4 SEM TDC PHYH (CBCS) C 8

2023

(May/June)

PHYSICS

(Core)

Paper : C–8

(Mathematical Physics—III)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×4=4

   (a) The value of $|3z_1 - 4z_2|$, if $z_1 = 2 + i$ and $z_2 = 3 - 2i$, is

      (i) 157

      (ii) 167

      (iii) $\sqrt{157}$

      (iv) $\sqrt{167}$

(Turn Over)

(b) The value of the integral $\oint_C \frac{1}{z} dz$, if the point $z = 0$ lies within the curve C, is

(i) $\frac{1}{2\pi i}$

(ii) 0

(iii) $2\pi i$

(iv) None of the above

(c) The Laplace transform $f(s)$ of $F(t) = t$ is

(i) 1

(ii) s

(iii) s^2

(iv) $1/s^2$

(d) If $g(\omega)$ is the Fourier transform of $f(t)$, the Fourier transform of $f(at)$ is

(i) $\frac{1}{a} g\left(\frac{\omega}{a}\right)$

(ii) $\frac{1}{\omega} g\left(\frac{\omega}{a}\right)$

(iii) $\frac{1}{\omega} g\left(\frac{a}{\omega}\right)$

(iv) None of the above

2. Answer the following :   2×5=10

(a) Express the equation $x^2 + y^2 = 36$ in terms of the conjugate co-ordinates $-5 + 5i$.

(b) Express the complex number $-1 + \sqrt{3}i$ in polar form.

(c) Differentiate between the terms 'essential singularity' and 'removable singularity' with examples.

(d) Using the Fourier integral formula, derive the Fourier cosine transformation.

(e) Prove that if $f(s)$ is the Laplace transform of $F(t)$, the Laplace transform of $e^{at}F(t)$ is $f(s-a)$.

3. Answer the following :

(a) State the Cauchy's residue theorem. Prove that $\int_0^\infty \frac{dx}{x^6 + 1} = \frac{\pi}{3}$.   1+4=5

(b) If $f(z) = u + iv$ is analytic and $u = e^{-x}(x \sin y - y \cos y)$, prove that u is harmonic. Also, find the value of v.   2+3=5

(c) State the Cauchy's integral formula for derivative of a function. Evaluate the integral $\oint_C \frac{e^{2z}}{(z+1)^4} dz$, where C is the circle $|z| = 3$.   1+3=4

(d) Find the residues of

$$f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+4)}$$ 4

(e) Find the Laurent series of $\dfrac{e^{2z}}{(z-1)^3}$ about $z = 1$.   3

4. Find the Fourier transform of the following functions (any *two*) :   3×2=6

(i) $f(x) = \dfrac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\dfrac{(x-\mu)^2}{2\sigma^2}\right)$

(ii) $f(x) = Ne^{-\alpha x^2}$ [N and α are constants]

(iii) $f(x) = \dfrac{1}{2\pi}\left(\dfrac{a^2}{x^2+a^2}\right)$

5. Find the Laplace transform of the following functions (any *two*) :   3×2=6

(i) $f(t) = \dfrac{e^{at} - 1}{a}$

(ii) $f(t) = \cos^2 t$

(iii) $f(t) = Kt$, where K is a constant

6. Write short notes on the following (any *two*) :   3×2=6

(a) Singularities of a complex function
(b) Fourier transforms and its applications
(c) Convolution theorem

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4 SEM TDC PHYH (CBCS) C 9

2 0 2 3

(May/June)

PHYSICS

(Core)

Paper : C–9

(Elements of Modern Physics)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Choose the correct answer from the following :   1×5=5

   (a) Which of the following expressions represents thermal de Broglie wavelength of a particle?

   (i) $\lambda = \dfrac{h}{\sqrt{3mkT}}$ (ii) $\lambda = \dfrac{h}{\sqrt{3kT}}$

   (iii) $\lambda = \dfrac{2h}{\sqrt{3mkT}}$ (iv) $\lambda = \dfrac{h}{\sqrt{kT}}$

     (Turn Over)

(b) The nuclear density

   (i) is independent of size of nucleus

   (ii) increases with increasing size of nucleus

   (iii) decreases with increasing size of nucleus

   (iv) None of the above

(c) The existence of zero-point energy is in conformity with

   (i) Compton effect

   (ii) uncertainty principle

   (iii) de Broglie hypothesis

   (iv) None of the above

(d) A metastable state has lifetime of the order of

   (i) 10^{-6} s

   (ii) 10^{-5} s

   (iii) 10^{-4} s

   (iv) 10^{-3} s

(e) Which of the following cannot be emitted by a radioactive substance during their decay?

   (i) Neutrino

   (ii) Protons

   (iii) Helium nuclei

   (iv) Electrons

2. Answer the following questions :   2×5=10

(a) What is photoelectric effect? Define work function of a material.

(b) What are three-level and four-level lasers? Give examples of each type.

(c) Write down the semi-empirical mass formula for a nucleus. Define binding energy.

(d) Show that the phase velocity is half of the group velocity for a non-relativistic free particle.

(e) Describe how an electron-positron pair is created by gamma photons in the vicinity of a nucleus.

3. (a) Explain the validity of Heisenberg's uncertainty principle using the gamma ray microscope thought experiment.   3

(b) Normalize the following wave function in one dimension :   3

$$\psi(x) = Ae^{-\alpha x} \text{ for } x > 0$$
$$= Ae^{\alpha x} \text{ for } x < 0$$

where α is a positive constant.

(c) Briefly explain the two cyclic processes involved in the thermonuclear fusion in driving stellar energy.   3

4. *(a)* What is a wave function? How can the stationary states of a particle be explained using the concept of wave function?   1+3=4

(b) Obtain the energy eigenvalues and eigenfunctions for a particle in a one-dimensional rigid box.   4

Or

Derive the time-dependent Schrödinger equation for a non-relativistic particle.   4

5. *(a)* Derive an expression for Planck's law of radiation.   6

(b) Explain the quantum mechanical tunnelling for a particle across a step potential and obtain the expression for transmission coefficient.   6

(c) Obtain an expression for the law of radioactive decay. Show that the half-life of a radioactive substance is inversely proportional to its decay constant.   3+3=6

6. Write a short note on (any *one*) :   3

(a) Davisson and Germer experiment

(b) Liquid-drop model

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4 SEM TDC PHYH (CBCS) C 10

2 0 2 3

(May/June)

PHYSICS

(Core)

Paper : C–10

(Analog Systems and Applications)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer : 1×5=5

   (a) Under forward bias, current in a *p-n* diode does not flow before it attains _____ in silicon and germanium *p-n* junction diode respectively.

