y = e^{2x}$  সমীকরণটিকে 'variation of parameter' পদ্ধতির সাহায্যে সমাধান করো।

(b) (i) Find the eigen values and eigen functions of 4

$$\frac{d}{dx} \left( x \frac{dy}{dx} \right) + \frac{\lambda}{x} y = 0, y'(1) = 0 = y'(e^{2\pi}), \lambda > 0.$$

$\frac{d}{dx} \left( x \frac{dy}{dx} \right) + \frac{\lambda}{x} y = 0, y'(1) = 0 = y'(e^{2\pi}), \lambda > 0$ -এর জন্য eigen মান এবং eigen অপেক্ষকটি নির্ণয় করো।

(ii) Use Laplace transform to solve 4

$$\frac{d^2 y}{dt^2} + 5 \frac{dy}{dt} + 6y = 5e^t, y(0) = 2, y'(0) = 1.$$

'Laplace transform'-এর দ্বারা  $\frac{d^2 y}{dt^2} + 5 \frac{dy}{dt} + 6y = 5e^t, y(0) = 2, y'(0) = 1$ -এর সমাধান করো।

(c) Solve by method of undetermined coefficients 8

$$\frac{d^2 y}{dx^2} + 6 \frac{dy}{dx} + 9y = 24e^{-3x}.$$

'Undetermined Coefficient' পদ্ধতির সাহায্যে নিচের সমীকরণটির সমাধান করো

$$\frac{d^2 y}{dx^2} + 6 \frac{dy}{dx} + 9y = 24e^{-3x}.$$

## GROUP-C

## বিভাগ-গ

7. Answer *all* questions from the following:  
নিম্নলিখিত সমস্ত প্রশ্নগুলির উত্তর দাও:
- (a) Show that  $7^n - 1$  is divisible by 6,  $\forall n \in \mathbb{N}$ . 2  
দেখাও যে,  $7^n - 1$  সর্বদা 6 দ্বারা বিভাজ্য,  $\forall n \in \mathbb{N}$ .
- (b) In a Boolean Algebra  $B$ , prove that 2  
 $(a + b) = a$ , if  $a' + b' = 1$ .  
প্রমাণ করো যে, যে-কোনো Boolean Algebra  $B$ -তে  $(a + b) = a$  যখন  $a' + b' = 1$ .
8. Answer any *two* questions from the following: 3×2 = 6  
নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:
- (a) Show that  $\phi(n)$ , is an even, where  $n > 2$  is an integer and  $\phi$  is a Euler's phi-function. 3  
 $\phi$  যদি Euler's phi-function হয় তবে দেখাও যে,  $\phi(n)$  যুগ্ম, যেখানে  $n > 2$  একটি পূর্ণসংখ্যা।
- (b) Is 9 780023 627219 a correct UPC for some product? 3  
কোনো বস্তুর জন্য 9 780023 627219 একটি নির্ভুল UPC কিনা বলো?
- (c) If  $a, b \in \mathbb{R}$ , then prove that  $(a - b)$  is a factor of  $a^n - b^n$ ,  $\forall n \in \mathbb{N}$ . 3  
যদি  $a, b \in \mathbb{R}$  হয় তবে প্রমাণ করো  $(a - b)$  হবে  $a^n - b^n$ ,  $\forall n \in \mathbb{N}$  -এর একটি উৎপাদক যেখানে  $n \in \mathbb{N}$ .
9. Answer any *two* questions from the following: 5×2 = 10  
নিম্নলিখিত যে-কোনো দুটি প্রশ্নের উত্তর দাও:
- (a) Express  $(x + y + z)(xy + x'z)'$  is DNF. 5  
 $(x + y + z)(xy + x'z)'$  কে DNF-এ প্রকাশ করো।
- (b) Prove that a complete DNF is identically 1. 5  
প্রমাণ করো যে একটি সম্পূর্ণ DNF অভিন্নরূপে 1.
- (c) Draw the circuit of the following function and simplify it. 5  
নিচের অপেক্ষকটির circuit অঙ্কন করো এবং সরলীকরণ করো।  
 $xz + y'z + z'x + zz' + y'z'$ .