2019

Time - 3 hours

Full Marks - 80

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

१ । (क) अधोलिखितेषु चतुर्णां सन्धिविच्छेदं कुरुत ।   (१ × ४

वपुरतितरा, वर्हेणेव, नुनयास्यत्यमरमिथुने
नाधमे, शापेनास्तं, रामगिर्य्याश्रिमेषु

(ख) कस्यापि द्वयो: सविग्रहसमासार्थनामानि लिखत ।   (२ × २

लब्धकामा, मेघदूत, वर्षभोग्येण
नयनशुभगम्, प्रियसरव

(ग) कस्यापि त्रयाणां सकारणविभक्तिं निरूपयत ।   (२ × ३

आकैलाशात्, गुरुजा,
स्तनितसुभग:, मुग्धा, जग्ध्वा

(घ) कस्यापि त्रयाणां प्रकृतिप्रत्ययञ्च लिखत ।   (२ × ३

प्रेक्षणीयम्, सन्नद्धे, व्यवसेत्,
प्रमत्त:, संपत्स्त्यन्ते, आशसत्य:

P.T.O.

GROUP - B

२ । मेघदूतानुसारं हिमालयं वर्णयत ।   (१२

अथवा

मेघदूतमवलम्ब्य प्रकृतिचित्रणं कुरुत ।

३ । केषुचिद् द्वयो: उत्तरं प्रदत्त ।   (६ × २

(क) ग्रन्थारम्भे कालिदासेन कथं यक्षस्य नामोल्लेखं न कृत: ?

(ख) मेघस्य यात्राकालीन शुभशकुनं आलोचयत ।

(ग) गङ्गावतरणप्रसङ्गेऽस्मिन् का पौराणिकी वार्त्ता आसीत् ?

(घ) ''स्त्रीणामाद्यप्रणयवचनं विभ्रमो हि प्रियेषु'' इत्यत्रं भावं प्रकटयत ।

४ । कस्यापि एकस्य सप्रसङ्गं व्याख्या कार्या ।   (१२

(क) ''नक्षुद्रोऽपि प्रथमसुकृतापेक्षया संश्रयाय।
प्राप्तेमित्रो भवति विमूख: किं पुनर्यस्तथोच्चै ।।''

अथवा

(ख) ''आशाबन्धं कुसुमसदृशं प्रायशो ह्यङ्गनानां ।
सद्यपाति प्रणयिहृदयं विप्रयोगे रुणद्धि ।।''

५ । गद्यकाव्यस्य लक्षणं विलिख्य तस्य वैशिष्ट्यं लिखत ।   (१२

अथवा

भर्तृहरे: शतकत्रयं विमर्शयत ।

६ । केषांचित् त्रयाणां संक्षिप्तटिप्पणी प्रदेया ।   (४ × ३

(क) वृहत्कथा

(ख) पञ्चतन्त्रम्

(ग) नीतिशतकम्

(घ) दशकुमारचरितम्

(ङ) कथासरित्सागर

(च) वुद्धचरितम्

(ख) <u>एकस्य</u> संक्षिप्तटिप्पणी प्रदेया ।   (६

   (i) उत्तमकाव्यम्

   (ii) काव्यप्रयोजनम्

   (iii) शृङ्गाररस:

UNIT – III

३ । (क) अभिधा-लक्षणा-व्यञ्जनानां लक्षण सोदाहरणञ्च लिखत ।   (१०

अथवा

''लक्षणातेन षड्विधा'' इति प्रतिपादयत ।

(ख) <u>एकस्य</u> संक्षिप्तटिप्पणी प्रदेया ।   (६

   (i) वाक्यम्

   (ii) ध्वनि

   (iii) अधमकाव्यम्

UNIT – IV

४ । अधस्तनेषु केषुचिद् <u>त्रयाणां</u> अलङ्काराणां लक्षणसोदाहरणञ्च लिखत ।

                                                          (६ × ३

   (क) यमकम्

   (ख) श्लेष

   (ग) रूपक

   (घ) उत्प्रेक्षा

   (ङ) विभावना

2019

Time - 3 hours

Full Marks - 80

Answer ALL questions.
Figures in the right hand margin indicate marks.

UNIT – I

१ । अधोलिखितेषु केषुचिद् सूत्रचतुष्टयस्य व्याख्या कार्या ।   (७$\frac{1}{2}$ × ४

   (क) इकोगुणवृद्धी:

   (ख) आद्यन्तौ टकितौ

   (ग) स्थानेऽन्तरतम:

   (घ) तस्मादित्युत्तरस्य

   (ङ) डिच

   (च) आदेपरस्य

UNIT – II

२ । (क) ''वाक्यं रसात्मकं काव्यम्'' – विश्वनाथ काव्यलक्षणं विमर्शयत ।

                                                          (१०

अथवा

मम्मटस्य काव्यलक्षणं विश्वनाथेन कथं खण्डितं तद् आलोचयत ।

P.T.O.

2019

Time - 3 hours

Full Marks - 80

Answer **ALL** questions.

Figures in the right hand margin indicate marks.

UNIT – I & II

१ । अधोलिखितेषु चतुर्णां सूत्राणां व्याख्या कार्या ।   (८ × ४

    (क) प्रातिपदिकार्थलिङ्गपरिमाणवचनमात्रे प्रथमा

    (ख) कारके

    (ग) अनविहिते

    (घ) अकथितञ्च

    (ङ) ह्क्रोरन्यतरस्याम्

    (च) अधिशिङ्स्थासां कर्म

    (छ) अभिनिविशश्च

UNIT – III

२ । सूत्रद्वयस्य व्याख्यां कुरुत ।   (८ × २

    (क) साधकतमं करणम्

(ख) कर्तृकरणयोस्तृतीया

(ग) इत्थम्भूतलक्षणे

(घ) सहयुक्तेऽप्रधाने

UNIT – IV

३। सूत्रद्वयस्य व्याख्यां कुरुत ।   (८ × २

(क) रुच्यर्थानां प्रियमाणः

(ख) स्पृहेरिप्सितः

(ग) तुमर्थाच्चभाववचनात्

(घ) क्रुधद्रुहोरुपसृष्टयोः कर्म

UNIT – V

४। उत्कलभाषया आङ्गलोभाषया वा अनुवादं कुरुत ।   (१६

भारतीयभाषासु संस्कृतभाषा देवभाषारूपेण स्तुयते । भारतीयसंस्कृति संस्कृतभाषां समाश्रयति । इयं भाषा मातामिव सेवते । अस्यां भाषायां ज्ञानविज्ञानानि परिपूरितानि सन्ति । संस्कृतभाषायां वेदवेदान्तोपनिषद-पुराणेतिहासानां वर्णनं समुपलभ्यते । नीतिशास्त्रं-राजनीति-अर्थशास्त्र-चिकित्साशास्त्रं-हस्तिशास्त्रं च संस्कृते परिलक्ष्यते । संस्कृतभाषा भाषासु मधुरा मुख्या च वर्त्तते । अतः संस्कृतभाषा सर्वासु भाषासु जननी इति कथ्यते।