      (i) 0·5 V and 0·7 V

      (ii) 0·7 V and 0·3 V

      (iii) 1·1 V and 0·7 V

      (iv) 0·3 V and 0·7 V

(Turn Over)

(b) Avalanche breakdown is primarily dependent on the phenomenon of

   (i) doping

   (ii) ionisation

   (iii) recombination

   (iv) collision

(c) The value of α of a transistor is

   (i) more than 1

   (ii) less than 1

   (iii) 1

   (iv) 0

(d) In CE arrangement, the value of input impedance is approximately equal to

   (i) h_{ie}

   (ii) h_{oe}

   (iii) h_{re}

   (iv) None of the above

(Continued)

(e) Which of the following amplifiers cannot be used for audio frequency amplifier?

   (i) Class A

   (ii) Class B

   (iii) Class AB

   (iv) Class C

2. (a) Draw the energy band diagrams of n-type and p-type semiconductors indicating the position of Fermi level.   3

Or

Distinguish between static and dynamic resistance of a p-n junction diode. Do they depend on temperature and bias voltage?   2+1=3

(b) Explain the formation of barrier potential in a p-n junction. Derive an expression for the barrier potential of a p-n junction.   4

Or

Discuss different types of p-n junction diodes on the basis of method of fabrication.

(Turn Over)

(4)

3. (a) Draw the circuit diagram of a full-wave rectifier and calculate its ripple factor. 1+2=3

(b) Write about the working and construction of a photodiode. 2

4. (a) What is a load line in the transistor characteristics? Explain its significance. 2

(b) Explain with necessary diagram, the mechanism of current flows in an n-p-n transistor. 3

Or

A load resistance of 4 kΩ is connected in collector circuit of a common emitter transistor amplifier with $V_{CC} = 12$ V. What are the cut-off point and saturation point of output characteristics of the amplifier? Find the coordinate of the operating point, if the zero signal base current is 20 μA and $\beta = 100$. 5

5. (a) Draw a fixed bias circuit. On the basis of stability factor, mention the merits and demerits of this circuit. 2+1=3

(Continued)

(5)

(b) Starting from the two equations for the hybrid parameters, draw the h-parameter equivalent circuit for a common emitter transistor circuit. 3

(c) In CE transistor amplifier, following current and voltages are found :

(i) When output ac is short-circuited,
$I_b = 20$ μA, $I_c = 2$ mA, $V_{be} = 20$ mV

(ii) When input ac is open-circuited,
$V_{bc} = 0.75$ mV, $I_c = 90$ μA, $V_{ce} = 1.5$ V
Find the h-parameters of the transistor. 2

6. (a) Explain the operation of a two-stage RC coupled CE transistor amplifier with a neat circuit diagram. 2+2=4

(b) What is negative feedback? Explain with necessary frequency response curve, how the bandwidth of an RC coupled amplifier is modified when negative feedback is used. 1+2=3

(c) Describe a Hartley or a Colpitts oscillator circuit and explain its operation. 3

(Turn Over)

7. (a) Draw the basic inverting amplifier with an input resistance R_1 and a feedback resistance R_f. Assuming the OP-AMP to be ideal, derive the expression for the voltage gain of the inverting amplifier.
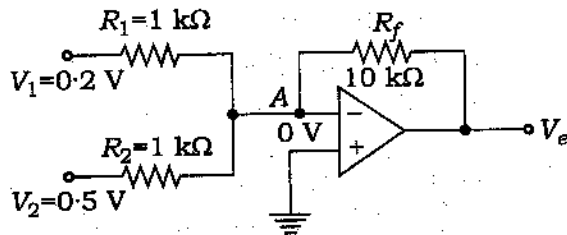
2+2=4

(b) Explain with circuit diagram of an OP-AMP as differentiator.   3

(c) Define CMRR and slew rate of an OP-AMP. What is the importance of CMRR?   2+1=3

Or

Determine the output voltage for the summing amplifier as shown below :   10

(Continued)

8. What is the function of a DAC? Write the advantage of the R-2R ladder type DAC over the weighted-resistor type DAC.   1+2=3

Or

Design a 4-bit weighted-resistor DAC whose full-scale output voltage is – 5 V. The logic levels are 1 = + 5 V and 0 = 0 V. What is the output voltage, when the input is 1101?   3

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4 SEM TDC ZOOH (CBCS) C 8

2 0 2 3

(May/June)

ZOOLOGY

(Core)

Paper : C–8

(Comparative Anatomy of Vertebrates)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Fill in the blanks with appropriate word(s) :

1×5=5

(a) The name of the integumentary gland secreting tear is _____ gland.

(b) Ribs are a part of _____ skeleton.

(c) Smallest arteries are connected to smallest veins by _____.

(d) Oviduct in vertebrates is modified _____ duct.

(e) A mass of cell bodies (perikaryon) within the gray matter of brain or spinal cord is _____.

2. Write notes on any *two* of the following : 4×2=8

(a) Auditory receptors in man

(b) Spinal cord

(c) Metanephros

3. Write about different types of epidermal glands found in vertebrates. 5

Or

Compare the epidermis of amphibia and mammals with suitable diagrams.

4. Describe the different types of jaw suspensorium in vertebrates. 8

Or

What are visceral arches? Give an account of modifications of visceral arches in tetrapoda. 2+6=8

(Continued)

5. Give a comparative account of digestive system of reptiles and birds. 6

Or

Write an account on the cranial nerves of mammals. 6

6. What are air sacs? What are its types? Mention their functions. 1+2+4=7

Or

Compare lung of reptiles and birds. 7

7. Give a comparative account of aortic arches in amphibia and reptilia. 7

8. What are cranial nerves? Prepare a note on autonomic nervous system. 2+5=7

Or

Write about evolution of urinogenital duct in vertebrates. 7

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4 SEM TDC ZOOH (CBCS) C 9

2023

(May/June)

ZOOLOGY

(Core)

Paper : C–9

(Animal Physiology : Life Sustaining Systems)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. *(a)* Fill in the blanks : 1×5=5

   (i) Salivary amylase converts starch into _____.

   (ii) _____ prevents the process of blood clotting.

   (iii) Oxyhaemoglobin after giving up its oxygen is called _____.

   (iv) The _____ prevents the entry of food into the respiratory tract.

   (v) Deficiency of oxygen in body tissue is called _____ condition.