अथवा

कालिदासेन कुमारसम्भवनामाख्यं महाकाव्यं विरचितम् । कुमारसम्भवे कार्तिकेयस्य जन्मवृत्तान्तं वर्णितः भवति । तारकासुरविनाशाय अस्य शंकरात्मज कार्तिकेयस्य जन्म अभूत् । कुमारसम्भवस्य पञ्चमसर्गे देव्याः पार्वत्याः तपक्रमः वर्णितः भवति । भगवन्तं शंकरं पतिरूपेण वरियतुं पार्वतिस्तपश्चकार: । पार्वती यदाश्रमे स्थितवती तदानीं भगवान् शंकरः ब्रह्मचारीवेशेन आश्रमेऽस्मिन् प्रविष्टवान् । पार्वतीमपि तस्य ब्रह्मचारिणः आतिथ्यसत्कारं कृतवती । तदनन्तरं ब्रह्मचारि पार्वतीं कानिचिद् कुशलानि प्रश्नानि पृष्टवान् ।

2019

Time - 3 hours

Full Marks - 80

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

<u>GROUP - A</u>

१ । (क) <u>चतुर्णां</u> सन्धिविच्छेदं कुरुत ।　　　　　　　(१ × ४

मेघमाशिलष्टसानुम्, प्रत्ययादारवसत्यः, द्रक्षत्यध्व,
वेत्रवत्याश्चलोर्मि, त्वयासन्ने, द्रक्षस्यपलविषमे

(ख) <u>द्वयोः</u> सविग्रहसमास च नामानि लिखत ।　　　(२ × २

राजराजस्य, कामार्त्ता, प्रियसखं. श्रवणशुभगं

(ग) केषुचिद् <u>त्रयाणां</u> सकारणविभक्तिं लिखत ।　　(२ × ३

आकैलाशाद्, जायां, वेत्रवत्या, मुग्धा, स्तनितसुभगम्

(घ) <u>त्रयाणां</u> प्रकृतिप्रत्ययञ्च लिखत ।　　　　　(२ × ३

प्रत्यासन्ने, जानामि, प्रेक्षणीयम्, आश्वसत्यः,
सन्नद्धे, व्यवसेत्, संपत्स्त्यन्ते

GROUP - B

२ । मेघदूतानुसारं उज्जयिनीवर्णनं कुरुत ।   (१२

अथवा

मेघदूत खण्डकाव्य दूतकाव्य वा सयुक्त्या प्रतिपादयत ।

३ । केषुचिद् द्वयो: उत्तरं प्रदत्त ।   (६ × २

   (क) कश्चिद्पदेन काव्यारम्भस्य किं कारणम् ?

   (ख) यक्ष: मेघं कथं स्वागतं व्याजहार: ?

   (ग) मेघदूतस्य मङ्गलपद्यं उल्लिखत ।

   (घ) 'अधम' इति पदस्य किं तात्पर्य्यम् ?

४ । कस्यापि एकस्य सप्रसङ्गं सरलार्थं लिखत ।   (१२

   (क) ''इत्यौत्सुक्यादपरिगणयन्गुह्यकस्तं ययाचे ।
        कामार्त्ता हि प्रकृति कृपणाश्चेतनाश्चेतनेषु ।।''

अथवा

   (ख) ''निर्विन्ध्याया: पथिभवरसाभ्यन्तर: सन्निपत्य: ।
        स्त्रीणामाद्यं प्रणयवचनं विभ्रमो हि प्रियेषु ।।''

५ । गीतिकाव्यस्य स्वरूपं वैशिष्ट्यञ्च आलोचयत ।   (१२

अथवा

गीतगोविन्दे वर्णितं दशावतारं उपस्थापयत ।

६ । त्रयाणां संक्षिप्तटिप्पणी प्रदेया ।   (४ × ३

   (क) कथासरित्सागर

   (ख) नीतिशतकम्

   (ग) मेघदूतम्

   (घ) बाणभट्ट

   (ङ) वेतालपञ्चविंशति

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Write notes on <u>any five</u> of the following.   [2 × 5

   (a) Plasmodesmata

   (b) Bicollateral vascular bundle

   (c) Porous and non-porous wood

   (d) Bulliform cells

   (e) Sunken stomata

   (f) Cuticle

   (g) Lysigenous cavity

GROUP - B

*Answer **ALL** questions.*

2. Give an account of complex permanent tissue and their functions.
   [10

OR

Write notes on : [5 × 2

(a) Anatomy of a typical dicot stem

(b) Parenchyma tissue

3. Give an account of various theories regarding organisation of root apex. [10

OR

Write notes on : [5 × 2

(a) Internal structure of monocot root

(b) Tunica corpus theory

4. Describe the organisation, function and seasonal activity of vascular cambium during secondary growth. [10

OR

Write notes on : [5 × 2

(a) Heart wood and Sap wood

(b) Extrastelar secondary growth in dicot stem

5. Give an account of anatomical adaptations of hydrophytes. [10

OR

Write notes on : [5 × 2

(a) Trichomes

(b) Adaptive features of Xerophytic leaves

6. Give an account of secretory tissue system in plants. [10

OR

Write notes on : [5 × 2

(a) Distribution of mechanical tissue in stem

(b) Mechanical tissue

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Write notes on <u>any five</u> of the following.   [2 × 5

   (a) Importance of Legumes to ecosystem

   (b) Genetic diversity

   (c) Plant introduction

   (d) Write the Botanical name of two oil yielding plants

   (e) Propagation of Potato

   (f) Medicinal uses of Cinchona

   (g) Rubber tapping

GROUP - B

*Answer **ALL** questions.*

2. Discuss the origin, cultivation practices and economic importance of Wheat.   [10

OR

Write notes on : [5 × 2

(a) Concept of centres of origin according to Vavilov's work

(b) Harvesting and uses of Rice

3. Discuss morphology, cultivation and uses of Sugarcane. [10

OR

Write notes on : [5 × 2

(a) Botany and uses of Potato

(b) Botanical name and uses of Groundnut

4. Write a note on morphology, processing and uses of Coffee.
[10

OR

Write notes on : [5 × 2

(a) Uses and health hazard of Tobacco

(b) Family name and uses of Clove

5. What are oils ? Describe extraction methods of fatty oils and their uses. [10

OR

Write notes on : [5 × 2

(a) Botanical name of Coconut and its uses

(b) Uses of Linseed

6. Describe the cultivation methods and economic importance of Cotton. [10

OR

Write notes on : [5 × 2

(a) Timber yielding plants and uses of Teak

(b) Economic importance of Rubber

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Answer <u>any five</u> of the following.   [2 × 5

   (a) What is pleiotropy ?

   (b) What are sex-chromosomes ?

   (c) State the law of dominance.

   (d) What are mutagens ?

   (e) Define sex-linkage.

   (f) What are genes ?

   (g) Define totipotency.

GROUP - B

*Answer **ALL** questions.*

2. Describe the double hellix structure of DNA molecule.   [10

OR

Write notes on :   [5 × 2

(a) Codominance

(b) Epistasis

3. Describe the steps of protein biosynthesis.   [10

OR

Write notes on :   [5 × 2

(a) Genetic code

(b) Central dogma

4. Describe the cytological basis of crossing over.   [10

OR

Write notes on :   [5 × 2

(a) Linkage

(b) Chromosome mapping

5. Describe the different types of variations in chromosome struc-
ture.   [10

OR

Write notes on :   [5 × 2

(a) Aneuploidy

(b) Gene mutation

6. Describe the basic steps of plant tissue culture technique.   [10

OR

Write notes on :   [5 × 2

(a) Germplasm conservation

(b) Organogenesis

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Answer <u>any five</u> questions briefly.   [2 × 5

   (a) What is Capsid ?

   (b) Mention major methods of the virus transmission.

   (c) What is pathogenesis ?

   (d) Which pathogen causes "Blight of Rice" ?

   (e) What are the types of plastids ?

   (f) In which stage of mitosis, chromosomes are arranged on the equatorial plate ?

   (g) Who first discovered bacteria ?

GROUP - B

*Answer **ALL** questions.*

2. Describe the genetic recombination in bacteria.   [10

OR

Write notes on :   [5 × 2

(a) Gram stain

(b) Structure of bacteria

3. Describe the replication of bacteriophage.   [10

OR

Write notes on :   [5 × 2

(a) TMV

(b) Nomenclature of virus

4. Write a note on the symptoms, causal organism and control measures of powdery mildew of Pea.   [10

OR

Write notes on :   [5 × 2

(a) Necrosis

(b) Important symptoms of bacterial disease

5. Describe the structure and functions of Mitochondria.   [10

OR

Write notes on :   [5 × 2

(a) Characteristics of prokaryotic cell

(b) Fluid mosaic model

6. Describe the process of Meiosis-I.   [10

OR

Write notes on :   [5 × 2

(a) Endoplasmic Reticulum

(b) Anaphase

2019

Time - 3 hours

Full Marks - 60

Answer **both groups** as per instructions.
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Answer <u>any five</u> of the following in 2–3 sentences each.   [2 × 5

   (a) What is retrogressive metamorphosis ? Give example.

   (b) State any three advanced features of vertebrates over protochordates.

   (c) State the differences between Chondriochthyes and Osteo-chthyes with examples.

   (d) Write composition of snake venome.

   (e) State significance of migration in birds.

   (f) What are milk teeth ? Name them.

   (g) Name the living orders of class Amphibia with examples.

   (h) State Continental drift theory of Vertebrate distribution.

GROUP - B

*Answer **ALL** questions.*

2. Give an account on Origin of Chordates. [10

OR

Write notes on any two : [5 × 2

(a) Ascidian tadpole

(b) Retrogressive changes in Urochordates

(c) General characteristics of Cephalochordates

3. State general characters of Cyclostomes. Add classification of Cyclostomes upto order. [10

OR

Write notes on any two : [5 × 2

(a) Structural peculiarities of Petromyzon

(b) Affinities of Myxine

(c) Agnatha and its affinities

4. Write an essay on accessory respiratory organs in fishes. [10

OR

Write notes on any two : [5 × 2

(a) Neoteny

(b) Migration in fishes

(c) Origin of Tetrapoda

5. Describe flight adaptations in birds. [10

OR

Write notes on any two : [5 × 2

(a) Poison apparatus in snake

(b) Skull in Reptilia

(c) General characters of Reptilia

6. Give an account on Zoogeographical realms of the world. [10

OR

Write notes on any two : [5 × 2

(a) General characters of Mammals

(b) Affinities of Metatheria

(c) Dentition in Mammals

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Answer <u>any five</u> of the following in 2–3 sentences each.   [2 × 5

   (a) State characteristics of epithelial tissues.

   (b) What is reflex arc ?

   (c) Define action potential.

   (d) What is sacromere ?

   (e) What is a motor unit ?

   (f) What do you mean by puberty ?

   (g) What is the function of thymus ?

   (h) Name the hormones that control gametogenesis.

GROUP - B

*Answer **ALL** questions.*

2. Give an account on different types of glands and their functions.

[10

P.T.O.

OR

Write notes on <u>any two</u> :   [5 × 2

(a) Simple epithelial tissues

(b) Ossification of bones

(c) Glial cells

3. What is a synapse ? Describe synaptic transmission briefly. [10

OR

Write notes on <u>any two</u> :   [5 × 2

(a) Structure of neuron

(b) Reflex action

(c) Physiology of vision

4. Describe ultrastructure of skeletal muscles.   [10

OR

Write notes on <u>any two</u> :   [5 × 2

(a) Cardiac muscles

(b) Summation

(c) Myosin

5. Explain different methods of contraception in men and women.

[10

OR

Write notes on <u>any two</u> :   [5 × 2

(a) Histology of female reproductive system

(b) Gonadal hormones

(c) Menstrual cycle

6. Explain signal transduction pathway of non-steroidal hormones.

[10

OR

Write notes on <u>any two</u> :   [5 × 2

(a) Hypothalamus

(b) Thyroid gland

(c) Adrenal gland

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.
Draw labelled diagrams wherever necessary.

GROUP - A

1. Answer <u>any five</u> of the following in 2–3 sentences each.   [2 × 5

    (a) What is axial skeleton ? Name its components.

    (b) State functions of air-sacs in fishes.

    (c) Name the different types of mammalian uteri.

    (d) What is archinephrous kidney ?

    (e) Name various photoreceptive cells and their functions.

    (f) What is the function of vagus nerve in mammals ?

    (g) What is primary data ?

    (h) State the empirical relation between mean, median and mode.