(Turn Over)

(b) Write short notes on (any *two*) :   4×2=8

    (i) Urine formation

    (ii) Regulation of water balance

    (iii) Nephron

2. Describe the chemical digestion of carbohydrate and protein in the mammalian digestive tract.   4+4=8

Or

Describe briefly the mechanism of hormonal control of secretion of enzymes in gastrointestinal tract.   8

3. What is carbon monoxide poisoning? Write a note on chemical control of respiration.   3+5=8

Or

Draw a labelled diagram of trachea. Write a note on respiratory pigments.   4+4=8

4. Describe the structure of mammalian heart with a labelled diagram. What is ECG?   6+2=8

Or

Discuss about nervous and chemical regulation of heart rate. What is blood pressure? Distinguish blood pressure from pulse pressure.   4+2+2=8

5. Write about the different components of blood and their functions. Write a note on structure and functions of haemoglobin.   3+5=8

Or

Define hemostasis. Write a note on the process of blood coagulation.   1+7=8

6. What is Rh factor? Give an account of different blood groups.   2+6=8

Or

Discuss the Kallikrein-Kininogen system. What is the difference between complement system and fibrinolytic system?   4+4=8

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4 SEM TDC ZOOH (CBCS) C 10

2 0 2 3

(May/June)

ZOOLOGY

(Core)

Paper : C–10

(Biochemistry of Metabolic Process)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Fill in the blanks :   1×5=5

   (a) Oxidative phosphorylation takes place in _____.

   (b) Ammonia for urea formation is derived from _____ acid.

   (c) Reverse process of glycogenesis is _____.

(d) The final electron acceptor in Electron Transport Chain is _____.

(e) In glycolysis number of ATPs produced (Net) from a glucose is _____.

2. Write short notes on (any *two*) : 4×2=8

   (a) Urea cycle

   (b) Ketogenesis

   (c) Pyruvate dehydrogenase complex

   (d) Carnitine acyl transferases

3. Write and complete reactions catalysed by the following enzymes : 2×5=10

   (a) Fatty acyl-CoA synthetase

   (b) Acetyl-CoA carboxylase

   (c) Glycogen phosphorylase

   (d) Pyruvate carboxylase

   (e) Lactate dehydrogenase

   Or

   Describe the process of palmitic acid biosynthesis. Write a note on the structure of fatty acid synthetase molecule. 6+4=10

4. Distinguish between (any *three*) : 4×3=12

   (a) Substrate level and oxidative phosphorylation

   (b) Transamination and oxidative deamination

   (c) Glycolysis and gluconeogenesis

   (d) β-oxidation in mitochondria and peroxisome

   (e) Glycogenesis and glycogenolysis

   (f) NADH and NADPH

5. What is glycolysis? Give an outline of glycolytic reactions including enzymes, coenzymes etc. 1+8=9

   Or

   Write the reactions of Krebs' cycle with special reference to the oxidative steps and their products. Mention the number of ATPs produced from a pyruvic acid molecule in the cycle. 7+2=9

6. What is chemiosmosis? Describe how electron transfer in the respiratory chain is couple with ATP synthesis. 3+6=9

   Or

   Draw a labelled diagram to display the respiratory chain. Write a note on Adenine nucleotide and phosphate translocase. 3+6=9

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4 SEM TDC CHMH (CBCS) C 8

2 0 2 3

(May/June)

CHEMISTRY

(Core)

Paper : C–8

(Inorganic Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Select the correct answer : 1×6=6

   (a) Common oxidation state of lanthanides is

   (i) + 2

   (ii) + 3

   (iii) + 4

   (iv) both + 2 and + 4

(b) Which of the following does not belong to lanthanides?

   (i) Am

   (ii) Pm

   (iii) Sm

   (iv) Tm

(c) Which of the following is labile?

   (i) $[Fe(CN)_6]^{3-}$

   (ii) $[Fe(H_2O)_6]^{2+}$

   (iii) $[Cr(CN)_6]^{3-}$

   (iv) $[Mn(CN)_6]^{4-}$

(d) Which of the following is paramagnetic?

   (i) $Fe(CO)_5$

   (ii) $[Ni(CN)_4]^{2-}$

   (iii) $[Co(NH_3)_6]^{3+}$

   (iv) $[Fe(NH_3)_6]^{2+}$

(Continued)

(e) The high-spin configuration of Mn(III) ion in octahedral field is

   (i) $t_{2g}^3 e_g^2$

   (ii) $t_{2g}^3 e_g^1$

   (iii) $t_{2g}^4 e_g^0$

   (iv) $t_{2g}^2 e_g^2$

(f) The oxidation state of Fe in haemoglobin is

   (i) 0

   (ii) +2

   (iii) +3

   (iv) None of the above

UNIT—I

2. Answer the following questions : 2×4=8

(a) Write the name and formula of each of the following types of ligands : 1+1=2

   (i) One asymmetric bidentate ligand

   (ii) One hexadentate ligand

(Turn Over)

(b) What is spectrochemical series? Write one application of the spectrochemical series. 1+1=2

(c) Write the IUPAC names of the following compounds : 1+1=2

(i) $Na_3[Co(CN)_5NO]$

(ii) $[(NH_3)_5Co—NH_2—Co(NH_3)_5]Cl_3$

(d) Draw the structures of all possible isomers of $[Co(en)_3]^{3+}$ ion. 2

3. Answer any *two* questions : 3×2=6

(a) On the basis of crystal field theory, explain the splitting of d-orbitals in an octahedral complex.

(b) Show the crystal field splitting of $[Fe(H_2O)_6]^{2+}$. Calculate its spin-only magnetic moment. 2+1=3

(c) Determine the structure of $[Ni(CN)_4]^{2-}$ in the light of valence bond theory. Discuss its magnetic property. 2+1=3

4. Answer any *two* questions : 4×2=8

(a) (i) What are chelating ligands? Discuss with a suitable example.

(ii) Give the structural formulae of the following compounds : 2+2=4

Pentaammineazidocobalt (III) sulphate

Tetrafluoro oxochromate (IV) ion

(b) What do you mean by CFSE (crystal field stabilisation energy)? Calculate CFSE for the following octahedral systems : 1+1+1+1=4

(i) d^3

(ii) d^5–high spin

(iii) d^6–low spin

(c) Define inert and labile complexes. Explain why $[Fe(H_2O)_6]^{2+}$ is labile but $[Fe(CN)_6]^{4-}$ is inert. 2+2=4

UNIT—II

5. Answer any *three* questions : 3×3=9

(a) Write any three differences between first and second transition series elements. 3

(b) Give reasons why (i) Sc^{3+} is more stable than Sc^{2+} and (ii) transition elements exhibit colour. Explain with example. $1\frac{1}{2}+1\frac{1}{2}=3$

(c) Give three applications of Latimer diagram.

(d) Explain the stability of various oxidation states of transition metals in terms of their e.m.f. values. What is Latimer diagram? $2+1=3$

6. Find the number of unpaired electrons and calculate spin-only magnetic moment in the following complexes : $2+2=4$

(i) $[Cr(H_2O)_6]^{3+}$

(ii) $[Mn(CN)_6]^{4-}$
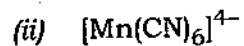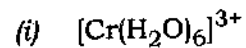
UNIT—III

7. Answer any *two* questions : $2\times2=4$

(a) What do you mean by lanthanide contraction?

(b) Eu and Yb exhibit +2-oxidation state. Explain.

(c) Give any two differences between lanthanides and actinides.

(Continued)

UNIT—IV

8. Answer any *two* questions : $4\times2=8$

(a) Discuss the structure and function of carbonic anhydrase. $2+2=4$

(b) What is sodium-potassium ion pump? Discuss its biological roles. $1+3=4$

(c) Write a note on mercury poisoning. How can it be treated? $2+2=4$

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4 SEM TDC CHMH (CBCS) C 9

2 0 2 3

(May/June)

CHEMISTRY

(Core)

Paper : C–9

(Organic Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer from the following : 1×4=4

   (a) Anthracene when reduced with sodium and ethanol gives

   (i) 9,10-anthraquinone

   (ii) 9,10-dihydroanthracene

   (iii) anthrone

   (iv) None of the above

(Turn Over)

(b) Which of the following is not a hetero-cyclic compound?

(i)   *(ii)*

(iii)   *(iv)*
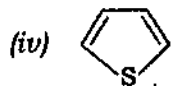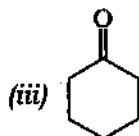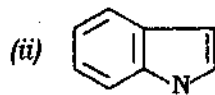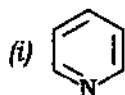
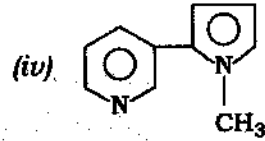*(c)* Which one of the following is not a terpene?

   (i) Myrcene

   (ii) Citral

   (iii) Camphor

   (iv) Quinine

(d) The chemical structure of nicotine is

(i)   *(ii)*

(iii)   *(iv)*

(Continued)

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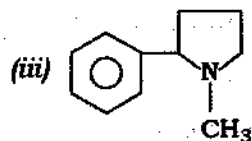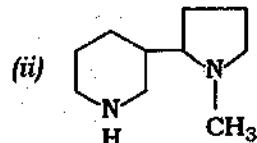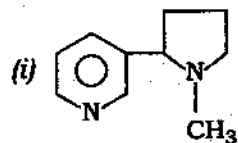
2. Answer any *four* questions from the following :   2×4=8

(a) What is diazotization? How is benzene diazonium chloride prepared in the laboratory?

(b) Aromatic amines are weaker bases than aliphatic amines. Explain.

(c) Sulphonation of naphthalene gives α-isomer at low temperature and β-isomer at high temperature. Explain.

(d) Thiophene is more aromatic in nature than furan. Explain.

(e) What are the structural formulae of hygrine and conine?

UNIT—I

3. Answer any *three* questions :   3×3=9

(a) How would you distinguish among 1°, 2° and 3° amines with the help of nitrous acid?

(b) Write short notes on any *two* of the following :   1½×2=3

   (i) Hofmann's exhaustive methylation

   (ii) Hofmann elimination reaction
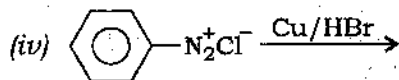
   (iii) Gabriel phthalimide synthesis

(Turn Over)
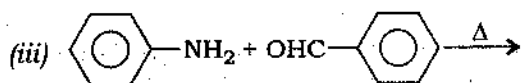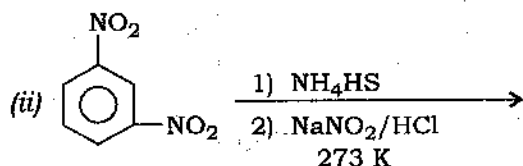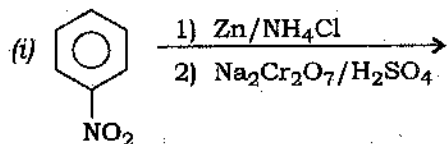
(c) Discuss the synthesis of the following :

$1\frac{1}{2}\times2=3$

(i) Azobenzene from aniline

(ii) m-nitroaniline from nitrobenzene

(d) Complete the following reactions (any *three*) :

$1\times3=3$

(i) $\xrightarrow[\text{2) } Na_2Cr_2O_7/H_2SO_4]{\text{1) } Zn/NH_4Cl}$

(ii) $\xrightarrow[\text{2) } NaNO_2/HCl \quad 273\ K]{\text{1) } NH_4HS}$

(iii) $-NH_2 + OHC-$ $\xrightarrow{\Delta}$

(iv) $-N_2^+Cl^- \xrightarrow{Cu/HBr}$

(Continued)

UNIT—II

4. Answer any *three* questions :

$3\times3=9$

(a) Complete the following reactions (any *three*) :

$1\times3=3$

(i) $\xrightarrow[\text{2) } H_2O/Zn]{\text{1) } O_3}$

(ii) $\xrightarrow{\text{acidic } KMnO_4}$

(iii) $+ H_2 \xrightarrow{CuO/Cr_2O_3}$

(iv) $OH + NH_3 \xrightarrow[150\ ^\circ C/\text{pressure}]{(NH_4)_2SO_3}$
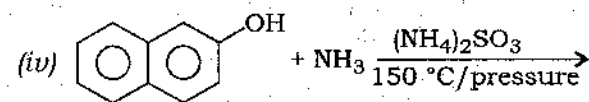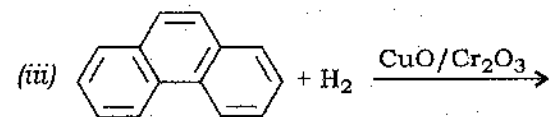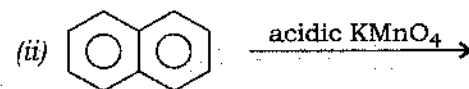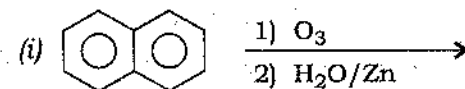
(b) Explain why, electrophilic substitution of anthracene and phenanthrene mainly takes place at 9 and 10 positions.

(c) How will you convert any *two* of the following?

$1\frac{1}{2}\times2=3$

(i) Naphthalene into α-naphthol

(ii) Phenanthrene into diphenic acid

(iii) Benzene into anthraquinone

(Turn Over)

(d) Prepare naphthalene with the help of Haworth's synthesis. What happens when naphthalene is treated with hydrogen in presence of nickel catalyst?