GROUP - B

*Answer **ALL** questions.*

2. Discuss the structure of alimentary canal of vertebrates.   [10

OR

Write notes on any two : [5 × 2

(a) Air-sacs in fishes

(b) Pancreas

(c) Skin in vertebrates

3. Give an account on epidermal derivatives of epithelium. [10

OR

Write notes on any two : [5 × 2

(a) Skull in different vertebrates

(b) Functions of integument

(c) Jaw suspensorium

4. Give an account on evolution of urinogenital duct in vertebrates.
[10

OR

Write notes on any two : [5 × 2

(a) General plan of circulation

(b) Metamorphous kidney

(c) Heart in reptiles

5. Discuss about comparative account of brain in vertebrates.
[10

OR

Write notes on any two : [5 × 2

(a) Cranial nerves in mammals

(b) Visual receptors

(c) Autonomic nervous system

6. Calculate mean, median and mode of the haemoglobin (gm %) of 50 patients recorded on a particular day in a hospital as given below : [10

Hb (%)	No. of patients
10 – 11	3
11 – 12	8
12 – 13	7
13 – 14	9
14 – 15	10
15 – 16	8
16 – 17	3
17 – 18	2

OR

Write notes on any two : [5 × 2

(a) Histogram

(b) Classification of data

(c) Frequency distribution table

OR

(a) Write generating function for Legendre polynomials.   [2

(b) Using generating function of Legendre polynomials, prove the following recurrence relations.   [4 + 4

(i) $(2n + 1)xP_n(x) = (n +1)P_{n + 1}(x) + nP_{n - 1}(x)$.

(ii) $nP_n(x) = x\dfrac{dP_n(x)}{dx} - \dfrac{dP_{n - 1}(x)}{dx}$.

6. Write down Laplace equation $\nabla^2\psi = 0$ in cylindrical coordinate system and obtain its solution by using separation of variable method.   [2 + 8

OR

An uncharged conducting sphere is placed in a region of uniform electric field. Derive expressions for electric potential and field at an outside point of the sphere. Also find surface charge density at any point on the surface of the sphere.   [6 + 2 + 2

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions.   [2 × 5

(a) State Dirichlet conditions.

(b) Show that

$2^n\,\Gamma\!\left(n + \tfrac{1}{2}\right) = 1 . 3 . 5 \,........... (2n - 1)\sqrt{\pi}$.

(c) Show that $P_n(x) = (-1)^n P_n(-x)$ where $P_n(x)$ is the Legendre polynomial of nth order.

(d) Distinguish between Systematic errors and Random errors.

(e) Find the singular points of differential equation

$(1 - x^2)\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + 6y = 0$.

State whether these singular points are regular or irregular singular points.

(f) Show that $H_{2n}(0) = (-1)^n\,\dfrac{2n\,!}{n\,!}$.

GROUP - B

*Answer **ALL** questions.*

2. Solve Hermite differential equation   [8 + 2

$$\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2ny = 0, \ n \ \text{being a positive integer.}$$

Find its polynomial solution.

OR

(a) Show that the Hermite polynomials are generated by the function   [6

$$f(x, z) = e^{2zx - z^2}.$$

(b) Prove that $H_n(x) = (-1)^n \ e^{x^2}\frac{d^n}{dx^n}(e^{-x^2})$,   [4

where $H_n(x)$ is Hermite polynomial of nth order.

3. Find the series of sines and cosines of multiples of x which represent f(x) in the interval $-\pi < x < \pi$ where :   [8 + 2

$$f(x) \ = 0 \quad \text{when } -\pi < x \leq 0$$

$$= \frac{\pi x}{4} \quad \text{when } 0 < x \leq \pi.$$

Hence show that $\dfrac{\pi^2}{8} = 1 + \dfrac{1}{3^2} + \dfrac{1}{5^2} + \dfrac{1}{7^2} + \ ....$

OR

(a) Obtain Fourier series expansion of the periodic function f(t) with period T and the form of which within the first period $0 \leq t \leq T$ is given by f(t) = t(T – t).   [8

(b) Can Fourier series represent a discontinuous function ? Justify your answer with example.   [2

4. (a) Show that   [5

$$\int_0^{\pi/2} \sin^p \theta . \cos^q \theta \ d\theta = \frac{\Gamma\left(\frac{p + 1}{2}\right)\Gamma\left(\frac{q + 1}{2}\right)}{2\Gamma\left(\frac{p + q + 2}{2}\right)}.$$

(b) Starting with Gamma function defined by   [5

$$\Gamma(z) = \int_0^\infty t^{z-1} \ e^{-t} \ dt \ (\text{Re } z > 0), \text{ evaluate } \Gamma(\tfrac{1}{2}).$$

OR

(a) Expand f(x) = cos x in a Fourier series in the interval $0 < x < \pi$.   [6

(b) What is Persaval's identity for Fourier series ? Derive its expression.   [4

5. (a) Write Rodrigue's formula for Legendre polynomials.   [2

(b) Show that   [8

$$\int_{-1}^{+1} P_m(x) \ P_n(x) \ dx = \frac{2}{2n + 1} \ \delta_{mn}$$

where $P_n(x)$ is the Legendre polynomial of order n and δ_{mn} is the Kronecker delta function.

OR

What are transport phenomena in gases ? On the basis of kinetic theory, derive an expression of the coefficient of thermal conductivity of a gas and show that it is proportional to the square root of the absolute temperature of gas. [6 + 4

6. Derive Van der Waal's equation of state. Deduce expressions for the critical constants of a gas in terms of Van der Waal's constants. [6 + 4

OR

What is Joule-Thomson effect ? Deduce an expression for the Joule-Thomson cooling produced in a Van der Waal's gas. Show that the ratio of the temperature of inversion and critical temperature does not depend on the nature of gas. [2 + 6 + 2

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions. [2 × 5

(a) A Carnot engine has efficiency 50% when its sink temperature is 7^0 C. By how many degrees should the temperature of source be increased so that the efficiency becomes 70% ?

(b) State and explain third law of thermodynamics.

(c) Name four thermodynamic potentials. Write their mathematical expressions.

(d) Explain cooling by evaporation of liquids on the basis of Maxwellian distribution of molecular speeds.

(e) Discuss affect of pressure on melting point of solids.

(f) The critical temperature of hydrogen is -240^0 C and the critical pressure is 12.8×10^5 N/m^2. Compute the critical volume of 1 mole of hydrogen.

GROUP - B

*Answer **ALL** questions.*

2. (a) State and prove Carnot's theorem. [2 + 5

   (b) What is a heat pump ? Write down expression of its efficiency. Can the efficiency of heat pump be more than 100% ? [1 + 1 + 1

OR

   (a) Write Kelvin-Planck statement and Clausius' statement of second law of thermodynamics. Show that these two statements are equivalent to each other. [1 + 1 + 4

   (b) Distinguish between reversible and irreversible processes with examples. [4

3. (a) Show that the entropy of the universe remains constant in a reversible cycle but increases in an irrevesible cycle. [6

   (b) State and explain the principle of increase in entropy. [4

OR

   (a) What is T-S diagram ? Obtain the slopes of (i) isobaric and (ii) isochoric curve in T-S diagram of an ideal gas.

[1 + 2 + 2

   (b) Represent Carnot's cycle in T-S diagram and derive the expression for efficiency of Carnot's engine. [1 + 4

4. (a) Derive the first and second TdS equations given by

[3 + 3 + 2

   (i) $TdS = C_V dT + T \left(\frac{\partial P}{\partial T} \right)_V dV.$

   (ii) $TdS = C_P dT - T \left(\frac{\partial V}{\partial T} \right)_P dP.$

   Show that a reversible adiabatic increase of pressure will produce an increase of temperature in any substance with a positive expansivity and a decrease of temperature in any substance with a negative expansivity.

   (b) Calculate the heat transfer when the pressure on 15 cm^3 of mercury at 20^0 C is increased reversibly and isothermally from 0 to 1000 atm. [2

OR

   (a) Distinguish between first order and second order phase transitions. [2 + 2

   (b) Derive the Clausius-Clapeyron equation. To which order phase transition, this equation can be applied ? [5 + 1

5. (a) Derive Maxwell Boltzmann speed distribution function. Hence calculate the rms speed of an ideal gas molecule at temperature T. (Assume molecule has three degrees of freedom.)

[6 + 2

   (b) Calculate the rms speed of Nitrogen (N$_2$) molecule at 27^0 C. (Take molar mass of nitrogen as 28 gm and Boltzmann constant k = 1.38 × 10^{-23} J/K.) [2

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions. [2 × 5

   (a) How many Transistors and Gates are integrated in LSI and VLSI ?

   (b) Convert the decimal number $(732)_{10}$ to its equivalent Binary number.

   (c) Convert the octal number $(11001)_8$ to its equivalent decimal number.

   (d) Write the truth table for AND and OR gates.

   (e) Explain commutative law obeyed by OR and AND operations.

   (f) Construct a Karnaugh map for two variables.

   (g) Write a short note on binary addition and add 10110 + 1011.

(h) Write short notes on RAM and ROM.

GROUP - B

*Answer **ALL** questions.*

2. Write down the advantages and drawbacks of ICs with discrete circuits. [5 + 5

OR

(a) Explain the classifications of ICs fabrication. [5

(b) Write the mode of operation of Linear IC and Digital IC. [5

3. (a) Obtain X-NOR gate using NAND gates only. [4

(b) Distinguish between X-OR and X-NOR gates. [6

OR

Realise AND and OR operators using transistors. [5 + 5

4. State and explain the laws of Boolean Algebra. [4 + 6

OR

Describe a 4-bit binary parallel adder and subtractor. [5 + 5

5. With block diagram, describe the construction and working of a cathode ray oscilloscope. [10

OR

(a) Explain multiplexer with block diagram. [3

(b) Describe functions of a four-two-one multiplexer. [7

6. (a) Describe the input and output devices of a computer. [4

(b) Write short notes on memory interfacing and memory map.
[3 + 3

OR

What is ring center ? Explain the working of a 4-bit ring counter with diagram. [2 + 8

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions.   [2 × 5

    (a) Calculate the r.m.s. speed of nitrogen at 27^0 C. Given

         $N = 6 \times 10^{23}$ molecules/mole

         $K = 1.38 \times 10^{-16}$ erg/K.

    (b) Define second law of thermodynamics. What is its expression in term of entropy ?

    (c) Define Planck's law for black body radiation. Write its formula.

    (d) Give two characteristics of Huygen's eye-piece.

    (e) How circularly and elliptically polarised lights are produced ?

    (f) Compute the rest-mass energy of an electron.

    (g) Calculate the de-Broglie wavelength of an electron of energy 10,000 eV.

(h) State group velocity and write the relationship between group velocity and particle velocity.

GROUP - B

*Answer **ALL** questions.*

2. Define Root mean square speed (V_{rms}). Find out its expression. Establish a relation between most probable speed, average speed and rms speed. [2 + 4 + 4

OR

(a) Define entropy. Show that in any reversible cycle, the net charge in entropy is zero. [2 + 6

(b) When 1 gram of ice at 0^0 C is given 79.6 calories of heat, it just melts without any change in temperature. Calculate the change of entropy in this process. [2

3. Define coefficient of thermal conductivity. Discuss the result of Ingen-Hausz experiment with experimental observation. [2 + 8

OR

(a) Discuss the construction and working of Huygen's eye-piece with a neat digram. [3 + 3

(b) Explain how chromatic and spherical aberration is minimum in Huygen's eye-piece. [2 + 2

4. (a) What is double refraction ? Explain it. [3

(b) Explain plane, circularly and elliptically polarised light. [1 + 1 + 1

(c) Explain how polarisation of light is occuring by reflection. [4

OR

Discuss the construction, theory and working of a linear acce-lerator. [3 + 4 + 3

5. What is de-Broglie hypothesis ? Verify it on the basis of Davisson and Germer experiment. [2 + 8

OR

State and prove Ehrenfest's theorem. [2 + 8

6. (a) Using time dependent Schrodinger equation, obtain the 3-D-time independent Schrodinger equation. [7

(b) State and explain eigen values and eigen functions. [1½ + 1½

OR

Consider a particle incident on a potential step of height V_0 with energy E greater than V_0. Calculate the coefficient of reflection and transmission. [10

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions.   [2 × 5

   (a) Write two limitations of Ellingham diagram.

   (b) What is Electrolytic Kroll process ?

   (c) Why carbon shows a covalency of four ?

   (d) Which is more acidic among hydrogen halides and why ?

   (e) Write the characteristics of soft acids.

   (f) What are pseudo halogens ?

   (g) Why noble gases are inert ? Explain.

GROUP - B

*Answer **ALL** questions.*

2. (a) Discuss the useful features of Ellingham diagram.   [7

   (b) What is parting process ?   [3

[2]

OR

Write short notes on :   [5 × 2

(a) Van-Arkel de-Boer process

(b) Electrochemical principle in the extraction of metals

3. Explain the hydrogen bridge structure of diborane.   [10

OR

Write short notes on :   [5 × 2

(a) Carboranes

(b) Silanes

4. (a) Explain the diagonal relationship of Li and Mg.   [8

(b) How basic beryllium acetate is prepared ?   [2

OR

(a) Explain the diagonal relationship of Boron and Silicon.   [8

(b) Explain the complex formation tendency of alkaline earths.

[2

5. Describe the valence bond and molecular orbital treatment of XeF_2.   [10

OR

Write short notes on :   [5 × 2

(a) Clathrates

(b) Lewis concept of acids and bases

[3]

6. (a) Give a comparison between organic polymers and inorganic polymers.   [5

(b) Write a note on Silicones.   [5

OR

Write short notes on :   [5 × 2

(a) Polysulphates

(b) Silicates

OR

(a) How will you prepare methyl lithium ? How can you prepare acetic acid from it ? [5

(b) Write a short note on keto-enol tautomerism. [5

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions. [2 × 5

(a) Phenol is acidic, but alcohol is neutral. Explain.