2+1=3

UNIT—III

5. (a) Pyrrole, furan and thiophene are more reactive than benzene to electrophilic attack. Explain. 2

(b) Starting with pyrrole, how will you get the following? 1+1=2

(i) 2-pyrrole sulphonic acid

(ii) Pyridine

(c) Answer any *three* questions : 2×3=6

(i) Prepare pyridine by Hantzsch synthesis.

(ii) Write a short note on Knorr quinoline synthesis.

(iii) Complete the following reactions : 1+1=2

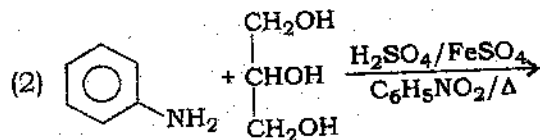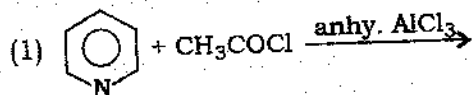(1) $\underset{N}{\bigcirc}$ + CH_3COCl $\xrightarrow{\text{anhy. } AlCl_3}$

(2) $\underset{NH_2}{\bigcirc}$ + $\underset{\substack{| \\ CH_2OH}}{\overset{\substack{CH_2OH \\ |}}{CHOH}}$ $\xrightarrow[C_6H_5NO_2/\Delta]{H_2SO_4/FeSO_4}$

(iv) Convert the following : 1+1=2

(1) Thiophene from sodium succinate

(2) Furan from furfural

(d) Explain why pyridine does not undergo Friedel-Crafts reactions. What happens when pyridine is treated with KNO_3 in presence of H_2SO_4 at 300 °C? 2+1=3

UNIT—IV

6. (a) Explain Zeisel method and Herzig-Meyer method with reference to the structure elucidation of alkaloids. 2

Or

Give one method of synthesis of hygrine.

(b) Write down the sequential steps when Hofmann exhaustive methylation is employed with nicotine and name the product. 2

(c) Give one medicinal use each of morphine and quinine. ½×2=1

UNIT—V

7. (a) What is special isoprene rule? Explain with example. 1

(b) How will you show that citral is an α, β
unsaturated aldehyde?   2

Or

Draw the geometrical structure of
citral.

(c) How will you synthesize the following
(any *one*)?   2

  (i) Citral from methylheptenone

  (ii) Geranic acid from geraniol

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4 SEM TDC CHMH (CBCS) C 10

2 0 2 3

(May/June)

CHEMISTRY

(Core)

Paper : C-10

(Physical Chemistry)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option (any *five*) :　1×5=5

   (a) The value of conductivity depends on

      (i) number of ions

      (ii) number of molecules of the electrolyte

      (iii) mobility of the ions

      (iv) Both *(i)* and *(iii)*

(b) The equation $\lambda_c = \lambda_0 - (A + B\lambda_0)\sqrt{c}$ is applicable to

(i) CH_3COOH

(ii) HCN

(iii) NH_4OH

(iv) KNO_3

(c) The potential of standard hydrogen electrode is

(i) 0 V

(ii) +1 V

(iii) –1 V

(iv) –0·184 V

(d) If copper rod is dipped into a ferrous sulphate solution, then

(i) copper will precipitate out

(ii) iron will precipitate out

(iii) both Cu and Fe will precipitate out

(iv) no reaction takes place

(Continued)

(e) The values of magnetic moment for the complexes $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ are, respectively

(i) 5·91 BM and 5·91 BM

(ii) 1·73 BM and 1·73 BM

(iii) 5·91 BM and 1·73 BM

(iv) 1·73 BM and 5·91 BM

(f) In the Gouy's balance experiment, when a paramagnetic substance is suspended in a magnetic field, then

(i) weight of the substance will decrease and the sample cylinder will go up

(ii) weight of the substance will increase and the sample cylinder will go down

(iii) weight of the substance remains same

(iv) weight of the substance may increase or decrease depending on the strength of magnetic field

2. Answer the following questions : 2×5=10

(a) Define ionic mobility and potential gradient.

(b) Why do lithium ions move slower than potassium ions in water?

(Turn Over)

(c) Write the advantages and disadvantages of standard hydrogen electrode (SHE).

(d) What is meant by reference electrode? Give examples.

(e) The dipole moment of chlorobenzene is $1.55\,D$. The bond distance of $Cl-C_6H_5$ is $2.8\,Å$. Calculate the percentage ionic character of the bond.

3. Answer the following question (either (a) or (b)) :

(a) Define transport number of an ion. State the Hittorf's rule. On the basis of this rule, how is the transport number of an ion related to the fall of concentrations? $1+1+1=3$

Or

(b) What are molar conductance and specific conductance? Write the relationship between specific conductance and molar conductance. $2+1=3$

4. Answer the following questions (any *three*) : $4\times3=12$

(a) What do you mean by abnormal transport number of an ion? Explain under what condition an aqueous solution of CdI_2 shows the negative transport number of Cd^{2+} ion. $2+2=4$

(b) Explain clearly what are meant by asymmetric and electrophoretic effect. $2+2=4$

(c) The equivalent conductance at infinite dilution of NH_4Cl is $150\ Scm^2g.eq^{-1}$. The ionic conductances at infinite dilution of OH^- and Cl^- are 198 and $76\ Scm^2g.eq^{-1}$, respectively. Calculate the Λ_{eq}^∞ for NH_4OH. If the equivalent conductances of a $0.01\,N$ solution of NH_4OH be $9.6\ Scm^2g.eq^{-1}$, what will be its degree of dissociation? $2+2=4$

(d) Explain the difference in the nature of the conductometric titration curves when (i) NH_4OH is titrated with HCl taken in the burette and (ii) HCl is titrated with NH_4OH taken in the burette. $2+2=4$

(e) Derive the relation between ionic conductance with ionic mobility. 4

5. Answer the following question (either (a) or (b)) :

(a) How can you detect whether a given cell is reversible or not? 3

Or

(b) Discuss with diagram the variation of the e.m.f. during the potentiometric titration of a strong acid with a strong base. How can the exact equivalence point in a potentiometric titration be detected? 2+1=3

6. Answer the following questions (any *three*) : 4×3=12

(a) Describe how the pH of a solution can be determined by using a hydrogen electrode.

(b) What is liquid junction potential? How can it be eliminated?

(c) Derive an equation showing the dependence of e.m.f. of a cell on the concentration of the electrolyte.