(b) What happens when ethyl chloride is treated with $AgNO_2$?

(c) Formaldehyde does not undergo Aldol condensation reaction. Explain.

(d) Give one test to distinguish ethyl alcohol and ethanoic acid.

(e) What happens when Cl_2 is passed through boiling Toluene in presence of light ?

(f) Ethylene glycol is more viscous than ethyl alcohol. Why ?

(g) Diethyl ether does not react with Sodium. Explain.

(h) Acyl derivatives do not give characteristic reactions of carbonyl group. Explain.

GROUP - B

*Answer **ALL** questions.*

2. (a) Give the mechanism and stereochemistry of SN^1 and SN^2 reaction for the hydrolysis of alkyl halides. [4 + 4

   (b) Explain the low reactivity of vinyl chloride for nucleophilic substitution reaction. [2

   OR

   (a) How chlorobenzene is prepared by – [4

      (i) Sandmeyer's reaction

      (ii) Gattermann reaction ?

   (b) Discuss the bimolecular displacement mechanism in aryl halide. [3

   (c) What is the effect of substituents on the reactivity of aryl halides ? [3

3. How can you prepare 1^0, 2^0 and 3^0 alcohols using Grignard's reagent ? How can they be distinguished by Lucas reagent ?[6 + 4

   OR

   Explain the following reactions with mechanism : [5 × 2

   (a) Reiman-Tiemann reaction

   (b) Kolbe's-Schmidt reaction

4. Discuss the mechanism of the following reactions : [5 × 2

   (a) Aldol condensation

   (b) Clemensen reduction

   OR

   Discuss the mechanism of Wittig reaction and Michael addition reaction. [5 + 5

5. (a) How monocarboxylic acid is prepared from – (i) alkyl nitriles and (ii) organometallic compounds ? [4

   (b) How ethyl thiol reacts with acetic acid and NaOH ? [4

   (c) What happens when Tartaric acid is heated with dil. H_2SO_4 acid ? [2

   OR

   (a) Discuss the mechanism of acidic hydrolysis of ester. [5

   (b) Discuss the mechanism of curtius rearrangement reaction. [5

6. How can you prepare diethyl malonate ? How can you synthesize the following from it ? [4 + (2 × 3)

   (i) Succinic acid

   (ii) Crotonic acid

   (iii) Barbituric acid

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions.   [2 × 5

    (a) What is protolytic reaction ? Give one example.

    (b) What is pseudo unimolecular reaction ? Give one example.

    (c) What is autocatalysis ? Give one example.

    (d) Why is heat of chemisorption more than physical adsorption ?

    (e) How graphical method helps to determine the order of reaction ?

    (f) Write Clausius-Clapeyron equation for solid-vapour equilibrium.

    (g) What is meant by adsorption isobar ?

GROUP - B

Answer ALL questions.

2. (a) Define phase, component and degrees of freedom. [3

   (b) Derive Gibb's phase rule thermodynamically. [7

   OR

   (a) Discuss phase diagram of Lead-Silver system. [7

   (b) Explain Pattinson's process for desilverisation of Lead. [3

3. Discuss the following reactions in liquid SO_2 :

   (a) Acid-base reaction [4

   (b) Precipitation reaction [3

   (c) Solvolytic reaction [3

   OR

   (a) What are the advantages and disadvantages of liquid NH_3 as a solvent ? [5

   (b) Explain solution of alkali metals in liquid NH_3. [5

4. (a) Derive an expression for rate constant of first order reaction. [7

   (b) A first order reaction is 50% complete in 100 minutes. How long will it take for 90% completion ? [3

   OR

Write short notes on : [5 × 2

   (a) Activation energy

   (b) Consecutive reaction

5. (a) Explain homogeneous and heterogeneous catalysts with examples. [4

   (b) What are promoters ? Give examples. [3

   (c) Explain catalytic poisoning with examples. [3

   OR

   (a) Derive Michaelis-Menten equation in enzyme catalysis. [5

   (b) Explain Acid-Base catalysis. [5

6. Derive an expression for Langmuir adsorption isotherm. What are its limitations ? [8 + 2

   OR

Write short notes on : [5 × 2

   (a) Electrokinetic potential

   (b) Chemisorption

2019

Time - 3 hours

Full Marks - 60

*Answer **both groups** as per instructions.*
Figures in the right hand margin indicate marks.

GROUP - A

1. Answer <u>any five</u> questions.　　　　　　　　　　[2 × 5

    (a) What is the difference between dissociation energy and bond dissociation energy ?

    (b) What happens to the concentration of the different reactants and products after the establishmnet of equilibrium ?

    (c) Why ΔG^0 obtained from K_P and K_C has different values ?

    (d) Define hydrolysis with an example.

    (e) Although benzene is highly unsaturated, it does not undergo addition reaction. Explain.

    (f) Phenol is an acid but does not react with sodium bicarbonate solution. Why ?

    (g) What is saponification ? Give one example.

    (h) Explain Rosenmund's reaction.

GROUP - B

Answer ALL questions.

2. State and explain Le-Chatelier's principle with suitable examples.   [10

OR

(a) Discuss the variation of enthalpy of a reaction with temperature.   [6

(b) Define integral and differential enthalpies of a solution.   [4

3. Write notes on :   [5 × 2

(a) Solubility product

(b) Strong, moderate and weak electrolytes

OR

What is salt hydrolysis ? Find out the hydrolysis constant, degree of hydrolysis and pH of a salt of strong acid and weak base with an example.   [2½ × 4

4. (a) Discuss the point of differences between SN^1 and SN^2 reactions.   [7

(b) Discuss the lust test to distinguish 1^0, 2^0 and 3^0 alcohols.   [3

OR

Explain the following :

(a) Williamson's ether synthesis   [3

(b) Oxidation of alcohol with PCC   [3

(c) Ester hydrolysis   [4

5. (a) Explain Benzyne mechanism.   [4

(b) Explain Gattermann reaction and Sandmeyer reaction with example.   [3 + 3

OR

(a) Discuss sulphonation and acylation reactions of benzene.   [4

(b) What happens when ethyl benzene is treated with alkaline $KMnO_4$?   [2

(c) Discuss the reactivity of benzyl halide and aryl halide.   [4

6. Write notes on :   [5 × 2

(a) Aldol condensation

(b) Wolff Kishner reduction

OR

(a) How acetaldehyde and acetone are prepared from CH_3COCl ?   [5

(b) Why formaldehyde does not respond aldol condensation ?   [2

(c) Discuss the sulphonation reaction of Phenol.   [3

2019

Time - 3 hours

Full Marks - 80

Answer **both groups** as per instructions.
Part of each question should be answered continuously.
Figures in the right hand margin indicate marks.
The symbols used have their usual meaning.

GROUP - A

1. Answer <u>any ten</u> questions.   [2 × 10

    (a) Find the limit of $\{n/(n + 1) : n \in N\}$.

    (b) Give an example of two sets A and B such that $A \subset B$ and $A^0 = B^0$.

    (c) Find the closure of the set (a, ∞).

    (d) Find the value of $\lim\limits_{x \to 0+} \dfrac{|x|}{x}$.

    (e) Find y_n if $y = \sin x \cos x$.

    (f) Define uniform continuity of a function.

    (g) Give an example of a function which is continuous but not differentiable at a point.

    (h) State intermediate value theorem.

P.T.O.

(i) State the necessary condition for a function has maximum or minimum at x = c.

(j) Find maximum value of $\dfrac{\log x}{x}$.

(k) Find the value of $\lim\limits_{x \to 0} \dfrac{(e^x - x - 1)}{x^2}$.

GROUP - B

*Answer **ALL** questions.*

2. Answer <u>any two</u> questions. [6 × 2

(a) Prove that the intersection of a finite number of open sets is open.

(b) If S and T are any two sets, then prove that

$$(S \cap T)^0 = S^0 \cap T^0.$$

(c) Prove that $S \cup D(S)$ is always a closed set.

3. Answer <u>any two</u> questions. [6 × 2

(a) Discuss the continuity of the following

$$f(x) = \begin{cases} x \sin\left(\frac{1}{x}\right) & , x \neq 0 \\ 0 & , x = 0. \end{cases}$$

(b) Let X be a closed and bounded subset of R and $f : X \to R$ be continuous. Then f attains its maximum and minimum. Prove it.

(c) Let S be closed and bounded subset of R. If $f : S \to R$ is continuous, then it is uniformly continuous on S. Prove it.

4. Answer <u>any two</u> questions. [6 × 2

(a) If $f(x) = x^2 \sin\frac{1}{x}$, $x \neq 0$ and $f(0) = 0$, show that f is derivable for every value of x but the derivative is not continuous at x = 0.

(b) Show that $f(x) = |x + 2|$ is continuous at x = −2 but not differentiable at that point.

(c) Verify Lagrange's Mean Value Theorem for the function $f(x) = \sqrt{x^2 - 4}$ defined on [2, 4].

5. Answer <u>any two</u> questions. [6 × 2

(a) Find the maximum and minimum value of

$$f(x) = \sin x + \cos x.$$

(b) Show that $\dfrac{x}{1 + x} < \log (1 + x) < x$, for all x > 0.

(c) Find the value of $\lim\limits_{x \to \frac{\pi}{2}} (\sin x)^{\tan x}$.

6. Answer <u>any two</u> questions. [6 × 2

(a) State and prove Rolle's theorem.

(b) Using Taylor's theorem, show that

$$\cos x \geq 1 - \dfrac{x^2}{2} , \text{ for all } x \in R.$$

(c) Find nth derivative of $e^{2x} \sin 3x$.

2019

Time - 3 hours

Full Marks - 80

Answer **both groups** as per instructions.
Part of each question should be answered continuously.
Figures in the right hand margin indicate marks.
The symbols used have their usual meaning.

GROUP - A

1. Answer <u>any ten</u> questions.   [2 × 10

   (a) Prove that the set of all odd integers is not a group under multiplication.

   (b) In a group G, prove that a and a^{-1} have the same order.

   (c) How many generators does a cyclic group of order 12 have ?

   (d) Prove that the group $\{1, -1, i, -i\}$ is cyclic and find its generators.

   (e) If $A = (1\ 2\ 3\ 4\ 5)$ and $B = (2\ 3)\ (4\ 5)$, find AB.

   (f) Let G be a group and $f : G \rightarrow G$ such that $f(x) = x^{-1}$ be a homomrphism. Show that G is abelian.

   (g) Give an example of two subgroups H, K which are not normal, but HK is a subgroup.

(h) Define Alternating Group.

(i) Show that $\phi(x^{-1}) = (\phi(x))^{-1}$ for all $x \in G$.

(j) Write all the subgroups of $G = \{0, 1, 2, 3\} + 4$

(k) Prove that H itself is a right coset as well as a left coset.

GROUP - B

*Answer **ALL** questions.*

2. Answer <u>any two</u> questions.   [6 × 2

   (a) Prove that if G is an abelian group, then for all $a, b \in G$ and all integers n, $(ab)^n = a^n b^n$.

   (b) A nonempty finite subset H of the multiplicative group G is a subgroup iff H is closed under multiplication. Prove it.

   (c) Prove that subgroup of a cyclic group is itself a cyclic group.

3. Answer <u>any two</u> questions.   [6 × 2

   (a) Prove, the center Z of a group of G is a normal subgroup of G.

   (b) If H is a subgroup of G, then there exists one-to-one correspondence between any two right cosets of H in G. Prove it.

   (c) If G is a group of prime order, then G is cyclic group. Prove it.

4. Answer <u>any two</u> questions.   [6 × 2

   (a) If ϕ is a hommorphism of G into $\bar{G}$ with kernel K, then K is a normal subgroup of G. Prove it.

   (b) Suppose that N and M are two normal subgroups of G such that $N \cap M = (e)$. Show that for $n \in N$, $m \in M$, nm = mn.

   (c) State and prove Fundamental theorem of homomorphism.

5. Answer <u>any one</u> question.   [12

   (a) Suppose G is a finite abelian group and p | O(G), where p is a prime number. Then there is an element a $\neq$ e in G such that a^p = e. Prove it.

   (b) If G is an abelian group of order O(G) and p is a prime number such that $p^\alpha \mid O(G)$, $p^{\alpha+1} \mid O(G)$, then G is a subgroup of order p^α. Prove it.

6. Answer <u>any two</u> questions.   [6 × 2

   (a) Find the product of two permutations and show that it is not commutative

   $$f = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{pmatrix}, g = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 3 & 2 & 1 & 4 \end{pmatrix}.$$

   (b) Prove, every group G is isomorphic to a permutation group.

   (c) (i) Find the inverse of the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & 5 & 4 \end{pmatrix}$

   (ii) Show that the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 5 & 6 & 2 & 4 & 1 & 3 \end{pmatrix}$ is odd and the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 6 & 3 & 4 & 5 & 2 & 1 \end{pmatrix}$ is even.

2019

Time - 3 hours

Full Marks - 60

Answer **both groups** as per instructions.
Part of each question should be answered continuously.
Figures in the right hand margin indicate marks.
The symbols used have their usual meaning.