(d) Calculate the electrode (reduction) potentials of the following single electrodes at 30°C :

(i) Sn/Sn^{2+} (0.01 *M*)   Given,

$E°_{Sn^{2+}/Sn}$ = –0.14 V and $[Sn^{2+}]$ = 0.01 *M*

(ii) $Ag/AgI(s), I^-$ (0.0001 *M*)   Given,

$E°_{AgI/I^-}$ = –0.15 V and $[I^-]$ = 0.0001 *M*

(Continued)

(e) Write the cell reactions of the following cells :

(i) $Zn(s)|Zn^{2+}(aq)||I^-(aq), CuI|Cu(s)$

(ii) $Al(s)|Al^{3+}(aq)||Ag^+(aq)|Ag(s)$
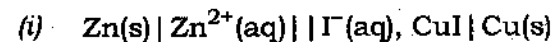
7. Answer the following questions (any *two*) : 4×2=8

(a) What are magnetic permeability and magnetic susceptibility? Deduce the relationship between them. 2+2=4

(b) Explain the Gouy method for the determination of magnetic susceptibility. 4

(c) Define polarizability of a molecule. Explain different types of polarizations that may take place when a molecule is placed in an electric field. 1+3=4

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4 SEM TDC BOTH (CBCS) C 8

2 0 2 3

(May/June)

BOTANY

(Core)

Paper : C–8

(Molecular Biology)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer of the following :

   1×5=5

   (a) The two strands of DNA are held together by—covalent bond/ionic bond/hydrogen bond/coordinate bond.

   (b) DNA synthesis in prokaryotes is brought about by—DNA polymerase-I/DNA polymerase-II/both DNA polymerase-I and II/None of the above.

(c) The new strand of DNA is replicated in—5'–3' direction/3'–5' direction/ 5'–5' direction/3'–3' direction.

(d) Which of the following is not a termination codon? (UAG/UAA/UAC/ UGA)

(e) Split genes consist of—introns only/ exons only/both introns and exons/ both DNA and RNA.

2. Write briefly on the following (any *three*) :

4×3=12

(a) Physical structure of DNA double helix

(b) Properties of genetic code

(c) RNA polymerase

(d) Chemical nature of gene

(e) RNA and protein synthesis

3. What are nucleic acids? Describe different types of DNA and mention the functions of DNA. 3+(5+4)=12

Or

Distinguish between : 4×3=12

(a) Unidirectional and bidirectional DNA replication

(b) Replication and Transcription

(c) Inducible operon and Repressible operon

4. What is transcription? Describe the molecular mechanism of transcription in prokaryotes. 2+10=12

Or

How is the regulation of gene expression maintained in organisms? Describe the lac operon mechanism of regulation of gene expression in prokaryotes. 3+9=12

5. Explain the process of translation in prokaryotes. State any four differences from eukaryotic translation. 8+4=12

Or

Write explanatory notes on the following :

6×2=12

(a) Structure and biological importance of tRNA

(b) Genetic code

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4 SEM TDC BOTH (CBCS) C 9

2 0 2 3

(May/June)

BOTANY

(Core)

Paper : C–9

(Plant Ecology and Phytogeography)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer of the following :

    1×5=5

    (a) All living organisms of the earth constitute biosphere / community / biome / association.

    (b) The word 'ecosystem' was first coined by Weaver and Clements / A. G. Tansley/E. P. Odum/All of them.

    (c) In a pond ecosystem, the food chain starts with phytoplankton / zooplankton / small fishes / aquatic insects.

(Turn Over)

(d) The branch of Ecology which deals with the study of soil and its influence on organisms is called Landscape Ecology/ Pedoecology/Autecology/Community Ecology.

(e) Ten percent law was given by Lindeman/Goldmann/Beckmann/None of them.

2. Write short notes on any *three* of the following : 4×3=12

   (a) Levels of organization

   (b) Soil water

   (c) Symbiosis

   (d) Logistic growth form of population

   (e) Detritus foodchain

3. Define plant community. Describe elaborately the analytical and synthetic characters of plant community. State the Raunkiaer's law of frequency. 2+7+3=12

   Or

   Write explanatory notes on the following : 6+6=12

   (a) Biological spectrum

   (b) Pyramid of energy

(Continued)

4. What do you know about nutrient cycling? Explain one sedimentary cycle with appropriate sketches. 4+8=12

   Or

   Define soil horizons. Discuss briefly the process of soil formation in nature. 7+5=12

5. What do you mean by endemism? Describe the theories regarding the origin of endemic plants and mention the factors responsible for endemism. Write scientific name of four endemic plants of India. 2+4+4+2=12

   Or

   Write notes on the following : 6+6=12

   (a) Moist tropical forest of India

   (b) Floristic regions of India

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4 SEM TDC BOTH (CBCS) C 10

2 0 2 3

(May/June)

BOTANY

(Core)

Paper : C–10

(Plant Systematics)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. (a) Choose the correct answer from the following : 1×3=3

   (i) The term taxonomy was coined by A. P. de Candolle/Carolus Linnaeus/Julian Huxley.

   (ii) When both the stamens and pistils of a flower fused to form a single structure is called pollinium/gynostemium/stylopodium.

   (iii) According to Hutchinson, the primitive angispermic flowers are pentamerous/trimerous/polymerous.

(Turn Over)

(b) Fill in the blanks :   1×2=2

    (i) Inflorescence of the family Lamiaceae is _____.

    (ii) When the anthers and filaments of stamens are united is called _____.

(c) Write briefly on the following (any *five*) :
                            2×5=10

    (i) Significance of plant systematics

    (ii) Floras and manuals

    (iii) Taxonomic species concept

    (iv) OTUs

    (v) Typification

    (vi) Author citation

2. Write notes on the following (any *three*) :
                            4×3=12

    (a) Dichotomous key

    (b) Phenograms and cladograms

    (c) Affinities of family Malvaceae

    (d) Primitive characters of the family Magnoliaceae

    (e) Rules and recommendations of ICN

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3. Define numerical taxonomy. State the principle of numerical taxonomy. Discuss the method of this study.   2+2+4=8

Or

Write about the distinguishing characters of the following families :   4×2=8

    (a) Brassicaceae

    (b) Poaceae

4. Describe the phylogenetic system of plant classification proposed by Engler and Prantl. Mention the merits and demerits of the classification.   6+4=10

Or

Write notes on the following :   5×2=10

    (a) Concept of parallelism and convergence

    (b) APG system of classification

5. What is herbarium? Describe the steps to preserve a plant in herbarium. Mention the importance of herbarium.   1+5+2=8

Or

Write notes on the following :   4×2=8

    (a) Virtual herbarium

    (b) Biometrics

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4 SEM TDC MTMH (CBCS) C 8

2023

(May/June)

MATHEMATICS

(Core)

Paper : C–8

(Numerical Methods)

Full Marks : 60

Pass Marks : 24

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Use of scientific calculator is allowed

1. *(a)* Define an algorithm and write one important feature of an algorithm. 1+1=2

   (b) Define error and relative error. 1+1=2

   (c) Write the convergence of numerical methods. 1

2. *(a)* State true or false : 1

   Iteration method is always convergent.