GROUP - A

1. Answer <u>any five</u> questions.   [2 × 5

   (a) Write the two sets of multipliers for finding out the integral curves of the equation

   $$\frac{dx}{z-y} = \frac{dy}{x-z} = \frac{dz}{y-x}.$$

   (b) Write the necessary and sufficient condition that the Paffian differential equation $\mathbf{X} \cdot d\mathbf{r} = 0$ is integrable.

   (c) Find out the primitive of the equation

   $$(2xyz + z^2)dx + x^2z\, dy + (xz + 1)dz = 0.$$

   (d) Form a partial differential equation by eliminating arbitrary constants a and b from the equation

   $$z = (x - a)^2 + (y - b)^2.$$

(e) Give an example of a first order partial differential equation which is linear and also give an example which is non-linear.

(f) Find out the complete integral of the equation

$$p^2 - q^2 = 1.$$

(g) Solve $\left(D^2 - 2DD' - 15D'^2\right)z = 0$ by writing the complementary function.

(h) Find out a particular integral of the equation

$$\left(D^2 - 3DD' + 2D'^2\right)z = e^{2x-y}.$$

GROUP - B

*Answer **ALL** questions.*

2. Find out the general solution of the equation [10

$$\frac{dx}{xz - y} = \frac{dy}{yz - x} = \frac{dz}{1 - z^2}.$$

OR

Solve the equation [10

$$2yz\, dx - 2xz\, dy - (x^2 + y^2)(z - 1)dz = 0.$$

3. Find out the complete integral of the equation [10

$$(p^2 + q^2)y = qz.$$

OR

Solve : $z = px + qy + p^2 + q^2.$ [10

4. Verify that the following differential equation is integrable and find out its solution. [10

$$(y^2 - z^2)dx + (x^2 - z^2)dy + (x + y)(x + y + 2z)dz = 0.$$

OR

Find out the complete integral of [10

$$p^2x^2 = z(z - qy).$$

5. Solve the equation [10

$$\left(D^3 - 7DD'^2 - 6D'\right)^3 z = \sin(x + 2y) + e^{3xy}.$$

OR

Solve : $\left(D^3 - DD'^2 - D^2 + DD'\right)z = \dfrac{x + 2}{x^3}.$ [10

6. Solve the equation [10

$$\left(x^2D^2 - xyDD' - 2y^2D'^2 + xD - 2yD'\right)z = \log\left(\tfrac{x}{y}\right).$$

OR

Solve the equation [10

$$x^2r - y^2t + xp - yq = \log x.$$

(b) Find the inverse of the matrix [12

$$\begin{bmatrix} 1 & 1 & 0 \\ 1 & -1 & 1 \\ 1 & -1 & 2 \end{bmatrix}$$

5. (a) A nonempty subset H of the group G is a subgroup of G iff

 (i) $a, b \in H \Rightarrow ab \in H$ [6

 (ii) $a \in H \Rightarrow a^{-1} \in H$

(b) The relation $a \approx b$ mod H is an equivalnce relation. Prove it. [6

OR

(c) Let ϕ be a homomorphism of G on to $\overline{G}$ with kernel K.

 Then $\frac{G}{K} \approx \overline{G}$. [6

(d) If G is a group and H is a subgroup of index 2 in G, then prove that H is a normal subgroup of G. [6

6. (a) A finite Integral domain is a field. Prove it. [12

OR

(b) The homomorphism ϕ of R into R' is an isomorphism if and only if $I(\phi) = (0)$. Prove it. [12

2019

Time - 3 hours

Full Marks - 80

*Answer **both groups** as per instructions.*
Part of each question should be answered continuously.
Figures in the right hand margin indicate marks.
The symbols used have their usual meaning.

GROUP - A

1. Answer any ten questions. [2 × 10

 (a) What is the span of x-axis and y-axis in V_3 ?

 (b) Define direct sum and find xy-plane $\oplus$ z-axis.

 (c) Define Row-reduced Echelon form.

 (d) Evaluate det A, if A is a nilpotent matrix.

 (e) $T : U \rightarrow V$ is defined by $T(u) = O_v$ for all $u \in U$. Then verify T is linear or not.

 (f) If an inverse of a matrix A exists, then show that it is unique.

 (g) Extend the set $\{(3, -1, 2)\}$ to be the basis of V_3.

 (h) Let U and W be two distinct $(n - 1)$ dimensional subspaces of an n-dimensional vector space V. Then find dimension of $U \cap W$.

(i)   If G is a group, then prove that for every a, b $\in$ G then $(a . b)^{-1} = b^{-1} . a^{-1}$.

(j)   Define Subgroup with example.

(k)   Give an example of a commutative ring with unity.

(l)   Write Second Isomorphism theorem of Rings.

(m) If U is an ideal of ring R with unity and 1 $\in$ U, prove that U = R.

GROUP - B

Answer ALL questions.

2. (a) Let U and W be two subspaces of a vector space V and Z = U + W. Then Z = U $\oplus$ W iff the following condition is satisfied. Any vector z $\in$ Z can be expressed uniquely as the sum z = u + w, u $\in$ U, w $\in$ W.   [6

   (b) In V_2 show that (3, 7) belongs to $[(1, 2), (0, 1)]$ but does not belongs to $[(1, 2), (2, 4)]$.   [6

OR

   (c) In a vector space V, suppose $\{v_1 , v_2 , ... , v_n\}$ is an ordered set of vectors with $v_1 \neq 0$. The set is LD if one of the vectors $v_2 , v_3 , ... , v_n$, say v_k belongs to the span of $v_1 , ... , v_{k-1}$ i.e. $v_k \in [v_1 , v_2 , ... , v_{k-1}]$ for some k = 2, 3, ... , n.   [6

(d) In a vector space V let B = $\{v_1 , v_2 , ... , v_n\}$ span V. Then the following two conditions are equivalent.   [6

   (i) $\{v_1 , v_2 , ... , v_n\}$ is linearly independent set.

   (ii) If v $\in$ V, then the expression

   $$V = \alpha_1 v_1 + \alpha_2 v_2 + ... + \alpha_n v_n \text{ is unique.}$$

3. (a) A linear transformation T is completely determined by its values on the elements of a basis. Precisely if B = $\{u_1 , u_2 , ...,$ $u_n\}$ is a basis for U and $v_1 , v_2 , ... , v_n$ be n vectors (not necessarily distinct) in V, then there exists a unique linear transformation T : U $\rightarrow$ V such that $T(u_i) = v_i$ for i = 1, 2, ... , n.   [12

OR

   (b) Let T : U $\rightarrow$ V be a linear map. Then prove that   [12

   (i)   R(T) is a subspace of V.

   (ii) N(T) is a subspace of U.

4. (a) Find the rank and nullity of the matrix   [12

$$\begin{bmatrix} 3 & 1 & 4 & 0 \\ 0 & 2 & 2 & 0 \\ 1 & -1 & 0 & 0 \end{bmatrix}$$

OR