   (b) Describe bisection method for solving an algebraic equation. 4

(Turn Over)

Or

Find a real root of the equation

$$x^3 - 2x - 5 = 0$$

by secant method correct up to three decimal places.

(c) Give the geometrical interpretation of Newton-Raphson method.   5

Or

Determine the real root of $\cos x = 2x$ by Newton-Raphson method correct up to three decimal places.

3. (a) Describe Gauss elimination method for the solution of the system of linear equations.   5

Or

Solve the following by Gauss-Jordan method :

$$x + y + z = 5, \; 2x + 3y + 5z = 8, \; 4x + 5z = 2$$

(b) Solve the following by Gauss-Jordan method :   5

$$5x - 2y + 3z = -1, \; -3x + 9y + z = 2,$$
$$2x - y - 7z = 3$$

Or

Find the solution of the system of equations

$$5x + 2y + z = 12, \; x + 4y + 2z = 15,$$
$$x + 2y + 5z = 20$$

by Gauss-Seidel method up to three iterations.

4. (a) Define interpolation.   1

(b) Find the relation between D and Δ, where D = differential operator and Δ = forward difference operator.   2

(c) Construct forward difference table for the following values :   2

x :	0	5	10	15	20
y :	7	11	14	18	24

(d) Deduce Newton's forward interpolation formula.   5

Or

Find the missing term in the following table using Lagrange's interpolation formula :

x :	0	1	2	3	4
y :	1	3	9	?	81

5. (a) Deduce composite Simpson's $\frac{1}{3}$rd rule for numerical integration.   5

(b) Evaluate $\int_0^6 \dfrac{dx}{1 + x^2}$ by trapezoidal rule.   5

Or

Evaluate $\int_0^1 \dfrac{dx}{1 + x}$ using Simpson's $\frac{1}{3}$rd rule.

(c) Evaluate $\int_1^2 \frac{dx}{x}$ by Simpson's $\frac{3}{8}$th rule.   5

Or

Evaluate $\int_{0\cdot2}^{0\cdot6} \frac{dx}{1+x}$ by Bool's rule correct to three decimal places, using $n = 4$.

6. (a) Find $y(0\cdot10)$ and $y(0\cdot15)$ by Euler's method from the equation

$$\frac{dy}{dx} = x^2 + y^2, \ y(0) = 0$$

correct up to three decimal places, taking $h = 0\cdot05$.   4

(b) Derive the actual computational formulae for Runge-Kutta method of order two.   6

Or

Using Runge-Kutta method of fourth order, find the numerical solution at $x = 0\cdot2$ for

$$\frac{dy}{dx} = 2x + y, \ y(0) = 1$$

taking $h = 0\cdot2$.

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4 SEM TDC MTMH (CBCS) C 9

2023

(May/June)

MATHEMATICS

(Core)

Paper : C–9

**(Riemann Integration and Series
of Functions)**

Full Marks : 80

Pass Marks : 32

Time : 3 hours

_The figures in the margin indicate full marks
for the questions_

1. *(a)* State the two vital requirements for
existence of

$$\int_a^b f(x)\,dx \qquad\qquad 1+1=2$$

(b) Show that if $f \in R[a, b]$, then the value

of $\int_a^b f(x)\,dx$ is unique.　　3

Or

Show that every constant function is integrable.

2. (a) Let $P = \{([x_{i-1}, x_i]), t_i\}_{i=1}^n$ be a tagged partition of $I = [a, b]$. Then define Riemann sum of $f : [a, b] \to \mathbb{R}$. Give an example of the Riemann sum if $I = [1, 2]$.　　2

(b) Let $P = \{([x_{i-1}, x_i]), t_i\}_{i=1}^n$ be a tagged partition of $I = [a, b]$. Then show that $S(kf, P) = kS(f, P)$.　　3

(c) Answer any *four* questions from the following :　　5×4=20

(i) Write an example with explanation thereof that all bounded functions are not Riemann integrable.

(Continued)

(ii) Let $f : [a, b] \to \mathbb{R}$ is such that if $x_1 < x_2$, then $f(x_1) \le f(x_2)$. Show that $f \in R[a, b]$.

(iii) Let $f : [a, b] \to \mathbb{R}$ be integrable. Then $|f|$ is integrable and show that

$$\left| \int_a^b f(x)\,dx \right| \le \int_a^b |f(x)|\,dx$$

(iv) Let $f, g : [a, b] \to \mathbb{R}$ be integrable and $f(x) \le g(x) \; \forall \; x \in [a, b]$. Then show that

$$\int_a^b f(x)\,dx \le \int_a^b g(x)\,dx$$

(v) Let $f : [a, b] \to \mathbb{R}$ be integrable. Define F on $[a, b]$ as $F(x) = \int_a^x f(t)\,dt$ where $x \in [a, b]$. Show that F is differentiable at $c \in [a, b]$ and $F'(c) = f(c)$.

(Turn Over)

3. *(a)* Show that

  (i) $\Gamma(1) = 1$

  (ii) $\Gamma(n+1) = n\Gamma(n)$ 1+2=3

(b) Show that if $m \in \mathbb{N}$, then $\Gamma(m+1) = \lfloor m$. 3

(c) Discuss the convergence of beta function. 4

Or

Show that $\int_{-\infty}^{\infty} e^{-u^2} du = \sqrt{\pi}$ and hence show that $\Gamma\left(\dfrac{1}{2}\right) = \sqrt{\pi}$.

4. *(a)* State whether true or false : 1

Pointwise convergence implies uniform convergence.

(b) Let (f_n) be a real sequence of functions defined on a finite set $X = \{a_1, ..., a_k\}$ converging pointwise to a function $f : X \to \mathbb{R}$. Establish that the convergence is uniform. 2

(c) Let (f_n) be a sequence of integrable functions on $[a, b]$. Let $f_n \to f$ uniformly on $[a, b]$. Show that f is integrable on $[a, b]$ and

$$\int_a^b f(x)\,dx = \lim \int_a^b f_n(x)\,dx$$ 4

(d) Show that if (f_n) be a uniformly Cauchy sequence on a set X in $\mathbb{R}$, then it converges to $f : X \to \mathbb{R}$ uniformly. 4

(e) Show that the series

$$\sum_{n=1}^{\infty} \frac{x}{(1 + nx^2)n}$$

converges uniformly on any interval $[a, b]$. 4

(f) State and prove Cauchy's criterion for the uniform convergence of a series. 5

(g) Let $f_n : (a, b) \to \mathbb{R}$ be differentiable and the sequence (f_n') converges uniformly to $g : (a, b) \to \mathbb{R}$. Let there exists $c \in (a, b)$ such that the sequence $(f_n(c))$ converges. Then show that the sequence (f_n) converges uniformly to a continuous function $f : (a, b) \to \mathbb{R}$.   5

5. (a) State whether true or false :   1

A power series is a particular case of infinite series of functions

$$\sum_{n=0}^{\infty} f_n(x)$$

(b) Let $\sum_{n=0}^{\infty} a_n(x-a)^n$ be a power series. Show that there exists a unique extended real number R; $0 \leq R < \infty$, such that $\forall x$ with $|x-a| < R$, the series converges absolutely and uniformly to a function f on $(-r, r); 0 < r < R$.   4

(Continued)

(c) Given a power series $\sum_{n=0}^{\infty} a_n(x-a)^n$, determine an extended real number R such that $\dfrac{1}{R} = \lim |a_n|^{\frac{1}{n}}$.   5

(d) State and prove Abel's limit theorem.   5

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4 SEM TDC MTMH (CBCS) C 10

2 0 2 3

(May/June)

MATHEMATICS

(Core)

Paper : C–10

(Ring Theory and Linear Algebra—I)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Define unit element in a ring. Give an example.   1+1=2

   (b) Let R be a ring and $a, b \in R$. Show that $a(-b) = (-a)b$.   2

   (c) Show that intersection of two subrings of a ring R is a subring of R.   3

(Turn Over)

(d) Show that the ring $\mathbb{Z}_p$ of integers modulo p (p being a prime) is a field. 3

(e) Let R be a commutative ring with unity and let A be an ideal of R. Show that $\dfrac{R}{A}$ is a field if and only if A is maximal. 5

Or

Define a principal ideal domain. Show that the ring $\mathbb{Z}$ of integers is a principal ideal domain. 1+4=5

(f) Define characteristic of a ring. Let R be a ring with unity. Then show that

characteristic of $R =$

$\begin{cases} n, \text{ if } 1 \text{ has order } n \text{ under addition} \\ 0, \text{ if } 1 \text{ is of infinite order under addition} \end{cases}$

1+2+2=5

Or

Prove that the ring

$\mathbb{Q}[\sqrt{d}] = \{a + b\sqrt{d} \,|\, a, b \in \mathbb{Q}, d \text{ is a positive integer}\}$

is a field. 5

2. (a) Give an example of ring homomorphism. 1

(Continued)

(b) Is the map $f : \mathbb{Z}_{10} \to \mathbb{Z}_{10}$ such that $f(x) = 2x$ a ring homomorphism? Justify. 2

(c) Let $f : R \to S$ be a homomorphism from ring R to ring S. If $\ker f = \{0\}$, then show that f is one-one. 2

(d) Let $f : R \to S$ be a ring homomorphism from ring R to ring S. Show that kernel of f is an ideal of R. 2

(e) Determine all ring homomorphisms from $\mathbb{Z}$ to $\mathbb{Z}$, $\mathbb{Z}$ being the ring of integers. 3

Or

Show that if R is a ring with unity and char $(R) = n > 0$, then R contains a subring isomorphic to $\mathbb{Z}_n$.

(f) Show that if $f : R \to S$ is an onto homomorphism, then

$$S \cong \dfrac{R}{\ker f}$$

5

(Turn Over)

Or

State the second theorem of ring isomorphism. Show that

$$\frac{\mathbb{Z}}{<2>} \cong \frac{5\mathbb{Z}}{10\mathbb{Z}}$$ 1+4=5

3. (a) Define a vector subspace. 1

(b) Is $Q(\mathbb{R})$ a vector space? 1

(c) Is the set $\{(1, 2, 5), (2, -1, 0), (7, -1, 5)\}$ linearly independent over $\mathbb{R}$? Justify. 2

(d) Let $S = \{e_1 - e_2, e_1 + e_2\} \in \mathbb{R}^2$, where $e_1 = (1, 0)$ and $e_2 = (0, 1)$. Find $L(S)$. 2

(e) Show that any basis of a vector space is a linearly independent set. 2

(f) Show the sum of two subspaces of a vector space V is a subspace of V. 3

(g) Let V be a vector space and W_1 and W_2 be two subspaces of V. Show that

$$\dim(W_1 + W_2) = \dim W_1$$
$$+ \dim W_2 - \dim(W_1 \cap W_2)$$ 4

Or

Let V be a finite dimensional vector space and W be a subspace of V. Show that $\dim V / W = \dim V - \dim W$.

4. (a) Define a linear map. Show that the map $T : \mathbb{R}^3 \to \mathbb{R}$ such that

$$T(x, y, z) = x^2 + y^2 + z^2$$

is not linear. 1+2=3

(b) Show that if $T : V \to W$ is a linear map from vector space V to vector space W, then—

(i) $T(0) = 0$

(ii) $T(V)$ is a subspace of W 2+2=4

(c) Extend the vector $(1, 1, 1)$ in $\mathbb{R}^3(\mathbb{R})$ to form a basis of $\mathbb{R}^3$. 3

(d) Answer any *four* of the following : 5×4=20

(i) Let V and W be two vector spaces and $T : V \to W$ be a linear map. Then show that

$$\dim V = \text{rank } T + \text{nullity } T$$

(ii) Let $\{v_1, \cdots, v_n\}$ be a basis of the vector space V and $w_1, w_2, \cdots, w_n$ be vectors in the vector space W. Show that there exists a unique linear map $T : V \to W$ such that

$$T(v_i) = w_i, \; i = 1, 2, \cdots, n$$

(iii) Let $T : \mathbb{R}^2 \to \mathbb{R}^3$ be defined by

$$T(x, y) = (x, x + y, y)$$

Then find the range of T.

(iv) Let $T : \mathbb{R}^3 \to \mathbb{R}^3$ be a linear operator defined by

$$T(x, y, z) = (3x, x - y, 2x + y + z)$$

Show that T is invertible. Also find the inverse map T^{-1}.

(v) Let the linear map $T : \mathbb{R}^2 \to \mathbb{R}^4$ be defined by

$$T(x, y) = (x, y, x + y, x - y)$$

Find the matrix of T with respect to the standard bases.

(vi) Let $T : V \to W$ be an invertible linear map from vector space V to vector space W where

$$\dim V = \dim W = n$$

Show that T is non-singular if and only if T is onto.

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